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RESPONSE OF NESTING RED-TAILED HAWKS TO HELICOPTER OVERFLIGHTS[1]

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Abstract. Low-level helicopter overflights of 35 Red-tailed Hawk (*Buteo jamaicensis*) nests were conducted at two study areas in southeastern and east-central Colorado in 1984 and 1985. Red-tailed Hawks nesting where low-level air traffic was nonexistent prior to 1983 exhibited stronger avoidance behavior than did hawks nesting where helicopter activity had occurred since the late 1950s. Nine (53%) of 17 birds in the first study area flushed from the nest while only one (8%) of 12 birds in the second study area flushed. Age of nestlings at the time an overflight occurred did not influence avoidance behavior, and overflights did not appear to influence nesting success at either study area. Our results are consistent with the hypothesis that Red-tailed Hawks habituate to low-level air traffic during the nesting period. However, naive birds may respond negatively to low-level helicopter activity prior to habituation and other species of raptors may respond differently than Red-tailed Hawks.

Key words: Red-tailed Hawk; Buteo jamaicensis; *Colorado; helicopter overflights; human disturbance; nesting behavior.*

INTRODUCTION

The impact of low-level air traffic on raptors has not been well established. Snyder, Kale, and Sykes (unpubl.) studied a nesting colony of Snail Kites (*Rostrhamus sociabilis*) in Florida and did not observe any effect on nesting success or any consequent changes in behavior caused by low-level jet traffic. In Arizona, D. H. Ellis (unpubl.) similarly found no apparent detrimental effects at a variety of raptor nests exposed to low-level military jet traffic and associated sonic booms. Platt (1977), however, found that nesting Gyrfalcons (*Falco rusticolus*) exposed to spring helicopter overflights were less likely than other Gyrfalcons to reoccupy the same site the following year.

None of these studies has compared the behavioral response to low-level air traffic of a nesting raptor in areas where air traffic has recently been initiated to areas where such traffic has occurred for an extended period. Here, we report on the results of a study conducted to determine the response of nesting Red-tailed Hawks (*Buteo jamaicensis*) to low-level helicopter overflights on the Pinon Canyon Maneuver Site (PCMS) in southeastern Colorado and the Fort Carson Military Reservation (FCMR) in east-central Colorado. Low-level air traffic was limited on the PCMS prior to its acquisition by the military in 1983, but on the FCMR, helicopter activity has been extensive since the late 1950s. We conducted controlled helicopter overflights at nests in both sites to determine: (1) whether low-level helicopter activity negatively affected the behavior of nesting Red-tailed Hawks, and (2) whether Red-tailed Hawks became habituated to helicopter overflights.

STUDY AREAS

The 1,040-km² PCMS is located in Las Animas County in southeastern Colorado. Climate is classified as dry continental and elevation ranges from 1,300 to 1,700 m. Topography consists of broad, moderately sloping uplands bordered by the Purgatoire River Canyon on the east, limestone hills on the west, and a basalt hogback on the south. Vegetation is dominated by shortgrass prairie and pinyon pine (*Pinus edulis*)-juniper (*Juniperus monosperma*) woodland (Costello 1954, Kendeigh 1961). The pinyon-juniper plant

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TABLE 1. Sample sizes, age of nestlings, reproductive success, and responses of nesting Red-tailed Hawks exposed to a single low-level helicopter overflight on the Pinon Canyon Maneuver Site (PCMS) and the Fort Carson Military Reservation (FCMR), Colorado during 1984 and 1985.

Site	Year	Date	Number of nests	Successful nests (%)	Number flushed (%)	Mean behavior score	Mean distance (m) flushed (*n*)
PCMS	1984	1 June	10	10 (100)	6 (60)	3.2	100 (6)
	1985	23 May	11	7 (64)	7 (64)	3.3	17 (7)
FCMR	1984	21 May	7	6 (86)	0 (0)	1.4	–
	1985	24 May	7	6 (86)	1 (14)	1.7	10 (1)

association is concentrated along the Purgatoire River Canyon and its associated side canyons, in the limestone hills, and on parts of the basalt hogback (U.S. Department of the Army, unpubl.). The PCMS was acquired by the U.S. Department of the Army in 1983. Prior to this acquisition, PCMS was heavily grazed and supported low human densities since it was settled in the late 1870s (Friedman 1985). Low-level air traffic was very infrequent (P. F. Stokes, pers. comm.).

The 556-km^2 FCMR is located in eastcentral Colorado along the eastern edge of the Front Range south of Colorado Springs, Colorado. The climate is similar to that at PCMS and elevation ranges from 1,650 to >2,000 m. Most of the eastern half of FCMR lies within the Colorado Piedmont and has a generally sloping surface with low relief (Hubbard and White 1976). The remainder of FCMR is characterized by moderately rolling high plains whose surfaces are often interrupted by scattered rocky escarpments and low foothills (U.S. Department of the Army, unpubl.). Major plant associations include pinyon pine-juniper, blue grama (*Bouteloua gracilis*)-western wheatgrass (*Agropyron smithii*), and cottonwood (*Populus* sp.)-willow (*Salix* sp.) (Costello 1954, U.S. Department of the Army, unpubl.). The FCMR was established in 1944 and helicopter training activity began there in the late 1950s. Since then, low-level aircraft training has been extensive, with approximately 15,000 hr flown in 1984 and in 1985 (FCMR-Aviation, pers. comm.).

METHODS

In May and June of 1984, and in May of 1985, we conducted experimental overflights at 35 active Red-tailed Hawk nests on PCMS and FCMR (Table 1). In 1985, four (36%) nests on PCMS were re-exposed to overflights. Likewise, two (29%) nests on FCMR were re-exposed to overflights in 1985. Nests that were flown over in both years were only included in the analysis of 1984 responses, to minimize the chance of including individual birds more than once.

One overflight a year was conducted at each nest in an Army UH-1 helicopter that flew directly at nests from a distance of at least 500 m at speeds of 45–65 km/hr. Altitude was maintained at 30–45 m above ground level and the helicopter passed directly over or just to one side of the nest. Nests at which birds did not flush were approached to within 30 m. Only nests where at least one adult was in attendance, standing or sitting at or near the nest, and where birds could observe the helicopter approach clearly from at least 500 m (White and Sherrod 1973) were selected for overflights. Overflights were conducted between 07:00 and 12:00 MDT on days when wind speed was <25 km/hr. Ambient temperature ranged from 6 to 26°C.

Responses of the hawks to the helicopter were assigned to one of five categories (Table 2). A possible sixth category, flight from the nest with aggressive behavior directed at the helicopter, was not observed. If the bird flushed we recorded at what distance, and the closest distance the helicopter approached the bird or the closest distance the flushed bird approached the helicopter. We visually estimated the age of the nestlings (Moritsch 1983) and later determined nestling age using wing measurements (Petersen and Thompson 1977; Bechard et al. 1985; Andersen, unpubl. data) taken during nest visits made after the overflights. On PCMS, three (18%) of 17 nests were on cliffs and 14 were in trees. On FCMR, two (17%) of 12 nests were on cliffs and 10 were in trees. Nest success for the year of the overflight was determined for all nests and in 22 (63%) nests 1 year subsequent to the overflight.

Nonparametric statistical procedures used to test for differences in behavior followed those outlined by Gibbons (1985). Parametric statis-

TABLE 2. Categories used to rank behavioral responses of Red-tailed Hawks to a single low-level helicopter overflight on the Pinon Canyon Maneuver Site and the Fort Carson Military Reservation, Colorado during 1984 and 1985.

Category	Description of behavior
1	No visible response to the helicopter—the bird did not appear to change its behavior in response to an overflight.
2	Crouch and remain motionless in nest—as the helicopter approached, the bird crouched and did not move.
3	Flight intention movements—the bird crouched and spread its wings as though in preparation for flight, but remained in or near the nest.
4	Flushed from nest—at the approach of the helicopter, the bird flushed from the nest and flew away from the helicopter.
5	Evasive flight away from the helicopter—the bird flushed from its position at or near the nest and flew away from the helicopter while performing evasive maneuvers.

tics followed Snedecor and Cochran (1980). To test for differences in behavior between years as well as study sites, we used a Kruskal-Wallis test and a simultaneous multiple comparison test (Dunn 1964) on behavior scores. Chi-squared procedures were used to test for differences in flushing frequencies and Spearman's rank correlation was used to test for association. Nests that had experimental overflights in both 1984 and 1985 (four on PCMS, two on FCMR) were excluded from 1985 samples in all statistical tests for independence considerations.

RESULTS

Red-tailed Hawks on PCMS exhibited stronger avoidance behavior to an overflight than hawks on FCMR ($H = 9.80$, df $= 3$, $P < 0.05$) with nine (53%) of 17 and one (8%) of 12 ($\chi^2 = 6.20$, df $= 1$, $P < 0.05$) hawks being flushed on PCMS and FCMR, respectively. Behavioral response to an overflight did not differ between years on either PCMS or FCMR. Hawks that did not flush were approached to a similar distance (±SD) on PCMS (24 ± 13 m, $n = 8$) and on FCMR (30 ± 18 m, $n = 13$; $t = -0.96$, df $= 19$, $P > 0.35$).

Nestlings averaged 23 days old (range = 14–34) on PCMS during overflights in 1984 and 7 days (range = 0–14) in 1985. On FCMR, they averaged 14 days (range = 6–20) in 1984 and 6 days (range = 0–10) in 1985. In 1984, nestlings on PCMS were significantly older ($t = 2.98$, df $= 15$, $P < 0.01$) than nestlings on FCMR. Nestling ages were not significantly different between PCMS and FCMR in 1985 ($t = 0.36$, df $= 9$, $P > 0.50$).

In 1984, all nests subjected to a helicopter overflight successfully fledged at least one young and in 1985, only one (14%) nest on PCMS and one (20%) nest on FCMR failed. One year subsequent to overflights, 10 (83%) of 12 nests which were relocated on PCMS and all five nests relocated on FCMR were successful.

DISCUSSION

Several factors may influence the behavioral response of nesting Red-tailed Hawks to low-level helicopter overflights. Parental investment theory (Trivers 1972) suggests that parent birds should defend their offspring more aggressively as more time and energy are invested (Barash 1975). Thus, adults with older nestlings should be less prone to leave the nest and more prone to defend nestlings (see Knight and Temple 1986). However, we found no significant association between the age of nestlings in the nest and the behavioral score of the parent ($r = 0.105$, $n = 28$, $P > 0.60$), indicating that cumulative parental investment was not a good predictor of the adult bird's response to an overflight.

Nesting densities and frequencies of intra- and interspecific interactions may influence a bird's willingness to leave its nest. Time spent defending territories from conspecifics should increase as nesting densities increase (Janes 1984). Likewise, past persecution history may also affect nest-defense behavior with birds in areas where they have been persecuted by humans for longer periods being less willing to remain at or near the nest when confronted with potential human disturbance (Knight et al., in press). Our results were inconsistent with both explanations because Red-tailed Hawk nesting density on PCMS and FCMR was comparable, at approximately one active nest per 25–30 km^2 (Andersen 1984, unpubl. data) and because PCMS has been settled by peoples of European descent for a shorter period (and presumably the hawks have been persecuted less; see Knight et al., in press) than FCMR (Friedman 1985).

Our results are consistent with the hypothesis that nesting Red-tailed Hawks habituate to low-level air traffic. Red-tailed Hawks on PCMS that had not previously been exposed to low-level helicopter overflights responded more strongly than did those nesting on FCMR, where the potential for previous experience with helicopters was high. It appears that over a period of time, the birds habituate to low-level air traffic and the intensity of avoidance behavior decreases. These observations have several important implications. First, although we found no difference between study areas in nesting success of Red-tailed Hawks, caution should be exercised during nesting surveys in areas where birds have not experienced low-level aircraft activity near their nests as they may leave the nest unattended (Fyfe and Olendorff 1976), abandon the nest during sensitive periods (Fyfe and Olendorff 1976, Steenhof and Kochert 1982), or dislodge eggs or nestlings during a hasty departure (Fyfe and Olendorff 1976). Second, although Red-tailed Hawks apparently habituate to low-level helicopter overflights, other raptors may not habituate as rapidly and care should be taken when surveying their nests from the air.

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