Effects of radio-tagging on the behavior of Red-shouldered Hawks

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In studies of several different species of raptors (Southern 1964, Nicholls and Warner 1972, Johnson 1973, Fuller 1979, Forsman 1980, McCrary 1981) radio-telemetry has been established as an invaluable technique for monitoring the movements of these highly mobile and often secretive birds. A significant consideration to any study utilizing radio-telemetry is the possibility that changes in behavior may occur as a result of transmitter attachment. Cochran (1972:39) has stated, "It seems axiomatic that the use of telemetric devices on birds will affect their performance." However, the same factors that necessitate the use of radio-telemetry are likely to prohibit behavioral observations of radio-tagged birds after their release.

During the first radio-telemetry study of an owl (Barred Owl, *Strix varia*), little or no effect on gross behavior was observed, and in most cases the owls appeared to adjust completely to the transmitter and harness after 2-3 days (Nicholls and Warner 1968). A similar lack of observable effect has also been noted for radio-tagged Great Horned Owls *(Bubo virginianus)* (Dunstan 1970). Although these studies on owls support the opposite view to that of Cochran, observations of this nature on other raptor species have not received adequate attention in the literature. Thus, researchers have had to assume that the long term survival of radio-tagged individuals and their successful reproduction indicate radio-tagging has little or no effect on behavior.

The purpose of this paper is to provide further qualitative and quantitative data on the behavioral effects of radio-tagging raptors, in this case the Red-shouldered Hawk *(Buteo lineatus)*.

Methods

During an ecological study of Red-shouldered Hawks conducted on Camp Pendleton Marine Corps Base in San Diego Co., California from February 1979 through May 1981 (McCrary 1981), 5 adults were trapped and radio-tagged with 151 MHz transmitters. The study area was a 4 km section of the Santa Margarita River where vegetation consists mainly of southern California coastal riparian woodlands dominated by sycamores *(Platanus racemosa)*, coast live oaks *(Quercus agrifolia)*, and willows *(Salix* sp.). Large tracts of cultivated trees dominated by eucalyptus *(Eucalyptus* sp.), jacarandas *(Jacaranda* sp.), and California peppers *(Schinus molle)* also occur within the study area.

Four of the birds were initially captured with Bal-chatri traps (Berger and Mueller 1959) baited with mice. This method proved ineffective for retrapping these birds, and a mist net baited with a live Red-tailed Hawk *(Buteo jamaicensis)* had to be employed to retrieve transmitters. A fifth bird was initially captured with a mist net baited with a live Great Horned Owl.

All telemetry equipment was purchased from Dav-tron Inc., Minneapolis, Minn. A multi-channel receiver (model RM-4) and a 5-element hand-held yagi antenna (model Y-5) were used to monitor the movements of the radio-tagged individuals; the transmitters (model LBT-403) had a maximum range of about 2 km and battery life was approximately 4 months. The transmitters were attached with a back harness method developed by Dunstan (1972) with the harness consisting of tubular teflon straps 4 mm in width (Bally Ribbon Mills, Bally Pa.). The transmitters were attached in such a fashion that a finger-width of slack occurred at any point under

Table 1. Effects of radio-tagging on the use of space by Red-shouldered Hawks.

Individual	Date of radio-tagging	Use of space first day (ha)	Use of space second day (ha)	Use of space after 4 weeks (ha)
Male 8	17 Feb 1979	13.9 (5.6/hr)	20.4 (3.7/hr)	23.1 (1.9/hr)
Male 11	17 Feb 1979	11.9 (2.5/hr)	21.6 (2.7/hr)	23.1 (1.9/hr)
Female 12	24 Feb 1979	3.7 (0.9/hr)	6.0 (0.5/hr)	12.6 (1.7/hr)
Female 9	17 Nov 1979	2.0 (0.6/hr)	18.1 (4.0/hr)	24.0 (2.3/hr)
Female 7	14 Jan 1981	11.1 (3.0/hr)	4.5 (0.9/hr)	5.1 (0.7/hr)

the harness. About 1.5 hours were required to band, weigh, measure, and radio-tag each bird. Sexes were initially determined by weight and confirmed by subsequent behavioral observations. The receiver channel number corresponding with a bird's transmitter has been used to designate each individual.

Immediately after release the behavior of each bird was carefully monitored to determine the effects, if any, of radio-tagging. Each bird was released 75 - 100 m from its nest in order to observe any flight abnormalities. Although the length of time for each individual varied with battery life and other factors (McCrary 1981), the subsequent movements and behavior of the 5 radio-tagged birds were visually monitored for a total of more than 1,000 hours.

Results and discussion

Upon release, each bird was observed to fly in a normal fashion for long distances, and no subsequent flight difficulties were observed during this study. Within 15 minutes after release, male 8 was observed soaring over his nest site in a territorial display, as well as flying from perch to perch, and landing without difficulty. Both male 11 and female 12 were observed flying, perching, nest building, and hunting in what seemed to be a normal fashion during the day after their release. Similarly, the hunting, and flight behavior of females 7 and 9 seemed normal on the day after their release.

Some radio-tagged birds of prey have been noted to use substantially less space initially after release than during subsequent observations (Fuller 1979, Nicholls 1973, Nicholls and Warner 1968). However, in these studies this period usually lasted for more than a single day. Adjustment to the transmitter package in this study appeared to be extremely rapid. Although most of the radio-tagged Red-shouldered Hawks used only a small amount of space during the day of release, these birds used a comparatively large area by at least the second day (Table 1). The amount of space used during the second day was similar to that used more than 4 weeks later, and the rate of space use during the first and second day was often higher than that noted subsequently (Table 1).

Although all the Red-shouldered Hawks exhibited normal behavior during the day after radio-tagging, none, as indicated above, appeared to adjust as rapidly as male 8. Usually after release a hawk spent at least 2-3 hours in dense vegetation, only rarely moving from perch to perch. During this adjustment period most of the birds were hidden from view; however, I was able to visually observe female 7 for several hours after her release, and her behavior was probably typical of that of the other radio-tagged individuals during the same period. Upon release, female 7 flew about 75 m to a tree frequently used by herself and her mate. Two minutes later she flew about 30 m to another tree where her mate, male 8, was perched. She remained in this tree for 75 minutes during which time she preened and tugged on her transmitter and harness for about 40 minutes. Female 7 then flew about 20 m to a more heavily foliaged tree where she remained for 104 minutes. During this period she preened and pulled on the transmitter package for another 44 minutes. After this, female 7 began to show more typical behavior, changing perches more frequently and traveling longer distances. At one point she soared for about 4 minutes over a large portion of her home range.

From the above observations, one might conclude that another possible effect of radio-tagging may be an increased amount of preening. Radio-tagged Mallards *(Anas platyrhynchos)* and Wood Ducks *(Aix sponsa)* were observed to preen more frequently when compared to untagged individuals (Gilmer et al. 1974). Aside from the first few hours after release, radio-tagging appeared to have little lasting effect on preening by Red-shouldered Hawks. Although comparable quantified observations have not been conducted on untagged birds, the radio-tagged Red-shouldered Hawks clearly spent relatively little time preening or tugging on the transmitter package after the day of their release. For example, during 5 hours of observation during the day after her release, female 7 preened and/or tugged on her harness for a total of only 125 seconds. This time spent preening does not seem to be excessive and was comparable to that noted during casual observations of untagged individuals.

As noted for other species, radio-tagging caused no apparent problem to reproduction in the Red-shouldered Hawk. Male 8 copulated twice with his mate within 15 minutes after his release, and both male 11 and female 12 were observed copulating with their respective mates during the day after their release. All radio-tagged pairs reproduced successfully in 1979, with each pair producing 3 young. In 1980, male 8 and his untagged mate also fledged 3 young as did male 11 and his radio-tagged mate, female 9; while in 1981, female 7 fledged 3 young. The nest of female 12 could not be located in 1980, although she occupied the same territory.

From these observations I would conclude that the transmitters and harness used in this study apparently had little, if any, effect on the activities of the Red-shouldered Hawks. Transmitter weight, however, may be one of the most important factors to consider in a radio-telemetry study. While Dunstan (1977) has determined that most raptors can tolerate back packages of up to 6% of their body weight, to provide added safety the total back package weight in this study was 4.5% or

less (Table 1). The lower comparative weights of the transmitters used in this study may account for the more rapid adjustment of the radio-tagged Red-shouldered Hawks than that observed for other birds of prey.

Table 2. Body weight and transmitter package weight* of radio-tagged Red-shouldered Hawks in southern California.

Individual	Body weight (g)	Transmitter package weight (g)	Transmitter package as % body weight
Male 8	555	24.5	4.4
Male 11	505	22.5	4.5
Female 12	699	26.5	3.8
Female 9	700	22.8	3.3
Female 7	635	26.0	4.1

* Weight of transmitter and harness

Three of the radio-tagged birds trapped in 1979 were retrapped in May 1980, at which time their transmitters were removed. Each bird was carefully inspected for injuries attributable to the transmitter and harness. The only apparent effect after 6-15 months of wear was a small area of feather loss over the sternum under the junction of the harness straps and a small area on the back directly under the transmitter. The skin in these areas appeared normal, although slightly dry. Nicholls and Warner (1968), utilizing a potentially more abrasive harness on captive Great Horned Owls, found no damage after 3 months of transmitter wear.

One of the hawks from this study (female 12) was found dead as a result of eye injuries, almost 2 years after she was radio-tagged (McCrary and Bloom, in prep.). The fact that she was wearing a transmitter was apparently unrelated to her death, as careful examination revealed no injuries resulting from the transmitter and harness; unlike the other retrapped birds, there was no feather loss under the transmitter or harness in this female.

Conclusions

Results of this study add support to the growing opinion that, when performed properly, radio-tagging has little long term effect on the behavior of most birds of prey. Although the behavior of Red-shouldered Hawks immediately after radio-tagging was substantially altered, the most obvious of these changes disappeared in a few hours. However, it should be noted that this period of adjustment may vary from species to species and with the technique used for transmitter attachment; transmitter weight may also affect the adjustment period. During the adjustment period, the movements of most individuals is greatly restricted and behavior is characterized by almost continuous preening; data from this period should be excluded from subsequent analyses. As observations on controls were not carried out in this study, more subtle changes in behavior may have occurred, but these, if any, did not appear to affect the data collected on the movements, habitat use, and breeding biology of the radio-tagged individuals (McCrary 1981).

Summary

Five adult Red-shouldered Hawks were radio-tagged on Camp Pendleton Marine Corps Base in San Diego Co., California. Transmitters and back harness attachments weighed 4.5% or less of each bird's body weight. During the first few hours after radio-tagging, the behavior of the hawks was substantially altered. During this period, space use was restricted and the radio-tagged birds preened excessively. Although this adjustment period for other raptors usually lasts for more than a single day, the behavior of the radio-tagged Red-shouldered Hawks appeared normal by at least the day after their release. During the second day, the use of space by these hawks was no longer restricted and time spent preening was not excessive. All the radio-tagged Red-shouldered Hawks successfully reproduced, and no injuries resulted from transmitter attachment. These observations support the view that, when performed properly, radio-tagging has little long term effect on the behavior of most birds of prey.

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Birds of the Qu'Appelle, 1857-1979. E. Manley Callin. 1980. Saskatchewan Natural History Society Special Publication No. 13. 168 pp. $7.00 Canadian (S.N.H.S., Box 1121, Regina, Sask. S4P 3B4 Canada).

Manley Callin's "Birds of the Qu'Appelle" describes the avifauna of that portion of the Qu'Appelle River valley and surrounding prairie from the Manitoba-Saskatchewan border to a point close to the eastern limit of Margaret Belecher's "Birds of Regina" in the same series.

The book is written well, with only a few minor factual and production errors, and is among the most thorough local avifaunal works that I have read. The introductory sections describe the area, discuss the birds in general, and document the history of ornithology in the area, with brief biographies of all significant past and current resident and non-resident observers. The species accounts document occurrence and seasonal patterns of many species for many years, including changes in populations over time.

Banding receives considerable coverage, both in the brief biographies and in the species accounts. Banding totals are listed for at least 90 species, with recoveries documented for at least 27 banded in the area. In addition, a color-banded Bald Eagle from the Besnard Lake study area in northern Saskatchewan, and a California Gull banded elsewhere in the province have been recovered in the Qu'Appelle area. Recoveries of Qu'Appelle banded birds have been reported from many states and provinces, the farthest away being a Black-crowned Night Heron recovered in Vera Cruz, Mexico. Robert Lang, the son of bander George Lang, showed his dedication when he captured and banded four White Pelicans as they were washed ashore on a lake during a "terrific windstorm!" Banders will also be pleased to note that specific information is given on readily identified races.

This book is a must for all ornithologists in the northern great plains, and should be checked by banders elsewhere for recoveries in their state or province of Qu'Appelle banded birds.

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