



12-31-1978

Raptors of the Uinta National Forest, Utah

James A. Mosher

Appalachian Environmental Laboratory, CEES, University of Maryland, Frostburg State College, Frostburg, Maryland

Clayton M. White

Brigham Young University

Joseph R. Murphy

Brigham Young University

M. Alan Jenkins

Brigham Young University

Follow this and additional works at: <https://scholarsarchive.byu.edu/gbn>

Recommended Citation

Mosher, James A.; White, Clayton M.; Murphy, Joseph R.; and Jenkins, M. Alan (1978) "Raptors of the Uinta National Forest, Utah," *Great Basin Naturalist*: Vol. 38 : No. 4 , Article 8.

Available at: <https://scholarsarchive.byu.edu/gbn/vol38/iss4/8>

This Article is brought to you for free and open access by the Western North American Naturalist Publications at BYU ScholarsArchive. It has been accepted for inclusion in Great Basin Naturalist by an authorized editor of BYU ScholarsArchive. For more information, please contact scholarsarchive@byu.edu, ellen_amatangelo@byu.edu.

RAPTORS OF THE UINTA NATIONAL FOREST, UTAH

James A. Mosher¹, Clayton M. White²,
Joseph R. Murphy² and M. Alan Jenkins²

ABSTRACT.— The past and present use of the Uinta National Forest by birds of prey was determined from historical records and surveys conducted during 1973, 1974, and 1975. Data describing the history, present status, and physical characteristics of each nest site were collected, along with the type and intensity of human activity within a half-mile radius of the nest. In addition, limited data on fall migration of raptors along the Wasatch Front and the food habits of Golden Eagles are presented. Management guidelines, based on the results of this study, are proposed.

The Uinta National Forest occupies an area in excess of 3600 km² in central Utah. It lies southeast of Salt Lake City (Fig. 1) and encompasses much of the Wasatch Mountain range and the northern portion of the San Pitch Mountains. The area is characterized by high, rugged mountains (to 3622 m) cut, especially on the western front, by deep canyons which are generally within the 1523 to 2745 m elevation range. These steep-walled canyons provide numerous potential nest sites for cliff-nesting birds. Riparian habitat found along the canyon floors and higher forested slopes and plateaus provide nesting habitat for woodland species. Habitat type changes with altitude, beginning with a zone of sagebrush at the valley floor and extending through scrub oak, aspen, and dense conifer before reaching the tree line. Each of these habitat types offer nesting potential for various species of raptors.

Agricultural and urban development are encroaching up the slopes of much of the western front of the Wasatch Range, and recreational development of the canyon areas is increasing. This activity and a generally increasing awareness of the susceptibility of some raptor species to human disturbances prompted the management personnel of the Uinta National Forest to initiate this study of its rare and endangered

raptors. Field work relating to this study was conducted from January 1972, to June 1975. The goals of this research were to determine: (1) what species of raptors were found in the Forest; (2) when and where they used Forest lands; (3) Forest use by raptors, and particularly by Golden (*Aquila chrysaetos*) and Bald eagles (*Haliaeetus leucocephalus*) and Peregrine Falcons (*Falco peregrinus*); (4) guidelines for management of raptors.

METHODS

An intensive literature search on Utah birds of prey was conducted, and the field notes of R. G. Bee (Brigham Young University Life Science museum) were searched and summarized. Public cooperation to increase sightings and nest records was solicited via radio and television publicity and distribution of posters.

Surveys by vehicles and on foot were conducted over most of the Forest from 1973 to 1975, paying particular attention to cliff areas. All recorded and reported nest sites were checked. Aerial surveys in a Cessna 172 were conducted over some extensive cliff areas and other areas of known Bald Eagle use during the winter.

Nest site data collected included elevation above sea level, height on cliff, height

¹Appalachian Environmental Laboratory, CEES, University of Maryland, Frostburg State College, Frostburg, Maryland 21532.

²Department of Zoology, Brigham Young University, Provo, Utah 84602. Present address of Jenkins is: U.S. Fish and Wildlife Service, Denver Wildlife Research Center, Building 16, Denver Federal Center, Denver, Colorado 80225.

of cliff, directional orientation of nest site, occupancy history, distance to nearest human activity (i.e., roads, campgrounds, pastures, etc.), type and intensity of human activity within a half-mile radius of the nest site, breeding chronology, and prey remains. Estimates of home range sizes of Golden Eagles are based on multiple observations of individual birds, identified by characteristic plumage patterns, around active nest sites. Migration data were collected by direct observations from a point east of Provo, Utah, on the Wasatch Mountain front at about 1980 m above sea level.

RESULTS AND DISCUSSION

Historical Summary

Table 1 is a compilation of raptor sightings on the Uinta National Forest up to the time of this study, largely from the unpublished field notes of R. G. Bee and K. Turley. Except as noted, breeding status is not given. More complete data are available for the Golden Eagle and Peregrine Falcon. Table 2 summarizes the history of the Gold-

en Eagle nest sites. Old nests located during this study were listed as sites with no recorded activity. Identification of Golden Eagle nests was based on size and location.

There is a long history of breeding activity by Golden Eagles in the Uinta National Forest. It is the most conspicuous breeding raptor. Allowing for alternate nest sites, some 21 territories are now known. Based on Bee's field note records of nest sites, the number of eagles appears to have changed little since the 1930s. The breeding season for this species extends from January to late June (Smith and Murphy 1973, and this study).

The Peregrine Falcon has occupied three known eyries in the forest. The last known nesting activity was in 1968. According to Porter and White (1973), "...the known active eyries of this species in Utah are now only about 10 percent of those known to have been present earlier in the century." The Peregrine was first recorded in Utah in 1871 (Allen 1872) and the first active eyrie reported in 1899 (Johnson 1899). Fossil evidence establishes both the Peregrine and the Prairie falcons (*Falco mexicanus*) in Utah back perhaps as far as 40,000 years (Porter and White 1973).

The known range of the Peregrine in Utah includes only a small part of the Uinta National Forest lands; however, three prior eyrie locations are known within the Forest boundary (Porter and White 1973). The history of these eyries is reproduced from Porter and White (1973) in Table 3. We have a recent report of repeated sightings of a Peregrine in the Spring Lake area from April to June or July 1972 (Turly, pers. comm.). An interesting review of the history and status of the Peregrine Falcon with references to relations with the Prairie Falcon in Utah is to be found in Porter and White (1973). Very little historical information about the Prairie Falcon in central Utah is available. It was, however, reported to be common in the rocky canyons of the Wasatch Mountains prior to the turn of the century (Ridgway 1874). We have records of its nestings in six locations on Forest land from 1930 to 1940, as well as sightings in four other Forest locations up to 1955. These birds may still nest on the Forest, al-

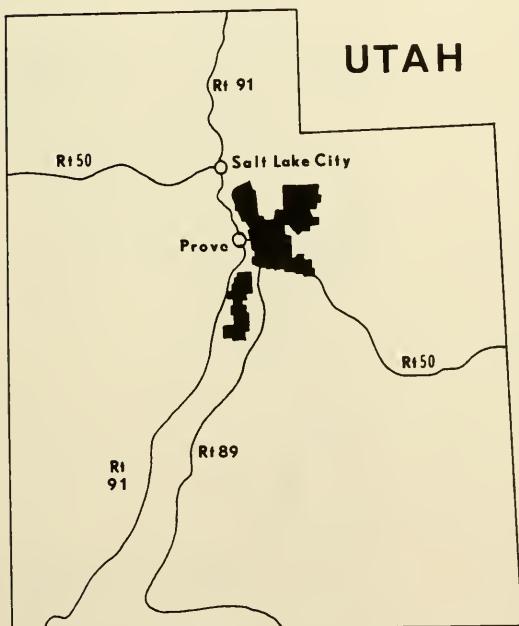


Fig. 1. Location of the Uinta National Forest (1972) within Utah.

though no individuals were seen during this study.

Recent Activity

The results of the 1973 survey, which was the most extensive and systematic survey, are summarized in Table 4. These results need careful interpretation because birds

are not necessarily sighted in proportion to their actual numbers. Eagles and Turkey Vultures (*Cathartes aura*) are very conspicuous because of their size and soaring habits. Kestrels (*Falco sparverius*) are also very conspicuous in spite of their small size because they hunt from perches (especially power lines) near roadways. Buteos are generally conspicuous, but less so than eagles

TABLE 1. History of raptor sightings on the Uinta National Forest prior to 1973.

Species	Date (month/year)	Location
Bald Eagle	10/69	Mt. Timpanogos
Golden Eagle (see also Table 2)	3/69	Y Mountain
	4/69	Mt. Nebo
	W-'72/'73	South fork, Provo
Peregrine Falcon	4-6/72	Spring Lake
Prairie Falcon	4/29	?
	*3/30	Dry Canyon, Mona
	*5/30	Provo Canyon
	*3/31	Alpine (several years), Fort
	*4/36	Grove Canyon
	*4/38	Days Canyon, Hobbie Creek
	*4/40	Alpine, Box Elder
Sharp-shinned Hawk	5/71	Spring Lake
	*5-8/72	Spanish Fork, Canyon
Cooper's Hawk	10/71	Spring Lake
Goshawk	8/70	Rock Canyon, Provo
	6/71	Left fork, White River
	2/72	Spring Lake
	12/72	Wallsburg, south
Harris Hawk	8/72	Current Creek guard station
Red-tailed Hawk	3/69	Fairview
	1/70	Current Creek
	3/71	Spring Lake
	2/72	Spring Lake
Rough-legged Hawk	1/72	Spring Lake
Swainson's Hawk	8/69	Nebo Loop Road
Turkey Vulture	8/72	Nebo Loop Road
Boreal Owl	3/69	Provo
Great Horned Owl	2/68	Y Mountain
	1/71	Spring Lake
	1/72	Spring Lake
Long-eared Owl	*7/72	Squaw Peak Trail
Pygmy Owl	12/71	Diamond Fork
Saw-whet Owl	1972	Dry Canyon, Linden
Screech Owl	6/72	Spring Lake
Short-eared Owl	1/71	Spring Lake
Spotted Owl	7/71	Rock Canyon

*Indicates sighting was at active nest.

or vultures. Falcons and accipiters are quite inconspicuous. Owls, by their nocturnal or crepuscular habits, are the least conspicuous of all in diurnal surveys.

Subjective estimates of population density were made for several resident species by estimating availability of suitable habitat, relative degrees of conspicuousness, and numbers seen on the Uinta National Forest. These were as follows: Golden Eagles, 84 (1/39 km²); Kestrels, 128 (1/26 km²); Red-tailed Hawks (*Buteo jamaicensis*), 60 (1/54 km²); Harriers (*Circus cyaneus*), 16 (1/202

km²); and Turkey Vultures, 52 (1/62 km²). The total raptor density for these species was 1 per 9.6 square kilometers. There was insufficient information to permit an estimate of population sizes for the other species. Some are, of course, wintering birds or migrant visitors.

Fall Migration

The use of north-south-oriented mountain chains by migrating raptors is a well known phenomenon, and the observation of fall mi-

TABLE 2. Nest site history of Golden Eagles on the Uinta National Forest.

Nest Site	1973	1972	1971	1970	1969	1968	1967	1966	Records prior to 1966*
Alpine	-Dry Canyon		A						'32, '34, '40, '50, '51
	-Fort Canyon	A							
American Fork	-Canyon Head								'33, '51
	-Mt. Timpanogos-N								'34
	-Pittsburgh Lake								'42
Heber	-East of 40 and 189°	A							
Levan	-Chicken Creek								
	-Deep Creek-N								
	-Deep Creek-S	A							
	-Pigeon Creek Road								
Nephi	-Pigeon Creek Trail								
	-Footes Canyon								
	-Red Cliffs								
	-Hop Creek°								'37
	-Salt Creek-S								'37, '38, '39, '46
Pleasant Grove Provo	-Grove Canyon								
	-Cascade		A						
	-Rock Canyon								'37, '40, '41, '44
	-Y Mountain								'33
	-Wallsburg-W								'39
	-Wildwood								'38, '39, '40, '41, '44, '46
Spanish Fork	-Lower Diamond Fork	A			A	A	A	A	
	-Upper Diamond Fork		Ⓐ						'31, '45, '46, '55
Springville	-Little Rock Canyon								
	-Balsam Campsite								
	-Days Canyon								'38
	-Kirkman Divide		A						
	-Power House							Ⓐ	'55
	-Hobble/Diamond								'45
	-Sulphur Campsite							'37	
Strawberry	-Current Creek°	A							
	-Current Creek and 6°								
	-Current Creek and 10								
	-Current Creek and 12								'41
	-Current Creek-W°								
Thistle	-Big Jane Canyon	A	A						
	-South°								
Wales	-UNF boundary	A							

A = Active nests

Ⓐ = Unsuccessful nests (i.e., no young fledged)

° = Not inside UNF boundary

** = Records from the field notes of R. C. Bee

grations from look-out points provides much useful population data (e.g., Hawk Mountain Sanctuary, Heintzelman 1975). The

Wasatch Front, which forms the eastern boundary of the Great Basin, would appear to provide a similar corridor in the intermountain west. Data collected on the Uinta National Forest near Provo, Utah, from 1972 to 1974 suggest that considerable raptor movement occurs along this Front (Table 5) and more continuous observation might prove valuable. The greatest amount of movement apparently occurred about mid-September, when 35 and 60.5 birds per hour of observation were recorded.

TABLE 3.—History of Peregrine Falcon eyries on the Uinta National Forest.¹

Site no.	First located and subsequent history	Last known to be active
17	1930s, 1940s, 1950s, 1967	1968
18	1930s, 1939-46	1969
19	1930-32	1932

¹Taken from Table 1 of Porter and White (1973)

TABLE 4. Summary of 1973 raptor sightings on the Uinta National Forest.

Species	Number of individuals	Number of sightings	Season present	Number of nest sites	Number active	Number fledged
Bald Eagle	27	8	FWS			
Golden Eagle	42	35	SFWS	27	4	4
Osprey	2	3	t ¹			
Sharp-shinned Hawk	2	2	SFW			
Cooper's Hawk	11	8	SFWS	5	4	
Goshawk	2	2	SFWS			
Ferruginous Hawk	1	1	SFS			
Red-tailed Hawk	15	13	SFWS			
Rough-legged Hawk	2	3	FWS			
Swainson's Hawk	4	2	SFS			
Harrier	8	6	SFWS			
Kestrel	32	20	SFWS	4	4	
Merlin	1	1	t			
Peregrine Falcon	1	1	SFWS			
Prairie Falcon	2	2	SFWS			
Turkey Vulture	39	16	SFS			
Great Horned Owl	3	3	SFWS			
Snowy Owl	1	1	WS			
Total of 18 species	195	127		36	12	4

¹t means transient

TABLE 5. Observations of fall movements of raptors along the Wasatch Front at Provo, Utah¹

	Date (Hours of observation)															Totals
	August		September							October						
	18 (2.25)	25 (2)	2 (1)	4 (0.5)	9 (5.5)	15 (2)	20 (2)	22 (2)	27 (2)	29 (1)	4 (2)	6 (1)	7 (2)	13 (1)		
Sharp-shinned	0	2	1	0	16	32	1	0	13	2	7	3	2	0	0	79
Cooper's	0	0	0	0	3	1	1	0	4	2	1	1	0	0	1	14
Red-tailed	0	2	0	1	8	1	2	0	10	0	0	0	1	0	5	30
Ferruginous	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Golden Eagle	1	1	0	1	2	1	0	7	1	5	0	0	0	0	1	20
Harrier	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
American Kestrel	3	2	0	0	8	30	112	0	11	1	5	0	1	0	0	73
Unidentified	0	3	0	3	4	5	0	7	0	0	0	1	0	0	0	23
Total	4	10	1	5	41	70	116	14	44	10	13	5	4	0	7	341
Totals/hour of observation	1.8	5	1	10	7.5	35	60.5	7	21	11	6.5	5	2	—	3.5	

¹Combined for 1972, 1973 and 1974

Wintering Bald Eagles

Field observations from January 1973 through May 1974 point out two aspects of the wintering Bald Eagle population. First, eagles are dispersed over the Forest during the arrival and departure periods. Second, a midwinter concentration occurs along the lower 14 km of one stream drainage in the southern sector.

During February 1974, aerial and ground surveys were conducted in an effort to locate a communal roost site for the dozen or more eagles observed in the area. The aerial survey was conducted at sunrise and the ground survey from late afternoon to sundown. Individual eagles were observed, but no communal roost was located. Unlike the desert population of Bald Eagles described by Platt (1976), where roosting is limited to relatively few groves of suitable trees, the Forest population has an abundance of roosting sites.

Golden Eagle Nesting and Human Disturbance

The Golden Eagle is a year-round resident and cliff nester on the Uinta National Forest. In 1973 and 1974, 18 pairs laid a total of at least 11 eggs and successfully fledged 10 young between 3 June and 29 June (Table 6). Nest sites were situated on cliff ledges exclusively and averaged 1891 m in elevation (1495 to 2562 m). There was a

significant tendency ($\alpha=0.01$, $n=37$) for nests to be situated in a northward direction (Mosher and White 1976).

Prey remains collected at three nest sites are summarized in Table 7. These data contrast sharply with comparable data from desert nesting eagles, in that the mountain birds have a broader prey base and appear to rely less heavily on the Black-tailed jack-rabbit (*Lepus californicus*) (Smith 1971). Prey which inhabit the higher elevations, such as Blue Grouse (*Dendragapus obscurus*), Mule Deer fawns (*Odocoileus hemionus*), and Snowshoe Hare (*Lepus americanus*), are of particular interest. These data may reflect a low rabbit density which prevailed during this study.

An estimate of minimum territory size was provided by multiple observations of two nesting pairs of eagles. The observations were plotted on 7½ minute USGS topographic maps and the perimeter points connected. The area contained within the polygon thus formed was estimated using a 1/10 in² grid. The territory sizes were 8.8 and 17.9 km², averaging 13.3 km².

The effect of human activity on nesting raptors is an area of debate. Although few "hard" data exist, this is an important aspect of raptor management. In this study, we recorded several types of human activities and their estimated intensity within 0.8 km of active and inactive Golden Eagle nests (Table 8). The most common activity

TABLE 6. Golden Eagle nesting, 1974.

Nest site	Pair in attendance		Eggs laid		Young fledged		Fledging date	
	1973	1974	1973	1974	1973	1974	1973	1974
Heber	yes	yes	yes	no	1	—	6/3-10	—
Alpine—Dry Canyon	yes	yes	—	yes	—	2	—	6/27
Pleasant Grove—Chris Flat	—	yes	—	?	—	?	—	—
Provo—Cascade	yes	yes	—	?	—	no	—	—
Springville—Hobble Creek (Sulphur)	yes	yes	—	yes	—	1	—	by 6/29
Diamond Fork—lower	yes	—	2	—	1	—	6/19-20	—
Diamond Fork—7 mi. cliff	—	yes	—	yes	—	1	—	by 6/29
Thistle—Big Jane Canyon	yes	yes	yes	no	1	—	by 6/28	—
Spring Lake	—	yes	—	yes	—	—	(nest destroyed)	—
Payson Canyon	no	yes	—	yes	—	1	—	?
Levan—Chicken Creek	no	yes	—	?	—	?	—	—
Levan—Deep Creek	yes	no	yes	—	1	—	6/10-16	—
Wales—UNF boundary	yes	no	yes	—	1	—	by 6/28	—
Totals	8	10	6	5	5	5	6/3-28	6/27-29

TABLE 7. Golden Eagle food habits on the Uinta National Forest.

Prey species	Nest site and year				Total
	Hobble Creek 1974	Diamond Fork 1969-79*		Alpine 1974	
Mule Deer	1			2	3
Black-tailed Jackrabbit		12	2		14
Cottontail Rabbit		6			6
Snowshoe Hare	3				3
Uinta Ground Squirrel	1	2	1	1	5
Rock Squirrel		5			5
Muskrat		2			2
Domestic Sheep			1		1
American Coot		1			1
Blue Grouse	1	1			2
Black-billed Magpie			1		1
Common Flicker		2			2
Steller's Jay		1			1
Unidentified Blackbirds		2			2
Nest site totals	6	34	5	3	48

*From W. B. Arnell, 1971

TABLE 8. Human activity at active and inactive Golden Eagle nest sites.

Active sites	Observed activity (intensity) ¹
1—Alpine—Dry Canyon	Hiking, vehicle traffic (1)
2—Alpine—Fort Canyon	None
6—Heber—40 and 189	Vehicle traffic, Shooting (2)
8—Levan—Deep Creek	Vehicle traffic (1)
13—Pleasant Grove—Chris Flat	Vehicle traffic, grazing (1)
14—Provo—Cascade	Vehicle traffic (1)
18—Spanish Fork—Upper Diamond	Vehicle traffic, hiking, climbing, shooting (3)
19—Spanish Fork—Lower Diamond	Climbing, grazing, shooting (1)
23—Springville—Sulphur Creek ¹	Vehicle traffic, camping, hiking, climbing, shooting (3)
24—Strawberry—Current Creek 1	Vehicle traffic (2)
27—Thistle—Big Jane	Vehicle traffic, grazing, hiking, shooting (2)
28—Wales—UNF boundary	Vehicle traffic (1)
30—Spring Lake	Climbing (3)
Inactive sites	
9—Levan—Pigeon Creek	None
10—Nephi—Red Cliffs	Vehicle traffic (1)
11—Nephi—Hop Creek	Grazing (1)
12—Pleasant Grove—Grove Canyon	Riding, hiking, shooting (3)
15—Provo—Rock Canyon	Vehicle traffic, riding, hiking, shooting (3)
20—Springville—Power House	None
21—Springville—Kirkman Divide	None

¹Intensity classes are (1) little or none, (2) moderate, (3) severe. Classifications were assigned on basis of frequency, proximity, and number of types of disturbance present within a half mile of the nest site.

was vehicular traffic. The relationships between intensity and type of activity near active and inactive nests are shown in Figure 2. Sample sizes are small, but the results suggest that there may be a great deal of individual variability in tolerance by eagles to one or more types of activity. Of 12 active nests in 1973 and 1974, five were visited on three or more occasions to collect data. No difference in fledging success between nests visited and not visited was found (Table 9). The failure of one nest was attributed directly to removal of the egg by rock climbers.

The following management guidelines were recommended to the Uinta National Forest as a result of the study:

1. All known Peregrine Falcon eyries should be preserved from further man-induced alteration until decisions are made about reintroduction, via captive breeding, of this species to central Utah.

TABLE 9. Fledging success of disturbed and undisturbed Golden Eagle nests.

Nest site	Year active	Disturbed ¹	Fledging success
1—Alpine— Dry Canyon	1974	Yes	2
2—Alpine— Fort Canyon	1973	No	1
6—Heber—40 and 189	1973	No	1
8—Levan—Deep Creek	1973	No	1
14—Provo—Cascade	1973	No	1
18—Diamond Fork— Upper	1974	No	1
19—Diamond Fork— Lower	1973	Yes	1
Springville— 23—Sulphur Camp	1974	Yes	1
23—Sulphur Camp	1975	No	(1)
28—Wales	1973	No	1
29—Payson Canyon	1974	Yes	1
30—Spring Lake	1974	Yes	0

Disturbed sites—5, Mean fledging success—1
Undisturbed sites—7, Mean fledging success—1

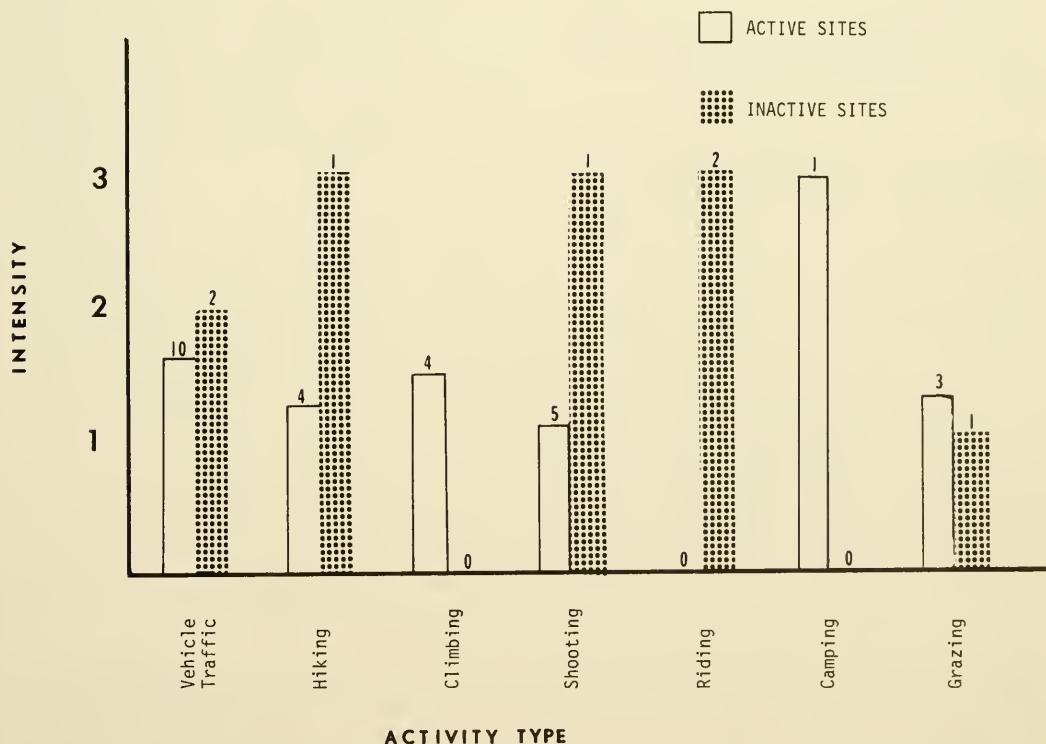


Fig. 2. Comparison of intensity of disturbance by type of activity at active and inactive Golden Eagle nest sites. (Numbers above bars refer to the number of nest sites in the sample.)

2. Human activity compatible with raptor nesting be permitted, provided the following criteria are met:
 - (a) no major alteration affecting the actual nest site or prey base occurs.
 - (b) disturbance is minimized prior to hatching.
 - (c) the nest cliff itself is protected from climbing.
3. Raptor surveys should be conducted annually to monitor population status.
 - (a) Golden Eagle nest sites should be checked during late May or early June to determine breeding activity and productivity.
 - (b) Road count of Bald Eagles should be conducted during January or February.

ACKNOWLEDGMENTS

This study was funded by the U.S. Forest Service, Uinta National Forest, under Contract 50-905.

We are grateful for the support provided by the Uinta National Forest personnel, especially R. Wiesert, F. Savage, and K. Turley.

Critical reviews of earlier drafts of this paper by Dr. C. P. Stone and Dr. G. A. Feldhamer were particularly helpful.

This is Contribution 848, Appalachian Environmental Laboratory, Center for Environmental and Estuarine Studies, University of Maryland.

LITERATURE CITED

- ALLEN, J. A. 1872. Notes on an ornithological reconnaissance of portions of Kansas, Colorado, Wyoming, and Utah. *Bull. Mus. Comp. Zool.* 3(6):113-183.
- HEINTZELMAN, D. S. 1975. Autumn hawk flights. Rutgers Univ. Press, New Brunswick, New Jersey. 397 pp.
- JOHNSON, H. C. 1899. A successful day with the Duck Hawks. *Condor* 1(3):45-46.
- MOSHER, J. A. AND C. M. WHITE. 1976. Directional exposure of Golden Eagle nests. *Canad. Field Natural.* 90(3):356-359.
- PLATT, J. B. 1976. Bald Eagles wintering in a Utah desert. *Amer. Birds* 30(4):783-788.
- PORTER, R. D., AND C. M. WHITE. 1973. The Peregrine Falcon in Utah, emphasizing ecology and competition with the Prairie Falcon. *Brigham Young Univ. Sci. Bull., Biol. Ser.* 18(1):1-74.
- RIDGWAY, R. 1874. Notes on the bird fauna of the Salt Lake Valley and adjacent portions of the Wasatch Mountains. *Bull. Essex Inst.* 5:168-173.
- SMITH, D. G. 1971. Population dynamics, habitat selection and partitioning of breeding raptors in the eastern Great Basin of Utah. Ph.D. dissertation. Brigham Young University. 260 pp.
- SMITH, D. G. AND J. R. MURPHY. 1973. Breeding ecology of raptors in the eastern Great Basin of Utah. *Brigham Young Univ. Sci. Bull., Biol. Ser.* 18(3):1-76.