

MONITORING RESULTS OF NORTHERN GOSHAWK NESTING AREAS IN THE GREATER YELLOWSTONE ECOSYSTEM: IS DECLINE IN OCCUPANCY RELATED TO HABITAT CHANGE?

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ABSTRACT.—I monitored a subset of Northern Goshawk (*Accipiter gentilis*) nesting areas on the Targhee portion of the Caribou-Targhee National Forest in eastern Idaho and western Wyoming from 1998–2002 (recent period) to provide occupancy and productivity data for U.S. Forest Service monitoring requirements. A total of 16 randomly-selected nesting areas, half in undisturbed and half in timber-sale project areas, were surveyed each year. Occupancy in 1998–2002 averaged 34%, which was significantly lower than the 61% measured at these nesting areas from 1992–95 (baseline period) using similar survey methods and effort. Productivity of successful nests was similar between the two periods. I used the dawn vocalization survey method in 2001–02, in addition to standard broadcast survey methods, to determine if low occupancy reflected a poor detection rate of pairs that occupied sites, but failed to reproduce. Detection rate of goshawks during the courtship period in these 2 yr averaged less than 50%, indicating that number of pairs reoccupying known nesting areas surveyed was low. I found no relation between weather factors and lower occupancy. Occupancy at nesting areas located in past timber-harvest areas in the recent period was significantly lower compared to those in less disturbed habitat (22% occupancy versus 45%, respectively) suggesting that occupancy may be influenced by the long-term effects of timber-management practices. Whether the observed decline during the recent period reflects spatial shifts of nesting pairs, short-term demographic responses to variation in weather or prey, or longer-term responses to changes in forest structure and age resulting from timber-management activities, cannot be determined using the current monitoring program. Long-term monitoring of study areas in the western United States, based on statistically valid study designs and adequate sample size, is needed to understand if the apparent decline in goshawk occupancy reported here and in other recent studies has serious implications for conservation of this species.

KEY WORDS: Northern Goshawk; *Accipiter gentilis*; nest-site occupancy; raptor monitoring; survey techniques; forest management.

RESULTADOS DEL MONITOREO DE ÁREAS DE NIDIFICACIÓN DE *ACCIPITER GENTILIS* EN EL AMPLIO ECOSISTEMA DE YELLOWSTONE: ¿ESTA RELACIONADA LA DISMINUCIÓN EN LA OCUPACIÓN CON EL CAMBIO DEL HÁBITAT?

RESUMEN.—Evalué un conjunto de áreas de nidificación de *Accipiter gentilis* en la porción Targhee del Bosque Nacional de Caribou-Targhee en el este de Idaho y oeste de Wyoming desde 1998 hasta 2002 (período actual) para proveer datos de ocupación y productividad para los requerimientos de evaluación del Servicio Forestal. Un total de 16 áreas de nidificación seleccionadas al azar fueron evaluadas cada año (la mitad en áreas no perturbadas y la mitad en áreas de proyectos de venta de madera). La ocupación promedio durante el período actual fue de un 34%, lo cual fue significativamente menor que el 61% medido en áreas de nidificación desde 1992 hasta 1995 (período de línea de base) usando métodos y esfuerzos de muestreo similares. La productividad de los nidos exitosos fue similar entre los dos períodos. Realicé muestreos de vocalizaciones durante el amanecer en 2001 y 2002, además de otros métodos estándar de reproducción de grabaciones, para determinar si la baja ocupación reflejaba una tasa de detección baja de las parejas que ocupaban los sitios pero que no se reproducían. La tasa de detección de *A. gentilis* durante el período de cortejo en estos dos años fue en promedio menos del 50%, indicando que el número de parejas que ocuparon nuevamente las áreas conocidas de nidificación fue bajo. No encontré una relación entre los factores climáticos y una baja ocupación de individuos. La ocupación durante el período actual en las áreas de nidificación en las que se cosechó madera en el pasado fue significativamente menor comparada con la de ambientes menos perturbados (22% de

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dus around nest sites are required to monitor previously identified nesting areas effectively (Reynolds et al. 1994, Woodbridge and Detrich 1994, Finn et al. 2002).

The amount of survey effort expended per nesting area (mean number of visits per site and area surveyed) for the current goshawk monitoring period matches or exceeds that reported in other long-term goshawk studies (Kennedy 1997, Boyce et al. 2005, Reynolds et al. 2005). The total number of nesting areas monitored per year was relatively low, however, and included only a subset of known areas scattered throughout the CTNF.

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The goshawk-monitoring plan for the CTNF is based on the assumption that goshawks exhibit territorial behavior and that "a stable population should revolve around some average occupancy rate" of known nesting areas (USDA 1997b). The plan assumes that the occupancy measured at a subset of known nesting areas can be used as an index of population stability or decrease for the species. The plan states: "A sustained downward trend of adult occupancy for at least four years may indicate a need for action" (USDA 1997b). There are no specific requirements that monitoring protocols developed for land management plans follow statistically rigorous study design criteria. The approach to monitoring on a forest level tends to be pragmatic and based on limited funding availability. Whether the study design used on the CTNF is adequate as an index for local population trend requires further statistical evaluation. For this analysis, I assumed that occupancy results apply to the target population of known nesting areas monitored and may not reflect forest-wide population trends.

Decline in Occupancy. Results of this study indicate that occupancy of known goshawk nesting areas on the CTNF was significantly higher in the early 1990s compared to later in the decade with no rebound evident through the 2002 nesting season (Fig. 3). Results are consistent with those reported from other goshawk study areas suggesting that there may have been a decline in some goshawk populations across the Intermountain West during the late 1990s (Fairhurst and Bechard 2005, Reynolds et al. 2005).

Results from dawn vocalization surveys on the CTNF indicated that the lower occupancy measured in the recent period likely did not result from failure to detect pairs that occupied sites but did not reproduce (Woodbridge and Hargis 2005).

However, it is possible, given the study design and low sample number that spatial shifts by pairs outside of areas surveyed may have confounded results. Studies of marked goshawks have shown that shifts between nesting areas by individual breeding adults occur to some extent and that some ephemeral territories are occupied only occasionally (Woodbridge and Detrich 1994, Reynolds and Joy 1998, Reynolds et al. 2005). If a proportion of pairs at study sites on the CTNF shifted each year between sites, or used certain sites only occasionally, occupancy results could be misleading.

Weather conditions can influence goshawk occupancy, but I did not find a significant difference between the recent and baseline periods in relation to total annual precipitation and snow water equivalents. The latter factor was negatively related to occupancy in the baseline study period (Patla 1997). There may be other local or regional weather/climatic trends not analyzed in this study that were influencing occupancy rates during the study period.

The amount and structure of forest habitat surrounding nest sites has been related to occupancy of historical goshawk nest sites in the western United States (Crocker-Bedford 1990, Woodbridge and Detrich 1994, Desimone 1997, Finn et al. 2002, McGrath et al. 2003). During the baseline study period, I also found an association between the proportion of mature forest habitat and occupancy rate of nesting areas on the CTNF. High occupancy nest clusters in timber harvest areas, defined as those with $\geq 50\%$ occupancy rate ($N = 16$, $\bar{x}$ occupancy = 81%), contained a significantly greater proportion of mature forest cover and less young forest/seedling cover within a 240 ha area surrounding known nests compared to low occupancy nest clusters ($N = 6$, occupancy = 37%; Patla 1997).

In the recent study period, occupancy of nesting areas on the CTNF in timber-harvest areas showed a greater proportional decline than those in less disturbed habitat, but vegetation differences between these categories were not quantified. There appears to be an association between reduction in mature forest habitat within nesting areas on the CTNF as a result of harvesting and decline in occupancy. This hypothesis requires further investigation of vegetation conditions at nest areas in relation to goshawk occupancy patterns.

In contrast to occupancy data, I found no difference in productivity of nesting goshawk pairs be-

5 studies
High Occupancy
750%

600 ac.

tween the baseline and recent periods or between timber harvest and undisturbed sites in the recent period. Pairs that nested successfully produced similar number of young supporting the suggestion by McClaren et al. (2002) that number of young fledged may not be useful for assessing spatial variability in goshawk nest habitat quality.

Whether the decline in occupancy measured at known nesting areas on the CTNF reflects a response to decline in quality of primary habitat, a shorter-term response to variation in weather and prey, or sampling error due to shifting of pairs outside of surveyed sites cannot be determined using the current monitoring study plan employed by the U.S. Forest Service. However, data from the CTNF reflects a pattern documented at other locations in the western U.S. that indicated a peak in the number of occupied goshawk nest sites in 1992 and a subsequent decline. It remains unknown if goshawk populations exhibit periodic cyclical highs in the western U.S. similar to those documented farther north (Doyle and Smith 2001) or if trend data indicates the onset of a more serious, longer-term decline related to habitat or climatic change. Because many goshawk studies and monitoring projects were initiated during or after the early 1990s, baseline data prior to 1992 are lacking from most areas. How to interpret recent trends since 1992 remains challenging.

Results of the current study emphasize the need to develop more comprehensive, well-funded, and statistically valid monitoring plans for goshawks that can track population trend, reproductive success, and habitat relationships in a timely and meaningful way. However, declines at known nesting areas measured since 1992 suggest that a conservative approach for managing remaining mature/old growth forests would be most prudent until our knowledge and understanding concerning the relationship between goshawk demographic parameters and loss of mature forest habitat increases (DeStefano 1998).

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