PREY REMAINS IN NESTS OF FOUR CORNERS GOLDEN EAGLES, 1998–2008

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The Golden Eagle (*Aquila chrysaetos*) is among the most studied of raptors (Watson 1997, Kochert et al. 2002). The easiest way to monitor its diet during the breeding season has been to sample remains in active nests (Collopy 1983). In western North America, Golden Eagle nests contain remains primarily of leporids (rabbits and hares) and sciurids (ground squirrels) but also of many other species (Olendorff 1976, Palmer 1988, Kochert et al. 2002). Published information for the southwestern U. S. is limited to prey collected from 41 nests in southeastern New Mexico and western Texas in the 1960s (Mollhagen et al. 1972), nine nests in central Arizona in 1985 (Eakle and Grubb 1986), and time-lapse photography and prey collected at four nests over two years in the trans-Pecos region of Texas (Lockhart 1976). Mammals, mostly hares, rabbits, and sciurids, dominate these samples.

From 1998 to 2008 we rappelled into 182 active Golden Eagle nests in 90 territories in northeastern Arizona, southeastern Utah, and northwestern New Mexico, visiting each territory one to five times for a total of 191 nest checks. The primary reason for these May and June visits was to band nestlings at an age of 4 to 6 weeks. The nests studied from 1998 to 2001 were distributed throughout the 65,000-km^2 Navajo Nation; those studied from 2003 to 2008 were in the much smaller 3550-km^2 Jicarilla Nation. All nests were on rock substrates (cliffs and buttes) within a variety of habitats ranging from nearly barren deserts at 1250 m elevation near the Colorado River in Arizona to rugged mesas and 2500-m mountains of the Navajo Nation, woodlands and forests near the continental divide, and the 2500-m mountains of the Jicarilla Nation in New Mexico. Great Basin desert scrub and desert grasslands dominate the lower desert habitats, while ponderosa pine (*Pinus ponderosa*) forests cover the mountainous areas; woodlands of pinyon pine (*P. edulis*) and juniper (*Juniperus* spp.) and flats with sagebrush (*Artemisia tridentata, A. frigida*) occupy the middle elevations (Brown 1982). While habitats varied, all nests were within the Colorado Plateau ecoregion. We did not census populations of prey, but lagomorphs were generally widespread and sometimes abundant, and ground squirrels and Gunnison's prairie dogs (*Cynomys gunnisoni*) were locally common. Large avian prey was lacking throughout the region, except for waterfowl at mountain lakes and Wild Turkeys (*Meleagris gallopavo*) in montane forests and openings.

During visits to nests we documented 660 prey items of 24 species (Table 1). We enumerated all species as the minimum number based on full bodies or counting of

Table 1 Prey Remains Found in 191 Visits to Golden Eagle Nests, Four Corners Region of Utah, Arizona, and New Mexico, 1998–2008

Prey	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	Total
Mammals											
Black-tailed Jackrabbit, *Lepus californicus*	62	34	63	25	2	14	4	6	2	7	219
Cottontail, *Sylvilagus* sp.	13	17	24	8	1	4	32	47	89	45	280
Gunnison's Prairie Dog, *Cynomys gunnisoni*	2	4	6	4		4	4	7	7	2	40
Golden-mantled Ground Squirrel, *Spermophilus lateralis*	2										2
Rock Squirrel, *Spermophilus variegatus*			4	1	1	2		1	7	6	22
Porcupine, *Erethizon dorsatum*				1							1
Red Fox, *Vulpes vulpes*			1								1
Mule Deer, *Odocoileus hemionus*									1		1
Sheep (domestic), *Ovis aries*	2	2	3	1							8
Mammal Totals	**81**	**57**	**101**	**40**	**4**	**24**	**40**	**61**	**106**	**60**	**574**
Birds											
Gadwall, *Anas strepera*							1		1		2
Mallard, *Anas platyrhynchos*		1									1
Northern Shoveler, *Anas clypeata*								1			1
Wild Turkey, *Meleagris gallapavo*	1	1					1		1		3

Table 1 (*Coninuted*)

Prey	1998	1999	2000	2001	2003	2004	2005	2006	2007	2008	Total
Great Blue Heron, *Ardea herodias*			1								1
Rock Dove, *Columba livia*			1								1
Red-tailed Hawk, *Buteo jamaicensis*	3										3
American Coot, *Fulica americana*						12					12
Great Horned Owl, *Bubo virginianus*	1	1							1		3
Northern Flicker, *Colaptes auratus*			1					1			2
Pinyon Jay, *Gymnorhinus cyanocephalus*			2	2		1	2	1	1		9
Clark's Nutcracker, *Nucifraga columbiana*			1								1
Common Raven, *Corvus corax*	3	1	5	7		1	1	2	1	3	24
Bird totals	**7**	**5**	**11**	**9**	**0**	**14**	**5**	**5**	**5**	**3**	**63**
Gopher Snake, *Pituophis catenifer*	6	1	3	7	1		3		1		22
Brown Trout, *Salmo trutta*					1						1
Nest visits	32	22	37	21	5	9	14	18	16	17	191
Mammals per visit	2.5	2.6	2.7	1.9	0.8	2.7	2.9	3.4	6.6	3.5	3.0
Snakes per visit	0.19	0.05	0.08	0.33	0.2		0.21		0.06		0.11
Birds per visit	0.22	0.18	0.30	0.43	0	1.55	0.36	0.28	0.31	0.18	0.33

parts (legs/wings/skulls). We based identification and counts of avian prey on bodies or parts with feathers attached, sometimes by a few to numerous feathers found in the nest. We never used just one feather to verify predation, assuming that it may have occurred there by chance.

Most (87%) of the prey remains were of mammals, and most of these (75.5%) were Black-tailed Jackrabbits (*Lepus californicus*: 33.2%) and cottontails (*Sylvilagus* spp.: 42.3%). Jackrabbits constituted 75% of leporids on the Navajo Nation (1998–2001), but cottontails constituted 86% of leporids on the Jicarilla Nation (2003–2008). Sciurids, including 64 individuals of three species, constituted <10% of remains. In nests on the Navajo Nation, where sheep grazing is common, we found parts of domestic sheep (*Ovis aries*) annually. More unusual was a red fox (*Vulpes vulpes*) in a nest in Apache County, Arizona, on 20 May 1999 (see also Mikesic and LaRue 2003). Finally, we found a porcupine (*Erethizon dorsatum*) below a nest in McKinley County, New Mexico, on 6 May 2001; the eaglet in this nest had a quill embedded in one foot. Over our entire study, we found 3.0 mammals per nest visit (Table 1).

Gopher snakes (*Pituophis catenifer*) were the only reptiles found in nests but were found seven of ten years and contributed 3.3% of all prey items. Gopher snakes were more commonly found in nests on the Navajo Nation (1998–2001). A brown trout (*Salmo trutta)* found in a nest in Rio Arriba County, New Mexico, on 28 May 2003 was likely scavenged from the shore of a nearby reservoir.

Among bird remains were nestlings of two species, one not previously reported as Golden Eagle prey, and several species taken under unique circumstances. The 63 avian prey belonged to 13 species (Table 1), representing nine families in nine orders. Two families, the Anatidae and Corvidae, were each represented by three species. We noted Common Raven (*Corvus corax*) remains in 24 nest visits in nine of ten years, making the raven by far the most common avian prey in these Golden Eagle nests. Ellis et al. (2000) considered the Common Raven as unusual prey.

American Coots (*Fulica americana*) were the second most numerous avian prey, but all coot parts were found on a single nest visit. On 18 June 2004, a Golden Eagle nest in western Rio Arriba County contained 23 coot legs. The likely source of this prey was incubating adult coots nesting among the sparse emergent bulrushes of a large, shallow lake 3 km from the eagle nest. Interestingly, we found no coot legs in this same nest earlier the following year on 26 May 2005; coots were present, but not nesting, on the same lake. We surmise that swimming coots are quick to dive underwater to avoid an attacking eagle, while incubating coots are reluctant to leave their nests until too late.

The third most common avian prey was another corvid, the Pinyon Jay (*Gymnorhinus cyanocephalus*), with nine individuals identified in six different years. This species had not previously been documented as Golden Eagle prey. On 7 May 2000 we found sheathed flight feathers of nestling Pinyon Jays in two nests 25 km apart in southwestern McKinley County, New Mexico. On 7 May 2001, we found two large-bodied Pinyon Jay nestlings in a third McKinley County nest, 38 km from the nearest 2000 nest with jay remains. The nestlings were about 75% grown and had sheathed primaries and remiges 10 mm long. Finally, we found one more body of a nearly fledged Pinyon Jay in a nest in western Rio Arriba County on 6 May 2007, about 150 km from the McKinley County nests. We could not age the jays from the feathers found in the other four cases.

In North America Golden Eagles are known to have taken nine species of diurnal raptors and four species of owls (Olendorff 1976, Cooper 1991, Kochert et al. 2002), including nestlings of five of those species (Kochert et al. 2002). Our most unusual observation involved a diurnal raptor. On 20 May 1998 we entered an eagle nest in eastern Apache County, Arizona, containing two large eaglets. Also in the nest were a freshly killed adult Red-tailed Hawk (*Buteo jamiacensis*), with only the skull opened and the brain eaten, and two 3- to 5-day-old nestlings of the same species. We surmise

that an eagle killed the hawk while it brooded the young and then made multiple trips to get all three hawks to the eyrie. If this inference is correct, this observation constitutes the first documentation of such an attack on a vulnerable adult on an open nest. This is also the first report of Red-tailed Hawk nestlings found as prey in a Golden Eagle nest. Both hawk nestlings were preserved and deposited in the Navajo Natural Heritage Program's animal collection (NNHP 0205) in Window Rock, Arizona.

Finally, we found the dried neck and head of a Great Blue Heron (*Ardea herodias*) in a nest in western Sandoval County, New Mexico, on 15 May 2000. Although this heron commonly forages terrestrially for small mammals, it does so mainly in uplands within a reasonable distance of nesting or roosting trees and more typical open-water foraging areas. The Golden Eagle nest where the heron head was found was at least 30 km from any stream, and it is most logical that the heron was taken while flying through the territory in migration, perhaps a month or more previously.

As other studies in the Southwest (Mollhagen et al. 1972, Lockhart 1976, Eakle and Grubb 1986) and elsewhere in North America (Olendorff 1976, Palmer 1988, Kochert et al. 2002) have also found, in the Four Corners region we found leporids to be by far the most frequent prey in Golden Eagle nests. Overall, we found mammals (3.0/nest visit) ten times more frequently than birds (0.33/nest visit) and 30 times more frequently than snakes (0.11/nest visit). An unusual high of 1.55 birds/nest visit in 2004 was due to one pair's propensity for capturing a locally abundant prey, the American Coot. Similarly, Ellis et al. (2000) documented a high proportion of fox (*Vulpes* spp.) remains in one Golden Eagle nest in Mongolia; they suggested that populations of the normal prey of hares (*Lepus tolai*) and marmots (*Marmota sibirica*) were locally depressed. Our above-average high of 6.6 mammals/nest visit in 2007 coincided with an obvious abundance of cottontails on the Jicarilla Nation that year. Conversely, lows in both rates in 2003 paralleled the eagles' reduced nesting in 2002 and 2003 that likely coincided with low prey availability (see Steenhof et al. 1997). Ultimately, Golden Eagles exploit prey that is most abundant and vulnerable within their local hunting areas, even other predators.

Interestingly, Mollhagen et al. (1972) found only one species of bird in 41 visits to Golden Eagle nests. Furthermore, Lockhart (1976) identified only three birds among 120 (2.5%) prey items recorded by time-lapse photography and six birds among 446 (1.3%) prey items found in 17 Golden Eagle nests in trans-Pecos Texas. Only six of their combined 58 nest visits took place when the nest was active. Therefore we surmise that either avian prey remains are less likely to persist in Golden Eagle nests or that eagles in that part of New Mexico and Texas preyed very little on other birds. Eakle and Grubb (1986) reported six species of birds among the 38 prey items they found. Thus our compilation of prey over ten years from active nests adds significantly to the knowledge of the diversity of prey taken by breeding Golden Eagles in the southwestern U. S., particularly in the kinds and numbers of birds taken.

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Golden Eagle

Sketch by George C. West