

VISITATION OF HIGH MOUNTAIN BOGS BY GOLDEN EAGLES IN THE NORTHERN GREAT BASIN

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Abstract.—Golden Eagles (*Aquila chrysaetos*) were observed drinking and bathing in three high mountain bogs in the Jarbidge Mountains of northern Nevada. Six additional sites in the Jarbidge and two in the Warner Mountains of northern California showed evidence of drinking activity. These “eagle bogs” all shared four physical attributes that distinguished them from other high mountain bogs in these ranges. These attributes were: (1) association with a spring above the highest quaking aspen (*Populus tremuloides*), (2) presence of an open area containing pools (without steep or undercut banks) near the spring, (3) cover on three sides in the form of cliffs and/or dense coniferous woodlands at least 10 m away from the pools, and (4) a narrow opening in the cover (10–30 m), on the lower side of the bog followed by a steep drop. The frequency of Golden Eagle visitation strongly suggests that eagle bogs are an overlooked but important habitat requirement for the species in the Great Basin.

VISITA DE ANEGADOS POR INDIVIDUOS DE *AQUILA CHRYSAETOS* EN LUGARES ELEVADOS DE LA GRAN CUENCA DEL NORTE

Sinopsis.—Se observaron individuos de aguililla dorada (*Aquila chrysaetos*) beber agua y bañarse en anegados de las elevadas montañas Jarbidge al norte de Nevada. Seis localidades adicionales, en los Jarbidge y dos en las montañas Warner del norte de California, mostraron evidencia de actividad en donde las aves bebieron agua. Estos “anegados de aguilillas” compar-tieron cuatro atributos físicos que los distinguen de otros anegados en estas montañas. Estos son: (1) asociación con manantiales sobre los más altos árboles de *Populus tremuloides*, (2) presencia de áreas abiertas que contienen pozas (sin precipicios o bancos entrecortados) cerca del manantial, (3) cubierta en tres de los lados en forma de farallones y/o densas arboladas de coníferos al menos a 10 m de las pozas, y (4) una estrecha apertura en la cubierta (10–30 m), en la parte baja del anegado seguido por una caída abrupta. La frecuencia de visitas por parte de estas aves a estas áreas sugiere que los “anegados de aguilillas” son un importante requisito de hábitat que requiere la especie en la “Gran Cuenca” y que hasta la fecha había pasado desapercibido.

The breeding, nesting, and feeding behavior of Golden Eagles (*Aquila chrysaetos*) has been well documented (e.g., Beecham and Kochert 1975, Bent 1937, Boeker and Ray 1971, Brown and Watson 1964, Cameron 1905, Hanna 1930, McGahan 1968). However, observations of Golden Eagles drinking or bathing have not appeared in the literature. The only reference we found to the drinking behavior of eagles states that all liquid requirements of eagles are met by the ingestion of prey (Brown and Amadon 1968:49). Brown and Amadon (1968) go on to state that a very large number of raptor species never drink, that evidence for bathing in the wild is scanty, and that little of their time is spent by searching for water. We present observational data on the frequent use of high mountain bogs in Great Basin mountains by Golden Eagles for drinking, bathing and preening, and describe the physical structure of these “eagle bogs.”

METHODS

The Jarbidge Mountains of northeast Nevada (41°50'N, 115°20'W) contain six peaks over 3200 m. They drain north, east and west into the Columbia River, and south into the Humboldt Sink of the Great Basin. The South Warner Mountains of northeast California (41°25'N, 120°20'W) contain three peaks over 2950 m, and drain west into the Sacramento River and east into Surprise Valley basin. The vegetation of both ranges is dominated by whitebark pine (*Pinus albicaulis*) subalpine woodlands above 2500 m (Loope 1969, Riegel 1982).

The Jarbidge Mountains have been visited annually from 1981–1990, and the South Warner Mountains were visited in 1988–1989. Our initial observations of Golden Eagles using bogs were made incidental to our plant collecting activities. We later assessed those sites for common features to characterize what we call “eagle bogs.” Many springs, whether associated with bogs or not, were then surveyed for those features and for use by Golden Eagles to verify our characterization and the extent of this behavior. Springs are defined as habitats where water emerges from the ground, whereas bogs are habitats of wet masses of vegetation overlying thick layers of undecomposed soil, or peat (Whittaker 1975:171).

During 1989–1990, 54 springs above 2450 m in the Jarbidge and 12 in the South Warner Mountains were visited to measure and characterize their physical features, aspect and elevations. Sightings of Golden Eagles or the presence of Golden Eagle feathers at these sites were considered indicative of visitation.

Elevations were determined by altimeter, calibrated at least three times daily from terrain features of known elevation as represented on United States Geological Survey 7.5' topographic maps. Springs visited were marked on these maps and were later found on National High Altitude Photography program 1:24,000 scaled infrared aerial photographs to verify their locations. A distance of 200 m was measured from each site along the steepest possible escape route for eagles, and the drop in elevation was determined by counting the number of 12-m contour lines crossed in that distance. Width of the escape route opening, pool size, and distances from surrounding cover to pools were measured with a meter tape at the site. Tree canopy cover was estimated by line intercept, and tree heights were determined by triangulation.

RESULTS

The first observation of bog use by Golden Eagles was in August 1985 when two adult Golden Eagles were seen and flushed from a bog at the headwaters of Marys River in the Jarbidge Mountains. In July 1987, another bog was discovered at the headwaters of the East Fork of the Jarbidge River where two more Golden Eagles were flushed. At both sites the eagles left the bog through a narrow gap in the trees where the bog's outlet flowed. Numerous primaries and secondaries and much downy plumage were observed throughout each bog.

These two bogs had the following attributes in common: (1) association

with a spring above the highest quaking aspen (*Populus tremuloides*), (2) presence of an open, flat area containing shallow (0.2–0.4 m) pools without steep or undercut banks near the spring, (3) cover on three sides in the form of cliffs and/or dense coniferous woodlands at least 10 m away from the pools, and (4) a narrow opening in the cover (10–30 m), on the lower side of the bog followed by a steep drop. We call these escape routes “runways.” Where Golden Eagles were observed bathing, primary feathers were always found. Thus, we consider the presence of primary feathers at a bog to be indicative of eagle bathing. Eight sites contained all or three of the four attributes, but contained only secondary feathers and down. These sites we call “drinking only” sites.

Many springs occur in both of our study areas below 2450 m, but quaking aspen at higher elevations, and black cottonwood (*Populus trichocarpa*) and willows (*Salix* spp.) at lower elevations dominate the vegetation of these wet areas, occluding the pools from the view of eagles. Thus, this study was restricted to sites above the elevational limit of quaking aspen.

In 1989–1990, we visited 66 springs (46 associated with bogs), including the 2 previously observed, at elevations of 2450–3025 m (mean = 2764 m) (Table 1). The aspects of the springs visited are as follows: 24 North, 24 East, 6 West, 2 South, 6 Northeast and 1 Southeast. Of these springs, 11 had Golden Eagles and/or their feathers in their associated bogs, 6 with north aspect and 5 with east aspect. Elevation of these eagle bogs ranges from 2550 to 2910 m (mean = 2875 m).

The surrounding cover of eagle bogs consists of a nearly closed canopy (60–80% cover) subalpine forest of whitebark pine and subalpine fir (*Abies lasiocarpa*) in the Jarbidge and whitebark pine alone in the Warner Mountains. Maximum tree heights along the borders of eagle bogs typically range from 10 to 25 m. An exception to this is at the Marys River eagle bog, where the side above the spring is a snowslide tract with a tangle of downed and small trees (3–5 m tall). Despite the smaller stature of the trees, the canopy at this height is >65%. Bogs unused by Golden Eagles have one or more sides bordered by mountain brush or alpine plant communities not exceeding 0.5 m in height, or by subalpine woodland with <25% cover.

Golden Eagles were seen on the ground on 17 d at all three bathing sites in the Jarbidge Mountains. On 3 d, five eagles were seen at one time (two matures and three immatures on 19 July 1988 at the East Fork Jarbidge River bog; five immatures on 19 July 1989 at the Jarbidge Lake bog; one mature and four immatures at Marys River bog on 29 July 1990). Drinking, bathing, and preening were observed at all these sites. When the birds left they always flew out along the runway. At the six Jarbidge drinking sites, eagles were never seen on the ground, but secondary feathers and down were found.

In the Warner Mountains, DAC's camp was serendipitously placed by the Modoc National Forest Wilderness Technician next to an eagle bog near Eagle Peak to conduct botanical research. Twenty days were

TABLE 1. Physical characteristics and Golden Eagle observations from all springs examined during Jul. and Aug., 1985–1990, in the Jarbidge and Warner mountains. Observations were made during visits lasting from 10 min to 6 hr at specific sites.

	Non-eagle springs	Drinking sites only	Drinking and bathing sites
No. sites examined	55	8	3
% sites having bog and spring	60	88	100
% sites with pools	47	75	100
% sites with cover	16	88	100
% sites with runway	73	100	100
Mean elevation of sites (m)	2802	2833	2800
Elevation range (m)	2450–3025	2550–2955	2765–2865
Total no. observations	459	69	28
% observations with sightings	0	38	68
Total eagles observed	0	48	126
% of eagles seen on ground	0	4	68

spent at this site (8–28 August 1989). Although no eagles were seen utilizing the water, a pair of immature Golden Eagles came daily (1800–2000 hours), apparently for the purpose of using it (Table 1). Each day the pair approached from the high side of the spring and came within 20 m of the ground before seeing the camp and departing. On three occasions, the birds then moved to a smaller spring and bog higher on the mountain, where secondary feathers and down were later found. Once, another pair of immatures arrived and the four were seen engaged in aerial combat over the smaller bog.

All three bathing sites shared the four physical attributes, whereas the 55 springs visited that had no evidence of eagle use lacked one or more of the attributes. The characters most often missing were adequate cover and the presence of shallow pools without undercut banks (Table 1).

Sixteen sites were missing only one attribute of an eagle bog and showed no sign of Golden Eagle visitation. One site had pools with undercut banks, 13 had no runway, 1 had a runway that dropped only 10 m in 200 m, and at 1 site the dense forest surrounding the bog was only 5 m from the pools.

Nearly all of the eight sites that contained Golden Eagle secondaries and down but no primaries had all four eagle bog attributes (Table 1). Two of these sites were visited only in early summer when there was still snow at the sites.

Common plants at the eagle bogs include: *Kalmia microphylla*, *Ledum glandulosum*, *Polygonum bistortoides*, *Aster occidentalis*, *Pedicularis groenlandica*, *Viola mackloskeyi*, *Gentiana calycosa*, *Platanthera dilatata*, *Dodecatheon alpinum*, *Carex* spp. (e.g., *C. scopulorum*), and *Sphagnum fibriatum*.

No individuals of any other raptor species were ever observed within 1 km of any eagle bog. No Bald Eagles (*Haliaeetus leucocephalus*) were seen at any time in either mountain range. Over 450 km have been

traversed on foot in both ranges, and only two primaries were ever found on dry sites. Only six secondaries were seen on dry sites, and all of these were under whitebark pine snags within 0.5 km of a Golden Eagle bathing site.

DISCUSSION

Golden Eagles are common throughout the Great Basin (Herron et al. 1985, Ryser 1985), and it is not unusual to see them in this region. It is unusual, however, to see five or more together at a time. Collectively, we have spent over 60 yr exploring the Great Basin and we have seen more than four Golden Eagles at a time only at eagle bogs. We consider the sighting on three occasions of congregations of five individuals at bogs to be significant, and further study of Golden Eagles at these bogs may reveal new insights into their social behavior. Furthermore, we have observed eagles at the first two Jarbidge eagle bogs on 17 of the 18 times that we have visited them. Therefore, we consider the use of these bogs to be a significant feature of the habitat requirements of Golden Eagles in the Great Basin.

During a 5-yr study of the wild horses of Nevada (Berger 1986), Golden Eagles were observed on four occasions utilizing three different bogs (2500–2700 m) in the Granite Range of northwestern Nevada, 41 km ESE of the Warner Mountains (J. Berger, pers. comm.). The sites shared the features common to the eagle bogs of the Jarbidge and Warner Mountains.

Golden Eagles were observed bathing, drinking and preening at eagle bogs, so these activities are clearly among the functions of their visit. The tremendous abundance of primaries, secondaries, rectrices and down seen in and near the pools at all of the eagle bogs strongly suggest that preening is an important activity of the birds at these sites.

Some of the sites we designated as "drinking only" habitat, due to the lack of direct observation of bathing and the absence of primary feathers (Table 1), may yet prove to be bathing sites, especially the two we visited early in the season.

Golden Eagle bathing sites contain bogs with shallow pools without undercut banks. Seven sites had all the attributes of a good eagle bog, except that they had no bog with pools, or the pools had undercut banks. None of these were eagle bogs.

If eagles were present when we visited an eagle bog, as soon as we were detected they left the site through the runway. Their escape flight was very slow, and they always lost elevation once they flew over the drop in the runway. They typically did not regain the elevation of the bog for about 200 m. It is well known that Golden Eagles have difficulty taking off from the ground, and particularly so when carrying prey. Similarly, we assume that taking off is more difficult after drinking and bathing. We conclude that the escape route with an adequate drop in elevation (>30 m drop in 200 m) is a very important feature in the selection of bathing sites by Golden Eagles. This conclusion is supported

by the characterization of an unused bog that had all our attributes except that the drop was only 10 m in 200 m.

Although the presence of a canopy over the pools in a bog prevents Golden Eagle use, we conclude that adequate cover surrounding the bog is critically important in their selection of a bathing and drinking site, since this cover prevents long distance detection of eagles by potential ground predators. At 10 sites where all other attributes would indicate eagle use, there was not cover on three sides and the bogs were not used. Alternatively, dense cover within 5 m of pools at one bog apparently prevented its selection as a watering site, presumably due to insufficient distance in the event of predatory ambush.

It is curious that Golden Eagles, not normally disposed to concealing themselves, invariably select secluded water sites. This feature of eagle bogs is probably why their drinking and bathing in the wild has remained unreported until now. Golden Eagles come to eagle bogs and drink, bathe and preen. These activities make the birds much more vulnerable to predators than under other circumstances, hence a site with heavy cover on three sides of the bog with a runway present on the fourth side is advantageous. This escape route has a severe drop in elevation that allows Golden Eagles a rapid departure if they encounter a predator, even if the birds are heavily laden with water.

We assume that occupation of these sites, by either humans or livestock, will preclude their use by eagles. The importance of these bogs for Golden Eagles is still unknown, but if they are a habitat feature that limits their range or reproductive success, special attention should be given to eagle bogs in land management practices.

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The annual meeting of the Association of Field Ornithologists will be held at Ohio Wesleyan University in Delaware, Ohio on 21-24 March 1991. A one-day Clark Fund Ornithological Symposium entitled, "Avian Conservation: Problems and Solutions," will be held on Friday, 21 March, and will highlight the meeting. Speakers for the Clark Fund symposium include Scott K. Robinson, Brian A. Harrington, Tom J. Cade, Carlos E. Quintela and Frances C. James. On Saturday sessions for contributed papers and a half-day symposium entitled, "History of North American Ornithology," organized by Jerome A. Jackson, will be held. Sunday will be devoted to field trips. You may register for the Clark Fund symposium only or for the entire meeting. For information on registration and accommodations, contact *Edward H. Burt, Jr., Department of Zoology, Ohio Wesleyan University, Delaware, OH 43015 (614-368-3886)*