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DENSITY AND PRODUCTIVITY OF NORTHERN GOSHAWKS: IMPLICATIONS FOR MONITORING AND MANAGEMENT

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Abstract. We studied Northern Goshawk (*Accipiter gentilis*) breeding populations on five study areas on the Fremont, Malheur, and Wallowa-Whitman National Forests in eastern Oregon during 1992 and 1993. We found 50 active territories, with average densities of 0.07 active territories per 100 ha (SE = 0.15, N = 3 study sites) in 1992 and 0.06 (SE = 0.15, N = 5 sites) in 1993. However, densities were variable both between years and among areas within each year, and no consistent patterns were seen based on forest cover type. Productivity (number of young fledged per nest) was also variable between years and among study sites within the same year. Current USDA Forest Service management for goshawks emphasizes reducing tree harvest around specific nest sites or post-fledging family areas (PFAs). Our data, however, show that numbers of nesting goshawks are variable among years, and not all breeding sites will be discovered in a single year of survey. We recommend multiple-year surveys for nesting birds and habitat management on a landscape rather than "per nest" basis.

Key Words: *Accipiter gentilis*; breeding; nesting; Northern Goshawk; Oregon.

Timber harvesting has been implicated as a factor in reducing the number and altering the distribution of nest sites of Northern Goshawks (*Accipiter gentilis*) throughout much of the forested western United States (Reynolds et al. 1982, Crocker-Bedford 1990, Ward et al. 1992). In Oregon, this concern has led the Oregon Department of Fish and Wildlife to place the Northern Goshawk on the state's list of sensitive species.

In the Pacific Northwest, scientific research and public attention has focused on forest ecosystems and wildlife populations on the west side of the Cascade Mountain Range, largely due to concern for the status of Northern Spotted Owls (*Strix occidentalis caurina*). Interest is growing, however, in east-side forest issues, such as timber harvest, forest health, and wildlife habitat. The Northern Goshawk has been identified as a species of special concern and is being considered as a potential indicator of the health of mature ponderosa pine (*Pinus ponderosa*) and mixed conifer forests in eastern Oregon (Marshall 1992).

We studied goshawk populations in eastern Oregon to determine the distribution, density, and productivity of nests in major forest types, describe diet, and make recommendations for goshawk management and monitoring of breeding populations.

METHODS

Study Sites

Research took place on three National Forests in eastern Oregon: the Fremont, Malheur, and Wallowa-Whitman. These Forests were located across eastern Oregon and represented a wide spectrum of forest types. Mixed conifer forest (including combinations of ponderosa pine, Douglas-fir [*Pseudotsuga menziesii*], western larch [*Larix occidentalis*], incense-cedar [*Calocedrus decurrens*], sugar pine [*Pinus lambertiana*], and firs [*Abies* spp.]) and forest stands with a large component of ponderosa pine were found on all three Forests. In addition, large expanses of lodgepole pine (*Pinus contorta*) were present on the Fremont National Forest. Topography on all Forests ranged from gently sloping ridges to steep-walled drainages, with elevations between 900–2000 m. Natural openings, such as wet meadows, grasslands, and burns, were distributed throughout the study sites. Partial cuts (shelterwood, overstory removal, commercial thinning) and some clear-cutting were the major tree harvesting practices.

Five survey areas (called Density Study Areas [DSA]) were established on the three National Forests and ranged from 11,500 to 15,500 ha. Two DSAs were located on the Fremont National Forest: the Paisley DSA contained mostly lodgepole pine (80%), with some ponderosa pine (15%) and mixed conifers (5%); the Bly DSA was primarily mixed conifer (70%) and ponderosa pine (30%). Two DSAs were located on the Malheur National Forest: Bear Valley East DSA was dominated by ponderosa pine, with about 25% of the area covered by islands of lodgepole pine and mixed conifers; Bear Valley West DSA was mostly mixed conifer, with about 25% of the area in ponderosa pine. The Spring Creek DSA on the Wallowa-Whitman National Forest was comprised of mixed conifer stands.

Surveys

We used survey protocol recommended by Woodbridge (pers. comm.) and Kennedy and Stahlecker (1993) to search for all nesting goshawks within the five DSAs. Survey stations were about 300 m apart and were set up on roads and trails and along transects through roadless areas to obtain complete coverage of each DSA. From mid-May to early August, taped goshawk calls were broadcast through a megaphone (modified Realistic® model 32-2030 coupled to a Sony® walkman model WMA53). Responses to the taped calls and incidental sightings of goshawks were followed by intensive searches to locate nests. Nest locations were marked on topographic maps and aerial photographs.

TABLE 1. NUMBER AND DENSITY OF NORTHERN GOSHAWK NESTING TERRITORIES ON THE FREMONT, MALHEUR, AND WALLOWA-WHITMAN NATIONAL FORESTS IN EASTERN OREGON, 1992–1993

Forest	DSA	Primary forest cover	1992				1993			
			Area (ha)	Known nests	Active territories	Density (active terr./100 ha)	Area (ha)	Known nests	Active territories	Density (active terr./100 ha)
Fremont	Paisley	Lodgepole	8780	3	4	0.046	12,960	6	8	0.062
	Bly	Mixed conifer/ponderosa					10,627	3	4	0.038
Malheur	Bear Valley East	Ponderosa/mixed conifer	9046	6	8	0.088	9046	6	6	0.066
	Bear Valley West	Mixed conifer/ponderosa					10,519	8	9	0.086
Wallowa-Whitman	Spring Creek	Mixed conifer	11,396	7	8	0.070	11,396	3	3	0.026

The Paisley, Bear Valley East, and Spring Creek DSAs were surveyed in 1992 and 1993. The Bly and Bear Valley West DSAs were surveyed in 1993 only. In some cases, there was evidence of nesting goshawks (responses by birds to taped calls, repeated observations of defensive adults in an area) but the nest was not found. We included them in our calculations of breeding densities.

Productivity of nests was determined by visiting nest sites in late July and counting nestlings either just before or just after fledging. Nesting phenology dates were based on back-dating from estimated weekly development of juveniles based on plumage characteristics and fledging dates. Prey remains and goshawk pellets were collected under nest trees and at plucking posts and were placed in labeled plastic bags and stored frozen for analysis at a later date.

RESULTS

We found a total of 20 active territories in 1992 and 30 in 1993 (Table 1). Overall density averaged 0.07 active territories per 100 ha (SE = 0.15, N = 3) in 1992 and 0.06 per 100 ha (SE = 0.15, N = 5) in 1993. Densities were variable both between years and among areas within each year. No consistent patterns were seen based on forest cover type (i.e., DSAs dominated by lodgepole pine, ponderosa pine, or mixed conifers).

There was a decreasing trend in productivity (number of young per active territory) from the Fremont National Forest in the south to the Wallowa-Whitman National Forest in the north in 1992 (Table 2). This trend was repeated in 1993, when the Paisley and Bly DSAs on the Fremont and the Bear Valley East and Bear Valley West DSAs on the Malheur were combined ($\bar{X}$ = 1.56 young per nest, SE = 1.15, N = 9 nests for Fremont; $\bar{X}$ = 1.00, SE = 0.96, N = 13 for Malheur; $\bar{X}$ = 0.67, SE = 0.76, N = 3 for Wallowa-Whitman). In some cases, however, productivity was variable between years (e.g., Bear Valley East DSA) and between DSAs on the same Forest (Table 2). Nesting phenology was similar among Forests, with eggs laid in late April to early May, eggs hatched during late May to mid-June, and young fledged from late June to mid-July.

Totals of 119 and 101 prey items were identified in 1992 and 1993, respectively (Table 3). Avian and mammalian species made up 100% of identifiable prey remains. Both percent composition and percent biomass indicated that mammalian prey was more prevalent on the Fremont and Malheur National Forests, whereas avian prey was proportionally larger on the Wallowa-Whitman. However, our sample of prey remains for the Wallowa-Whitman was very low in 1993 because few pairs of goshawks nested.

DISCUSSION

Our estimates of density of goshawk breeding sites in eastern Oregon are probably minimums

TABLE 2. PRODUCTIVITY (NUMBER OF FLEDGLINGS PER KNOWN NEST SITE) OF NORTHERN GOSHAWKS ON THREE NATIONAL FORESTS IN EASTERN OREGON, 1992–1993

Forest	Density study area	1992			1993		
		$\bar{X}$	SE	N	$\bar{X}$	SE	N
Fremont	Paisley	2.2	0.75	6	2.2	1.08	6
	Bly				0.3	0.76	3
Malheur	Bear Valley East	1.9	0.57	10	0.3	0.72	6
	Bear Valley West				1.6	0.89	7
Wallowa-Whitman	Spring Creek	1.0	0.71	9	0.7	0.76	3

because we may not have found all active territories (Kennedy and Stahlecker 1993). In addition, nest failures early in the breeding season would have precluded us from detecting some active territories. However, our use of survey protocol recommended by Woodbridge (pers. comm.) and Kennedy and Stahlecker (1993) allowed us to obtain complete coverage of all five DSAs with equal effort, and to survey all forest types and seral stages for goshawk nests. Thus, we believe that our estimates of density are relatively accurate and directly comparable among the five study sites.

There was a substantial reduction in numbers of active territories from 1992 to 1993 on the Spring Creek DSA. This trend was also noted elsewhere on the Wallowa-Whitman National Forest (A. Blumton, pers. comm.) and adjacent Boise-Cascade Company lands (M. McGrath, R. Riggs, pers. comm.). This drop in breeding activity may have been due to cold, wet spring weather in northeastern Oregon. Densities of active goshawk territories also varied between DSAs on the same Forest, especially the Paisley and Bly DSAs on the Fremont.

There was a latitudinal trend in productivity, with higher numbers of juveniles fledged from south to north. This may have been a function of diet, as higher proportions of mammals were found in prey remains on the Fremont and Malheur than the Wallowa-Whitman. Bull and Hohman (*this volume*) reported similar productivity and diet results during 1992 from their study area on the Wallowa-Whitman National Forest. A relationship between high productivity and proportionally more mammalian species in the diet is speculative, however, and additional data on diet and productivity are required to draw conclusions.

Current USDA Forest Service management for Northern Goshawks in Region 6 (Oregon and Washington) calls for establishing protected zones around some nest sites (nest sites in areas under current timber harvest contracts are often exempt), where no or reduced timber harvest would take place. These zones are of variable size and often are on the order of 2–12 ha (5–30 acres). More recently, managers have been directed to protect a larger area around goshawk nest sites corresponding to the post-fledging family area (PFA).

Either of these approaches necessitate finding active goshawk breeding sites, and promotes management on a "per nest" basis. Our data show that not all sites are active in all years, and thus searching for goshawk nests in a single season in preparation for potential timber sales could easily overlook territories. This variability between years in nest site use by goshawks could be due to a poor breeding year because of inclement spring weather or some other environmental variable, as we believed happened in northeastern Oregon in 1993. Also, use of alternate nest sites by goshawks or early nest failure

TABLE 3. PERCENT COMPOSITION AND PERCENT BIOMASS OF PREY REMAINS COLLECTED AT NESTS AND PLUCKING SITES OF NORTHERN GOSHAWKS ON THE FREMONT, MALHEUR, AND WALLOWA-WHITMAN NATIONAL FORESTS IN EASTERN OREGON, 1992–1993

Forest	1992					1993				
		Composition (%)		Biomass (%)			Composition (%)		Biomass (%)	
	N[1]	Birds	Mammals	Birds	Mammals	N[1]	Birds	Mammals	Birds	Mammals
Fremont	49	49	51	34	66	47	53	47	27	73
Malheur	44	34	66	16	84	50	60	40	37	63
Wallowa-Whitman	26	62	38	64	36	4	50	50	51	49

[1] N = number of separate prey remains or goshawk pellets examined.

also influences the ability of surveyors to locate all nest sites.

Because of the variability in nest site use by goshawks, we recommend as an absolute minimum that surveys be conducted for at least two, and preferably three or four years in an area before allowing timber harvest. An alternative to the per-nest management approach would be to manage forest habitat on more of a landscape scale. Management plans, such as suggested by Reynolds et al. (1992), consider other forest-dependent species and promote management at a more holistic level. We believe that similar landscape-level recommendations are appropriate to other diurnal and nocturnal raptors.

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