

Appendix AP

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BREEDING ECOLOGY OF THE NORTHERN GOSHAWK IN HIGH-ELEVATION ASPEN FORESTS OF NORTHERN NEVADA

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Abstract. We examined the habitat requirements of Northern Goshawks (*Accipiter gentilis*) nesting in small, isolated aspen (*Populus tremuloides*) stands in high-elevation, shrubsteppe habitat in northern Nevada. We found 14 and 22 occupied goshawk nests in 1991 and 1992, respectively. Nests were in aspen stands consisting of mature trees with a closed canopy and little understory cover. All were located near water and most were in north- or east-facing stands situated on variable slopes (4–39%). Fourteen breeding pairs fledged 18 young in 1991 and 22 breeding pairs fledged 61 young in 1992 for an average productivity of 2.2 young/occupied nest. Nest observations from blinds indicated that Belding's ground squirrels (*Spermophilus beldingi*) were the primary prey item, followed by various species of birds that were taken in the latter half of the breeding season after ground squirrels had estivated.

Key Words: *Accipiter gentilis*; *Artemisia*; aspen; Belding's ground squirrel; Northern Goshawk; *Populus tremuloides*; *Spermophilus beldingi*.

In the western U.S., the Northern Goshawk (*Accipiter gentilis*) typically nests in mature coniferous forests dominated by ponderosa pines (*Pinus ponderosa*), Douglas-firs (*Pseudotsuga menziesii*), and white firs (*Abies concolor*) (Palmer 1988, Johnsgard 1990). In drier areas of the west such as the Great Basin, goshawks also nest in high-elevation shrubsteppe habitats supporting small, highly fragmented stands of aspen trees (*Populus tremuloides*). Very little information is available on the habitat requirements of goshawks in these shrubsteppe habitats.

METHODS

The study was conducted in the Independence and Bull Run Mountain ranges between the Idaho–Nevada border and a point approximately 50 km north of Elko, Nevada. The ranges are ca. 150 km long and vary from 10 to 30 km in width. Elevations range from 1700 m on the adjacent plain to over 3000 m on the highest peaks. Vegetation is predominately open sagebrush (*Artemisia* spp.) with conifers (*Pinus albicaulis*, *P. flexilis* and *Abies lasiocarpa*) above 2500 m and aspen (*Populus tremuloides*) growing in riparian areas (Loope 1969). Most of the range is publicly owned and administered by the USDA Forest Service.

We conducted helicopter surveys for all raptor nests in the study area in April of 1991 and 1992 prior to emergence of aspen catkins. In addition, we searched stands of aspens or mixed aspen/conifer that either had a history of occupancy by breeding goshawks or appeared to be suitable nesting habitat. Searches were concentrated in the southern portion of the study area in 1991 but were extended in 1992 to include the northern portion where higher elevations created a shift from aspen to conifer habitat. A nest was classified as occupied if a raptor was seen in the vicinity of a nest structure or if there was evidence of fresh nesting material in nests. Locations of all occupied nests seen from the helicopter were recorded using a Loran C unit and later transcribed onto U.S.G.S. 7.5 min. topographical maps of the region. A nest or nest structure was the

platform of sticks on which eggs were laid, and a nesting stand was the stand of trees that contained the nest.

During May and June we checked all goshawk nests on foot to verify occupancy and to determine if eggs had been laid. An occupied nest was defined as a nest where territorial defense, courtship, or a goshawk was seen. Evidence of egg laying included the presence of eggs or young in the nest, or any field sign indicating that eggs were laid (e.g., adults in incubating posture, egg shell fragments in fresh nesting material). Characteristics of aspen stands used by breeding pairs of goshawks were also recorded. Measurements of slope, elevation, aspect, and distances to nearest water were obtained from Geographic Information System (GIS) maps that were developed from data previously collected by USDA Forest Service personnel. We used diameter at breast height (dbh) tapes and increment borers to obtain measurements on sizes and ages of nest trees.

In 1992, we observed eight pairs of goshawks throughout the nesting period from blinds to obtain information on diet and nesting behavior. Blinds were built with lumber and white canvas and placed 30–50 m from a nest tree. Observation periods lasted 3–5 hours and were scheduled to incorporate all times of the day. By continuously recording activities at the nest, observers monitored the types of food that were delivered to nests, the number of food deliveries per hour, and the time spent away from the nesting area by both sexes.

In 1992, adult goshawks were also captured in nest areas in June using a live Great Horned Owl (*Bubo virginianus*) and dho-gaza net. Adults were aged in the hand using plumage characteristics (B. Woodbridge, pers. comm.), and banded with green (male) and blue (female) alpha-numeric, anodized aluminum bands on the left leg and U.S. Fish and Wildlife Service aluminum bands on the right.

RESULTS

In 1991, 123 nest structures were found during helicopter surveys and goshawks were seen at or near ten of these nests. In 1992, only 66 nest

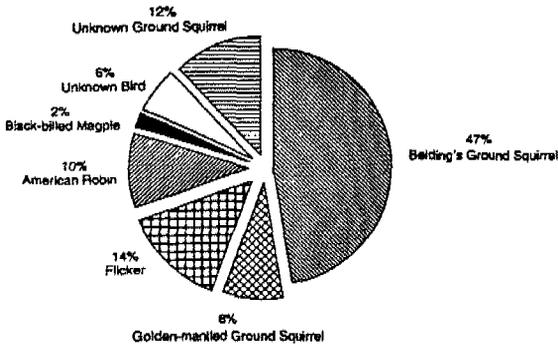


FIGURE 1. Frequency of occurrence of prey species in the diet of Northern Goshawks nesting in shrubsteppe habitats of northern Nevada.

structures were found and goshawks were seen at only six of these nests. Subsequent ground searches showed 14 and 22 of the nests to be occupied by goshawks in 1991 and 1992, respectively. The 1992 survey resulted in 11 new goshawk nest sites not located in 1991. Although the 1992 helicopter survey covered conifer forests, and these areas were searched on foot, no goshawks were found nesting there.

All goshawk nest stands had similar characteristics. Mean stand elevation was 2119 m (range 1975–2386 m). Aspens used as nest trees usually had the largest dbh in the stand ($\bar{X} = 29 \pm 3.8$ [SE] cm) and averaged ca. 60 years of age based on core samples. Nest stands were relatively open with a park-like appearance and little understory cover. Although nest stands were small ($\bar{X} = 24.9 \pm 21.9$ ha), the terrain was not steep (\bar{X} slope = $19.4 \pm 8.3\%$) and slopes generally faced north or east. Water, such as a stream or spring, was also usually present within 100 m ($\bar{X} = 91 \pm 129$ m).

Breeding began in April. By backdating from known-aged nestlings and using an incubation period of 33 days, we estimated that egg laying was completed on average by 1 May. We did not observe eggs so could not calculate egg hatchability, but the modal brood size was 3 young. Productivity increased significantly (t-test, $P < 0.05$) from a mean of 1.2 young/ breeding pair in 1991 to a mean of 2.8 young/ breeding pair in 1992. Young also fledged significantly earlier in 1992 ($\bar{X} = 1$ July ± 5 days) than in 1991 ($\bar{X} = 11$ July ± 8 days), possibly because of a very cold and wet spring in 1991.

All 22 adult females and 15 of 22 males were trapped and color marked in 1992. Aging in the hand showed that 11 of the 22 females were in second-year plumage, and none showed 1-year-old plumage characteristics (B. Woodbridge, pers. comm.). We expected the younger females to be less productive, but this was not the case (2.54

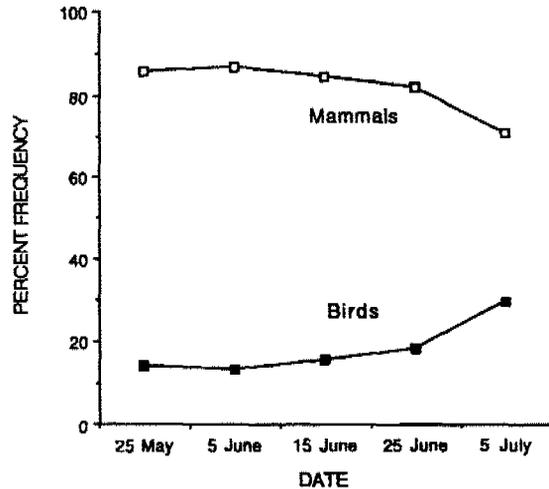


FIGURE 2. Seasonal variation in the frequency of occurrence of prey species in the diets of Northern Goshawks nesting in shrubsteppe habitats of northern Nevada.

vs. 3.0 young per nest). Two-year-old females did fledge young at a significantly later date than older birds (means of 28 June vs. 5 July, t-test, $P < 0.01$). Based on the plumage of birds observed with binoculars in 1991, 5 of 14 breeding females were 1 year of age. We did not trap adults in 1991, so no yearly comparison of 2- and 3+-year-old birds could be made. In both years, only one breeding male was estimated to be less than 3 years of age.

Based on the frequency of occurrence of prey delivered to nests, observations from blinds showed that goshawks ate mostly Belding's ground squirrels (*Spermophilus beldingi*) (Fig. 1). Ground squirrels were delivered by males on 24 of the 51 observed prey deliveries. We did not collect prey remains from plucking posts because goshawks were found to pluck birds and not ground squirrels. Instead, ground squirrels were brought directly to the nest. Mean rate of prey delivery was 0.31 prey item per hour. This was comparable to delivery rates reported by Boal and Mannan (*this volume*). As the nesting season progressed and ground squirrels began to estivate, we observed a shift in the types of prey that were delivered. After 1 July, males began to bring in more birds such as American Robins (*Turdus migratorius*) and Northern Flickers (*Colaptes auratus*) (Fig. 2).

DISCUSSION

In high-elevation shrubsteppe habitats, goshawks nest in small, widely-spaced stands of mature aspen trees that grow along creeks and drainages. These aspen stands are located primarily on north or east-facing slopes. The tree in which

the nest is built averages 60 years of age. The canopy is mostly closed and the understory is open with little cover. Understory cover is probably limited by livestock that use the stands for grazing and shading during the hot summer months.

Helicopter surveys were effective in surveying this type of habitat for nesting goshawks. These surveys are best conducted when the ground is snow-covered and prior to aspen catkin emergence. Lack of snow and early catkin emergence made survey conditions less favorable in 1992. As a result, the number of adults seen in the vicinity of nests was reduced from ten in 1991 to six in 1992. Also, the lack of contrasting snow cover lowered the visibility of nest structures in trees.

Nest observations indicated that female goshawks remained almost continuously in the vicinity of nests, even when young approached fledging age. Male goshawks did almost all the hunting. Many authors state that the female begins to hunt as the young get older (Palmer 1988, Johnsgard 1990). We did not observe this. Females were never seen to leave the immediate vicinity of the nest, even when the young were near fledging.

In 1992, 11 of 22 breeding females were in "sub-adult" plumage of 2-year-old birds (Bent 1937, Johnsgard 1990). We expected to find sub-adult females less successful than older females in rearing young, but found no difference. No females in 1-year-old plumage bred in 1992, but 5 of 14 breeding females observed in 1991 were in first-year plumage. In Alaska, younger birds bred during years of increasing prey abundance that follow a sharp decline in both prey and goshawk numbers (McGowan 1975). Apparently it is when populations of their preferred food, snowshoe hares (*Lepus americanus*), are increasing that younger females are recruited into the breeding population. A similar increase in the

population of the preferred food of goshawks in northern Nevada may have accounted for the large number of one-year-old females that bred in 1991.

Our results indicated that the collection of prey remains from plucking posts to determine goshawk diets may be highly biased when they are feeding on mammals as opposed to birds. We observed that males delivering ground squirrels to nests brought them in unplucked. They did, however, pluck birds at plucking posts. This indicates that, in places where goshawks feed heavily on small mammals, dietary studies must focus on both prey at nests and plucking posts to develop an unbiased estimate of the diets of these birds.

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