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Ecology of Eurasian Black Vultures (*Aegypius monachus*) in Ikh Nart Nature Reserve, Mongolia

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Abstract

We studied the nesting ecology and movement patterns of Eurasian black vultures (*Aegypius monachus*) nesting in and near Ikh Nart Nature Reserve, Dornogobi Aimag, Mongolia. From 2003 till 2009, we monitored nesting pairs from incubation to fledging and compared nesting success for pairs nesting on rocks and trees. We captured chicks just prior to fledging to apply leg bands and wing tags. We also captured adults in June and attached solar-powered global positioning system (GPS)/satellite telemetry units, leg bands, and wing tags. We collected re-sighting data on marked birds opportunistically and telemetry data on tagged birds. We monitored 363 nesting pairs from 2003 to 2009. Most nesting failures occurred during the ~ 55 day incubation period. Overall, 50.9 % of nesting pairs raised a chick to fledgling. Nesting substrate (i.e., rock or tree) did not influence nesting success. Between 2006 and 2009 we received reports of sightings for 21 individual birds and on 37 occasions (n = 1 – 6 sightings/bird). Thirty three sightings (89 %) came from South Korea between November and March, with other sightings in Mongolia, China, and Russia. We placed 5 GPS/satellite telemetry units on adult vultures in 2008 and 2009, but one did not work. We received 2,767 locations from the other 4 units through 2009. Adult vultures used large foraging areas, covering a mean minimum convex polygon home range of 27,025 ±11,922 SE km^2, a mean 95 % kernel home range of 4,953 ±1,596 SE km^2, and a mean core home range (i.e., 50 % kernel) of 526 ±168 SE km^2. Our data suggest that only fledgling and juvenile birds disperse from Mongolia in late autumn/early winter, while adults remain in near their nesting sites, but we require more data. We do not know if most of our tagged birds travel to Korea or the large number of reported re-sightings there result from the stronger bird watching tradition in that country compared with other areas.

Key words: *Aegypius monachus*, dispersal, Eurasian black vulture, fledgling, nesting, Mongolia

1. Introduction

Eurasian black, or cinereous, vultures (*Aegypius monachus*) are the largest raptors in Eurasia, sporting impressive 2.5 - 3 m wingspans and weighing 7 - 13 kg (DEL HOYO et al. 1992, ÁLVAREZ AND GARCÉS 1997). The species ranges across the Palaearctic, from Spain in the west to southeastern Siberia, Mongolia, and China (FERGUSON-LEES & CHRISTIE 2001). Eurasian black vultures appear to be faring well in Mongolia, although internationally conservationists have expressed concern over the status of the species. Listed as Vulnerable in 1994 by the IUCN, the species was upgraded to Near Threatened in 2000, where it remains today, despite continued population declines (IUCN 2008). Little is known about the species in Mongolia, although researchers have conducted a few research projects, such as a Korean study in Ikh Gazariin Chuluu, Dundgobi Aimag and a joint Mongolia-American project in Hustain Nuruu National Park and Erdenesant Soum, Tov aimag from 2002-2008 (BATBAYAR 2004). The Denver Zoological Foundation and Mongolian Academy of Sciences have been conducting research on the ecology of Eurasian Black Vultures (*Aegypius monachus)* in the Ikh Nart Nature Reserve (Ikh Nart) in southeastern Mongolia since 2003. We expanded our work in 2008 to include nesting pairs from Gun Galuut Nature Reserve, Tov Aimag and Choyr and Sansar Mountains, Gobi-Sumber Aimag.

Ikh Nart supports a large, dense (measured by total nests per unit area) breeding colony of cinereous vultures that usually includes ~ 55-60 active nests/year in just the northern 23,000 ha of the reserve. Vultures in Ikh Nart nest primarily on rocky outcrops and the scattered elm trees (*Ulmus pumila*) in the reserve. As with other vulture species in other areas of the world, nest site availability appears to constrain breeding cinereous vultures to areas with suitable nesting habitat; in this case, the more rugged areas like Ikh Nart (SARÀ & DI VITTORIO 2003, BATBAYAR 2004, PARRA & TELLERÍA 2004, READING et al. 2005, GAVASHELISHVILI et al. 2006). Nests on outcrops appear to be readily approachable by people and ground predators, such as wolves (*Canis lupus*). In late fall many Eurasian black vultures leave Mongolia while others remain throughout the winter (MEYBURG & MEYBURG 1983, BATBAYAR 2006).

We began our reseach to better understand the factors influencing cinereous vulture nesting success in Ikh Nart and expanded our work to study other aspects of the species' ecology. We hope such data will be useful for cinereous vulture conservation initiatives elsewhere in the species' range in Mongolia and in other countries. In this paper we examine nesting success comparing nesting success rates of pairs that nest in trees or rocks, movements of fledged vultures to try to determine where individuals go after leaving the nest, and adult movement patterns using GPS photovoltaic rechargeable backpack transmitters.

2. Study Areas

Ikh Nart Nature Reserve (Ikh Nart) was established in 1996 to protect ~66,600 ha (~163,150 ac) of rocky outcrops in northwestern Dornogobi Aimag (MYAGMARSUREN 2000, READING et al. 2006). The region is a high upland (~1,200 m) covered by semi-arid steppe vegetation. Permanent cold-water springs are available in some of the several, shallow valleys draining the reserve. Climate is strongly continental and arid, characterized by cold winters (to -40 °C), dry, windy springs (to 25 mps), and relatively wet, hot summers (to 43 °C). Humidity is extremely low. Precipitation is low and seasonal, primarily falling in summer (READING et al. 2006a).

Fig. 1: Permanent research camp at Ikh Nart Nature Reserve southeastern Mongolia (Photo: D. KENNY).

Flora and fauna are representative of the semi-arid regions of Central Asia, with a mixture of desert and steppe species (MURDOCH et al. 2006, READING et al. 2006). Vegetation is sparse. Xerophytic and hyperxerophytic semi-shrubs, shrubs, scrub vegetation, and turfy grasses dominate, including *Haloxylon ammodendron*, *Sympegma ergelli, Anavasis brevifolia*, *Ephedra prjewaliskii*, *Ilynia regeli*, *Stipa glareosa*, *S. orientalis*, and *Reumuria songarica*. Different plant communities can be found around oases and streams, on rocky outcrops, and other localized areas. Large mammals in the region include argali (*Ovis ammon*), ibex (*Capra sibirica*), goitered gazelle (*Gazella subgutturosa*), Mongolian gazelle (*Procapra gutturosa*), and wolves, several of which are locally or globally threatened. Common avifauna includes saker falcons (*Falco cherrug*), steppe eagles (*Aquila rapax*), upland hawks (*Buteo hemilasius*), black kites (*Milvus migrans*), little owls (*Athene noctua*), pied wheatears (*Oenanthe pleschanka*), white wagtais (*Motacilla alba*), horned larks (*Eremophila alpestris*), Guldenstadt's redstarts (*Pheonicurus erythrogaster*), red-billed choughs (*Pyrrhocorax pyrrhocorax*), and Daurian partridges (*Perdix dauurica*). Of the many small mammals and reptiles in Ikh Nart, more common species include, Tolai hares (*Lepus tolai*), Pallas' cats (*Otocolobus manul*), red foxes (*Vulpes vulpes*), corsac foxes (*Vulpes corsac*), Mongolian gerbils (*Meriones ungulatus*), several species of voles and jerboas, toad-headed agamas (*Phrynocephalus versicolor*), Mongolian racerunners (*Eremias argus*), Central Asian vipers (*Aqkistrodon halys*), and Pallas' colubers (*Elaphe dione*).

3. Methods

Nest monitoring

To assess reproductive success, we monitored vulture nests from incubation to fledging. Late each winter (late February to early March) we visited all known nest sites (currently > 220) using a global positioning system (GPS) and recorded whether or not a pair of vultures used each site (STEENHOF 1987). We also recorded any new nest sites we encounter with a GPS and noted the nesting substrate (i.e., tree or rock). We visited nest sites with an active pair of vultures several times throughout the breeding season (nestlings usually fledge in September) to check on activity levels (i.e., whether or not the egg or nestling was still viable or "active"). Where necessary, we used binoculars or spotting scopes or climbed into nests or onto adjacent rocks or tree limbs to confirm the presence of an active nesting pair with an egg or chick. We spent as little time as possible in the vicinity of nests to minimize disturbance (STEENHOF 1987).

Since 2003 we measured a variety of nest characteristics for all nests sites (whether or not a pair of vultures was using the nest), including nest height, diameter, cup diameter in 2 dimensions, and height off the ground; perceived difficulty of entry for ground predators (subjectively determined on a scale of 1 to 5, where a 1 is a nest most easily entered and a 5 represents a nest that ground predators cannot access); and, for nests on rocks, slope of the nest in the direction the nest faced, aspect, and view shed (i.e., the estimated number of radial degrees a sitting vulture can see). We measured nest characteristics when we first located nests site unless it a pair of vultures was using the nest during a sensitive period (e.g., hatching time), in which case we waited until the nesting paired failed or fledged their young. We collected other data using a geographic information system, such as distance to nearest neighboring nests, number of nests within 1 km, and the distance to other important features, such as water sources and nomadic pastoralist camps (BATBAYAR 2004).

Vulture capture and marking

We captured cinereous vulture chicks just prior to fledging (late July through early September) to collect morphometric data and apply leg bands and wing tags. Adults generally left nests upon approach and we easily grabbed and constrained chicks with thick gloves. Older nestlings occasionally jumped from the nest and some glided up to 1 km (usually far less) from the nest. We recaptured these animals and returned them to their nests (we captured > 30 nestlings in this manner; none were injured and all remained in their nests once returned). We captured adult cinereous vultures during the nesting period using leg snares on a 1 m x 1 m wire grid noose beds we constructed and tied down at nesting sites. We followed BUB (1991) for noose construction. We safely secured chicks at the edge of the nest during trapping.

Once constrained, we covered the vultures' eyes and collected morphometric data. We used leg bands obtained from the Ornithology Laboratory of the Mongolian Academy of Sciences (ARE-ANA Inc, ul. Zgierska 124/140 m. 208, 91-320 Łódź, Poland)) and constructed vinyl (Gallagher Tent & Awning, 809 Plaenert Dr., Madison, Wisconsin 53713, US) patagial wing tags following WALLACE et al. (1980) for California Condors (*Gymnogyps californianus*). Each leg band was inscribed with "Ornith. Lab. Inst. Biol. Mongolia" followed by a unique number and an e-mail address, mjwillis@denverzoo.org (added to metal bands fabricated in 2009). For adult vultures only we attached 70 g solar-powered GPS/satellite telemetry units with ground track and mortality signal units (Microwave Telemetry, Inc., 8835 Columbia 100 Parkway, Suites K and L, Columbia, MD 21045 USA) using Teflon coated straps and crimped metal ferrules in a backpack design (BUEHLER et al. 1995) that we tested on captive animals first (to insure no adverse affects). We glued foam rubber pads on the bottom of the units to raise them above feather level (about 2.5 cm).

Analyses

We incorporated telemetry data into a geographic information system (GIS) to help us understand habitat use, home range sizes, and movement patterns. We determined simple minimum convex polygon (MCP) home range sizes for each bird and estimated home ranges using the fixed kernels method (WORTON 1989) with least squares cross validation to select the smoothing parameter (SEAMAN & POWELL 1996). We made these calculations using ArcGIS 9.3.2 Geographic Information Systems software (Environmental Systems Research Institute, Redlands, CA) along with xTools, Animal Movement, and Hawth's Tools extensions. Our sampling unit was each individual bird, so birds with multiple years of data; we used means for analyses to avoid pseudo-replication.

We examined all variables for normality using the Shapiro-Wilk's test and homogeneity of group variance using Bartlett's test. We transformed data or excluded outliers to normalize data, where appropriate. We compare paired means using simple t-tests, with corrections for separate variances where appropriate. We use general linear models, linear and logistic regressions, and chi-square tests to evaluate the affect of year and nest substrate on nesting success. We set significance at $P < 0.05$.

4. Results

Nesting Success

We monitored 363 nesting pairs from 2003 to 2009, including 344 pairs in Ikh Nart and 19 pairs at other sites (Fig. 2). Nesting pairs in Ikh Nart used trees (n = 103), primarily Siberian elms (*Ulmus pumila*), or rocky crops and ledges (n = 241), while pairs in Gun Galuut Nature reserve and Choyr and Sansar Mountains nested solely on rocky ledges (Fig. 3 and 4**)**. Because we had such a small sample size of nests outside of Ikh Nart, we focused our analyses on vulture pairs that nested in and near Ikh Nart. We found egg laying dates between February 28 and March 12, but also know that some pairs laid eggs well after this period because some nests that were empty in late March held nestlings later in the year. These were probably pairs that experienced early nest failures and attempted to re-nest.

Most nesting failures occurred during the approximately 55 day incubation period from March to early May (Fig. 2). By May 15, most (84.1 %) of the nestlings that we located survived until fledging. In 2006, 2008, and 2009, we were able to track nesting success starting at the beginning of March, rather than the beginning of April (Fig. 5**)**. The pairs we monitored experienced loss rates of 5.9 % for tree nests, 13.6 % for rock nests, and 11.5 % overall in March and 19.6 % for tree nests, 30.3 % for rock nests, and 27.3 % overall in March and April. Overall, 50.9 % (n = 175) of the nesting pairs we monitored from 2003 - 2009 raised a chick to fledgling.

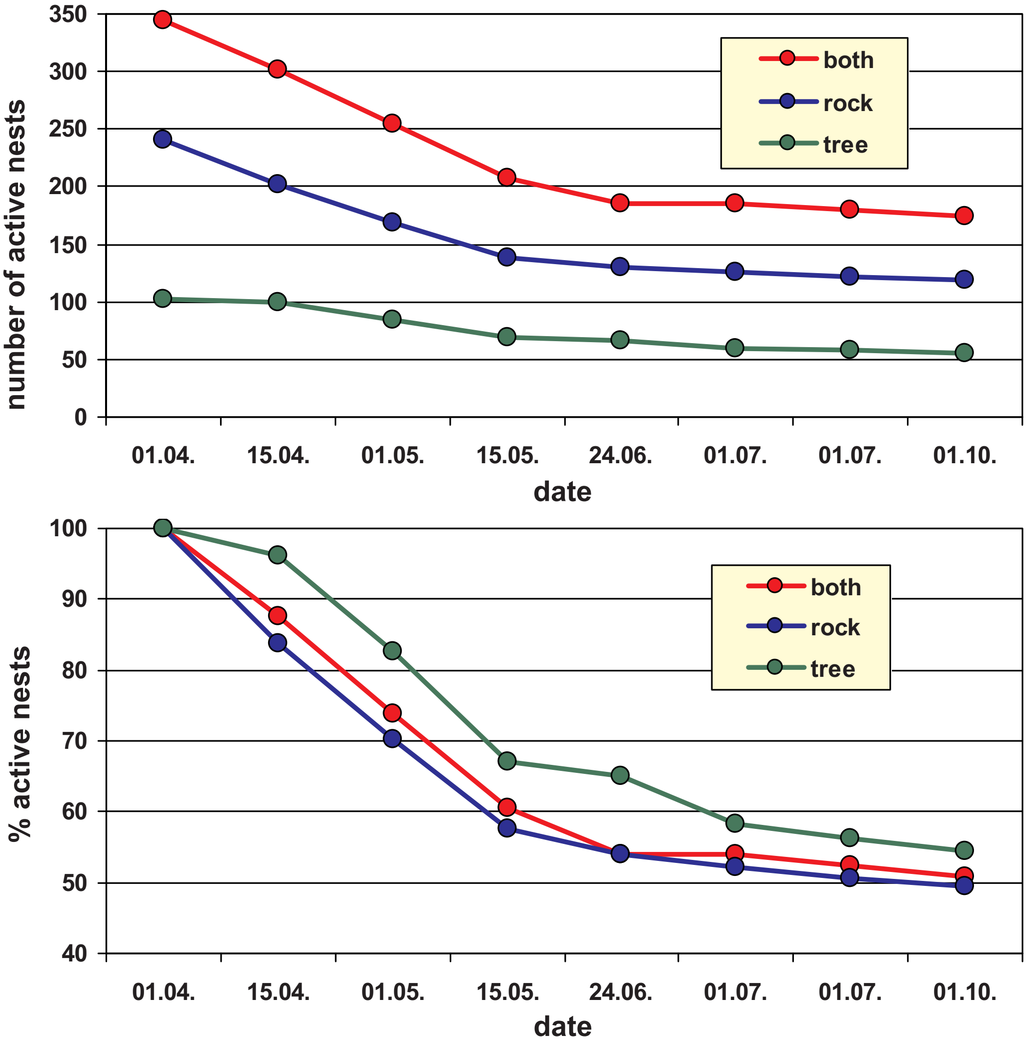

Fig. 2: Comparison of cinereous vulture (*Aegypius monachus*) nesting success for pairs nesting in trees, on rocky outcrops, or all nests pooled over time in Ikh Nart Nature Reserve, Mongolia, 2003-2009. Top: Number of active nests remaining over time. Bottom: Percentage of active nests remaining over time.

Nesting substrate (i.e., rock or tree) did not influence whether or not a vulture pair successfully raised a chick to fledging (X^2 = 0.00, *df* = 1, *P* = 0.99), yet we did find a year effective (Table 1, Fig. 2). When we examined nesting pairs that failed to raise a chick to fledging, we found that chicks of pairs nesting on trees (75.66 ±33.89 SE days) lived significantly longer (adj. R^2 = 0.03, *F* = 6.39, *df* = 1, 182, *P* = 0.012) than chicks of pairs nesting on rocks (60.75 ±36.19 SE days). Substrate only accounted for about 2.9 % of the variation in chick survival. So, although chicks raised in tree nests lived longer than chicks raised in rock nests, they suffered high mortality rates later in the nesting season such that overall fledging rates were similar (Fig. 2). Using a step-wise general linear model, we found that 2003 and 2004 accounted for most of the year effects (Table 2). Vultures experienced a significantly lower success rate in 2003 (26.83 %) and a significantly higher success rate in 2004 (63.16 %) than other years (adj. R^2 = 0.04, *F* = 7.60, *df* = 2, 359, *P* = 0.001), but again these years accounted for little (3.5 %) of the variance in success rates overall.

Table 1: Effects of year and nesting substrate (rock or tree) on Eurasian black vulture (*Aegypius monachus*) nesting success in Ikh Nart Nature Reserve, Mongolia from 2003-2009. General linear model adjusted R^2 = 0.035

Variable	Type III Sums of Squares	df	Mean Squares	F	P
Substrate	0.004	1	0.004	0.02	0.90
Year	3.21	6	0.534	2.17	**< 0.05**
Error	87.51	355	0.247		

Table 2: Effects of different years on Eurasian black vulture (*Aegypius monachus*) nesting success in Ikh Nart Nature Reserve, Mongolia from 2003-2009. SE = standard error. Step-wise general linear model (adjusted R^2 = 0.04, F = 7.60, df = 2, 359, P = 0.001)

Variable	Coefficient	SE	Standard Coefficient	Tolerance	t	P
Constant	136.12	20.16	0.00	–	6.75	**< 0.001**
2003	35.20	11.84	0.15	0.99	-2.26	**0.024**
2004	-38.04	16.82	-0.12	0.99	2.97	**0.003**

Fig. 3: Rock nest (Photo: D. KENNY).

Fig. 4: Tree nest (Photo: D. KENNY).

Fledgling and Movement Patterns

We applied bilateral patagial tags (Fig. 4 and 5) to 151 Eurasian black vultures at 3 different sites in Mongolia, including 5 yellow and 121 white tags in Ikh Nart Nature Reserve (N45.72380, E108.64502), 14 green tags at Choyr and Sansar Mountains (N46.25302, E108.78042/ N46.39938, E108.63356), and 1 blue tag in Gun-Galuut Nature Reserve (N47.60522, E108.39603). We uniquely numbered the patagial tags and in 2005 changed colors in Ikh Nart from yellow vinyl with black numbers, to white vinyl with black numbers so that birds from Ikh Nart would have a unique color (vultures from other sites in Central Mongolia also receive yellow vinyl wing tags; BATBAYAR 2004). We also placed 114 metal leg bands on the tarsi of fledgling vultures. We noted two vultures that lost one wing tag. We placed leg bands on one vulture with bilateral fractured wings that we found dead 12 km from the nest site. Since this bird did not successfully fledge, we did not include it in our re-sighting study. We know of at least 3 other birds that died during or just after fledgling, leaving 162 birds available for re-sightings.

Fig. 4: Nestling (Photos: Fig. 4 & 5 D. KENNY). Fig. 5: Eurasian black vulture with patagial band.

Between 2006 and 2009 we received reports of sightings for 21 individual tagged birds and on 37 occasions (1 to 6 sightings per individual bird). For every 7.2 birds we tagged prior to fledging we received 1 re-sighting report. Thirty three of the sightings (89%) came from South Korea between November and March. A rehabilitation center in China contacted us with information on a tagged bird they received in January and two birds were sighted in Yakutsk, Russia in July. Staff from the Yakutsk Zoo captured one bird and brought it into captivity, where it later died.

In March 2008 we sighted two wing-tagged vultures in Ikh Nart, one with a yellow tag and the second with a white tag, but we could not discern the numbers given the flying height of the animal. Since other researchers use yellow patagial tags for vultures in other parts of Mongolia, this individual may have originated from elsewhere; however, as far as we know, white tags are only used in Ikh Nart. We observed both birds in association with several other vultures. We received a report of a white tagged vulture in July 2008 ~110 km from the reserve feeding with several vultures near a sheep abattoir. We re-sighted a vulture that we know we tagged during a previous year in Ikh Nart in September 2009.

Adult Movement Patterns

We placed 2 solar powered GPS/satellite backpack units on adult cinereous vultures in 2008 and 3 more on adult birds in 2009. One of the units we deployed in 2008 never transmitted data. We attempted to recapture the bird with the malfunctioning unit, but were unsuccessful. We received 2,767 locations from the other 4 units through 2009, including 1,471 locations (590 locations in 2008 and 881 locations in 2009) from the bird we tagged in 2008 and 131, 398, and 467 locations from the birds we tagged in 2009 (Fig. 6). The unit we deployed in 2008 stopped transmitting data in early December through early February each year due to lack of sufficient sun to recharge the battery. We adjusted our units for 2009 and these units continued to transmit data through February 2010.

The 4 adult vultures used large foraging areas. Although we determined home range sizes, for most birds we had data for only seven months (Table 3). Preliminary results found that vultures moved over a mean MCP area of 27,025 ±11,922 SE km^2 (range = 4,180 - 42,883 km^2) (Table 3). Cumulatively, the foraging area for these birds covered terrain in 4 separate *aimags* (or provinces) and 17 *soums* (or counties) (Fig. 6). Birds ranged primarily east of their nesting sites in and near Ikh Nart (Fig. 6). We found similarly large and variable kernel home range sizes. Mean 95% kernel home ranges covered a mean of 4,953 ±1,596 SE km^2 (range = 603 - 7,548 km^2) (Table 3). We found mean core home range (i.e., 50 % kernels) of 526 ±168 SE km^2 (range = 23 - 745 km^2) centered on nest sites (Table 3). We cannot discern any seasonal pattern to their movements. The 2 birds we placed backpack on in 2008 re-nested in the Ikh Nart in 2009. One bird successfully reared a chick with its mate in 2009, but the other did not. None of the adult birds left Mongolia in the winter.

Table 3: Adult Eurasian black vulture (*Aegypius monachus*) home range sizes for 4 birds captured in Ikh Nart Nature Reserve, Mongolia from 2008-2009. MCP = minimum convex polygon; SE = standard error

			Kernel (% volume contours; km^2)	
ID	**Dates**	**MCP (km^2)**	**95%**	**50%**
74524	July 2008 – June 2009	27,062	5,746	745
74524	June – December 2009	23,536	3,327	603
74524	Mean	25,274	4,537	674
84760	June – December 2009	4,180	603	23
84761	June – December 2009	35,761	7,126	681
94475	June – December 2009	42,883	7,548	725
Means (±SE)		**27,025 (±11,922)**	**4,953 (±1,596)**	**526 (±168)**

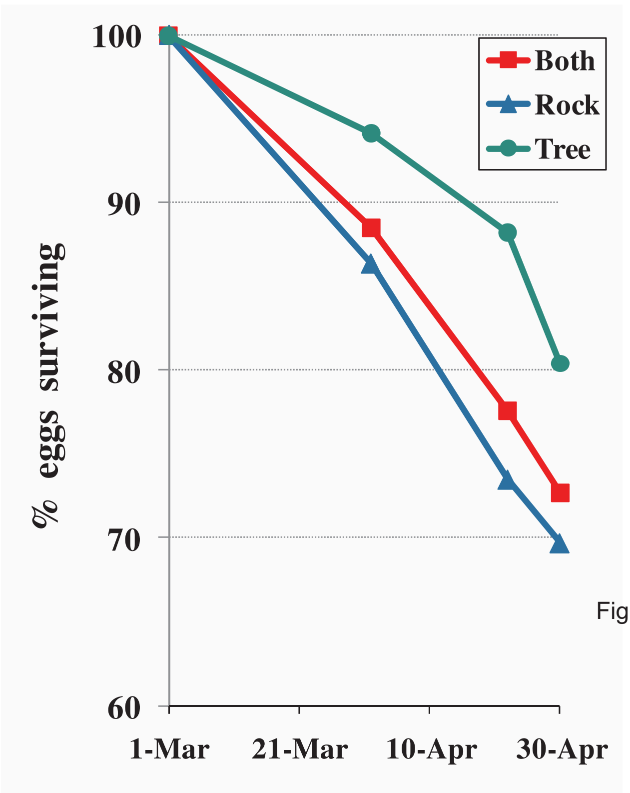

Fig. 5: Cinereous vulture (*Aegypius monachus*) early nesting success for nests located in trees, on rocky outcrops, or both in Ikh Nart Nature Reserve, Mongolia in 2006, 2008, and 2009.

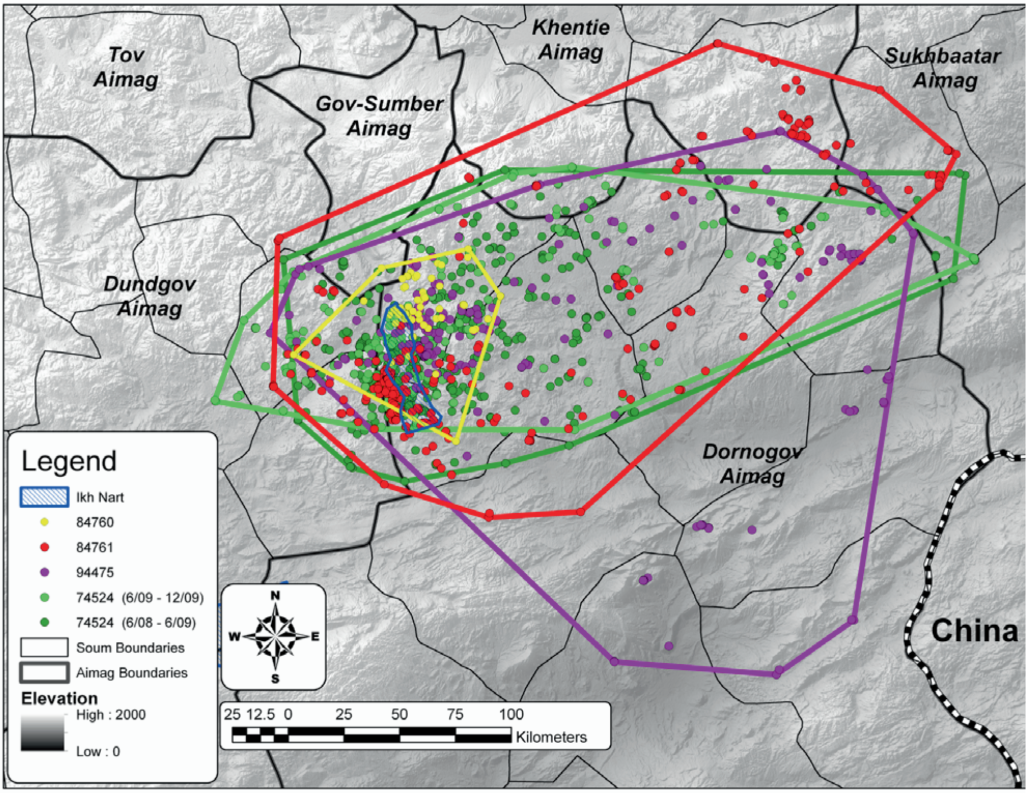

Fig. 6: Movements and minimum convex polygon home ranges of radio-tagged Eurasian black vultures (*Aegypius monachus*) from Ikh Nart Nature Reserve, Mongolia.

5. Discussion

We initially hypothesized that vulture pairs nesting in trees would experience higher fledging rates than pairs nesting on rocks, due to the ease of access to nests on rocky outcrops by ground predators, such as wolves, lynx (*Lynx lynx*), foxes (*Vulpes* spp.), etc. (READING et al. 2005). Despite longer mean survival time for chicks raised in tree nests, overall fledging rates were similar. Previous studies of Eurasian black vulture nesting success in Europe found that anthropogenic disturbance (measured by distance to human habitation) exerted the strongest negative impact on nesting success (DONÁZAR et al. 2002, POIRAZIDIS et al. 2004). Yet, very few humans utilize Ikh Nart during the nesting season of these vultures in most years. Several nesting pairs lose eggs and chicks each year due to heavy winds that blow nests from trees and rocks and even blow over trees. We also believe that aerial predators of eggs (such as ravens, *Corvus corax*) pose a threat to nesting pairs, but we have yet to witness an actual depredation.

We believe the year effects relate to mortality among livestock or weather in Mongolia, something we hope to test in the future. However, the year effects may also be an artifact of sampling, as in 2003 and 2004 we monitored relatively few nesting pairs relative to subsequent years and we began our monitoring later in the nesting season.

We reported preliminary Eurasian black vulture re-sighting findings in two previous papers (BATBAYAR et al. 2008, KENNY et al. 2009). Our observations of lost wing tags on 2 birds reinforce the importance of tagging both wings, as both birds retained a single wing tag. After first receiving reports of vultures we tagged in Mongolia from other countries, we believed that many, if not most; vultures left Mongolia during autumn and returned in February (BATBAYAR et al. 2008, KENNY et al. 2009). Recent data from adult vultures with backpack transmitter suggests a new hypothesis. We now believe that only fledgling and juvenile birds disperse from Mongolia in late autumn and early winter, but that adults remain in home ranges surrounding their nesting sites. We require more data to support this hypothesis and plan to attach 2-5 more telemetry units to adults birds in 2010, depending on funding. We will also continue to tag fledglings. GAVASHELISHVILI & MCGRADY (2006) also found that a fledgling Eurasian black vulture from Georgia traveled long distances after fledging, moving south to central Saudia Arabia in autumn and returning to Georgia in mid-April before traveling on to Russia, where they lost the signal.

As we discuss elsewhere (KENNY et al. 2009), we do not know if most of our tagged birds travel to Korea or the large number of reported re-sightings there result from the stronger bird watching tradition in that country compared with China, Siberia, the Russian Far East (where some vultures reportedly also spend winter; SHIBNEV 1989, KULIKOVA et al. 2003), North Korea, and other countries further afield. Distances travelled by resident birds may be dictated by food availability (KULIKOVA et al. 2003). We hypothesize that our transmittered birds moved further east than west due to the prevailing winds, which blow west to east. As we tag and transmit more birds and examine other variables, such as movements in relation to food availability and winds, we should be able to test these various hypotheses. Such information should help us understand important foraging areas in Mongolia and how large an area Eurasian black vultures require for foraging.

Colleagues in South Korea report that the major causes for mortality are starvation, toxins from agricultural chemicals and pesticides, heavy metals like lead, power line strikes and electrocution, and gunshot victims (JUNG et al. 2009, NAM & LEE 2009; personal communication: Young-Jun Kim, Conservation Genome Resource Bank for Korean Wildlife, Seoul National University, Seoul, Republic of Korea). We suspect many of the tagged birds have suffered these fates as fledglings or juveniles, but are never found or reported.

Eurasian black vultures do not nest and reproduce until they are about 4 to 5 years old. We hope to start seeing birds tagged as fledglings start to return to the Reserve for breeding and nesting in the near future. We are particularly interested in learning if birds that travel to Korea and other locations in winter as juveniles continue to do so after they begin nesting.

We believe we collected the first data on movements of nesting pairs of cinereous vultures, but require more data on more individuals before we can adequate understand and describe their movement patterns and home and core range sizes. Still, we found that birds moved primarily away from nest sites in the direction of prevailing winds, although we are unsure why this is the case. We found large variances in home and core range sizes for reasons that also remain unclear. We hope to collect additional data to better understand factors influencing home and core ranges sizes and movement patterns among adult cinereous vultures in Mongolia.

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