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THE USE OF POWER LINES BY BREEDING RAPTORS AND CORVIDS IN MONGOLIA: NEST-SITE CHARACTERISTICS AND MANAGEMENT USING ARTIFICIAL NESTS

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ABSTRACT.—The use of power line support structures as nesting sites enables some raptors and corvids to increase their breeding range and/or density in landscapes where alternative nest sites are limited. We report on the use of power poles for nesting by two nest-building species, Common Raven (*Corvus corax*) and Upland Buzzard (*Buteo hemilasius),* and two falcon species, Saker Falcon (*Falco cherrug*) and Eurasian Kestrel (*Falco tinnunculus)* in the nest-site-limited steppes of central Mongolia. Various power pole designs differed in their attractiveness to nest-building species, with structures that provided stable support and shelter being significantly favored. Trials of artificial nest barrels to (i) provide alternative nest sites on favored nesting support structures and (ii) provide additional nest sites on unfavored support structures, failed to induce nest-building species to shift their nest location in the first instance or to increase overall breeding density of large raptors and corvids in the second case. However, both trials resulted in large increases in the number of nesting Eurasian Kestrels.

KEY WORDS: *Upland Buzzard*; Buteo hemilasius; *Saker Falcon*; Falco cherrug; *Eurasian Kestrel*; Falco tinnunculus; *artificial nests*; *nesting*; *power lines*; *raptors.*

USO DE TENDIDOS ELÉCTRICOS POR RAPACES REPRODUCTIVAS Y CÓRVIDOS EN MONGOLIA: CARACTERÍSTICAS DEL SITIO DE ANIDAMIENTO Y MANEJO UTILIZANDO NIDOS ARTIFICIALES

RESUMEN.—El uso de las estructuras de soporte de los tendidos eléctricos como sitios de anidamiento permite a algunas rapaces y córvidos incrementar su área de reproducción y/o densidad en paisajes donde los sitios de anidamiento alternativos son limitados. Informamos el uso de postes de electricidad para anidar por parte de dos especies constructoras de nido, *Corvus corax* y *Buteo hemilasius,* y dos especies de halcones, *Falco cherrug* y *Falco tinnunculus,* en las estepas con sitios de anidamiento limitados del centro de Mongolia. Varios diseños de postes de electricidad difirieron en su atractivo para las especies constructoras de nidos, con una preferencia significativa por estructuras que proveen de un soporte estable y refugio. Los intentos de anidación en sitios artificiales, que implican (i) proveer sitios de anidamiento alternativos en estructuras de soporte preferidas para el anidamiento y (ii) proveer sitios de anidamiento adicionales en estructuras de soporte desfavorecidas, fallaron en el intento de inducir a las especies constructoras de nidos de cambiar la ubicación de sus nidos en primera instancia o en incrementar la densidad reproductiva total de rapaces grandes y córvidos en el segundo caso. Sin embargo, ambos intentos resultaron en grandes aumentos en el número de individuos anidando de *F. tinnunculus.*

[Traducción del equipo editorial]

The use of power line support structures for nesting by raptors and corvids is a well-known phenomenon that has been recorded on most continents (e.g., Kemp 1972, Olendorff et al. 1981, Castellanos and Ortega-Rubio 1995, Emison et al. 1997, Puzović 2008, Gombobaatar et al. 2010). The use of such structures for nesting tends to be most prevalent in areas where alternative natural sites are limited (Krueger 1998) and the habit of nesting on power lines can increase breeding populations in nest-limited habitats (Steenhof et al. 1993, Potapov 1999).

Prior to 1960, electricity generation and distribution in Mongolia was primarily limited to the environs of the capital city, Ulaanbaatar. The 1960s witnessed the

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development of industrial centers in the north (Darkhan) and east (Choibalsan) of the country, with further expansion to create several other industrialized towns across the country in the 1970s and 1980s (Worden and Savada 1989). The power system of Mongolia consists of three unconnected energy systems (central, eastern and western; Kurokawa et al. 2007). In particular, the development of the integrated power generation and distribution systems in the central and eastern regions resulted in the creation of electricity transmission and distribution lines across central and eastern Mongolia, especially in the period 1986–90 (Worden and Savada 1989, Lubsan 1997).

Baumgart (1978) made no reference to Saker Falcons (*Falco cherrug*) nesting on power lines in Mongolia during his surveys in 1977. The first record of a raptor nesting on a power pole in Mongolia was in 1994, but the habit probably began several years earlier, as nests on power line support structures were proven to be commonplace and widespread in 1995 and nests were also found on other anthropogenic structures (Ellis et al. 1997, Ellis 2010). Artificial nests for Saker Falcons have been extensively employed as a conservation management technique in Hungary and Slovakia since 1980, where the provision of artificial nests particularly focuses on electricity power lines (Bagyura et al. 2004, Chavko 2010). Artificial nest platforms were first erected in Mongolia in 1997, primarily on power line poles, and in the following year, nine (13.6%) were occupied by Saker Falcons and 10 (15.1%) by other species (Ellis et al. 2001, Ellis 2010). In all, over 150 artificial nest platforms were created from 1997 to 2000 (Ellis 2010) and this initiative was expanded by Mongolian researchers in subsequent years and several hundred platforms have since been erected on power poles across Mongolia (Gombobaatar et al. 2005), though monitoring and maintenance of these structures has been limited.

Although power lines can potentially benefit raptor populations by increasing available nesting habitat, there are also potential negative effects. Raptor nests can interfere with power transmission when nest material contacts the energized conductors causing power outages (James et al. 1999, Sundararajan et al. 2004). Consequently, risk management often results in the removal of nests, especially when they are situated in high risk locations on the power poles, though the provision of artificial nest sites in safe locations can reduce power transmission problems caused by nests (Kochert and Olendorff 1999).

In this study, we describe the frequency of nesting by raptors relative to the characteristics of power line support structures in central Mongolia and present the results of two separate trials that provided (i) additional nesting sites and (ii) safe alternative nesting sites on power lines using artificial nest barrels. The trials were designed to determine if nest-site supplementation would increase breeding densities where nest sites were limited and to determine if provision of nest sites in safe locations would encourage raptors to shift to a safe nesting situation on the same pylon. We discuss our results relative to conservation management of the globally threatened Saker Falcon and risk management for electricity transmission and distribution.

Methods

During 2005–09, we undertook opportunistic surveys during May of 16 power lines in seven provinces (*aimags*) and 18 districts (*soums*) of central Mongolia (Fig. 1). The electricity transmission and distribution lines we surveyed in central Mongolia can be grouped into two basic types: (i) *Tall* lines with a combination of tall metal pylons and concrete poles (ca. 20 m tall, conducting 35–220 kV; Fig. 2) and (ii) *Wooden* lines consisting of wooden poles (ca. 8 m tall, conducting 10–35 kV). The concrete poles of *Tall* lines are spaced at ca. 260-m intervals; along these lines metal pylons are typically used at deviation points and at intervals along straight sections where strain-insulators are required (ca. 1 metal pylon every 6 to 7 km). On *Wooden* lines, the support structures typically consist of single wood poles spaced at intervals of ca. 100–150 m and 'A-frame' poles at deviation points and where strain-insulators are required on anchor poles (ca. one every 3–4 km). There was an important structural difference in 'A-frame' poles on 10-kV and 35-kV *Wooden* lines, in that the crossarm of the former was not braced with wooden beams because the relatively light-weight insulating hardware on these anchor poles did not require additional support (Fig. 2).

Based on initial observations from the opportunistic surveys, we set up two experimental trials during September 2008 with artificial nest barrels on two sections of *Tall* lines conducting 110 kV, and subsequently surveyed these lines in 2009 and 2012 to determine occupancy. On *Tall* lines it was clear from prior observation that metal pylons were the favored support structures utilized by nest-building species and relatively few nests were found

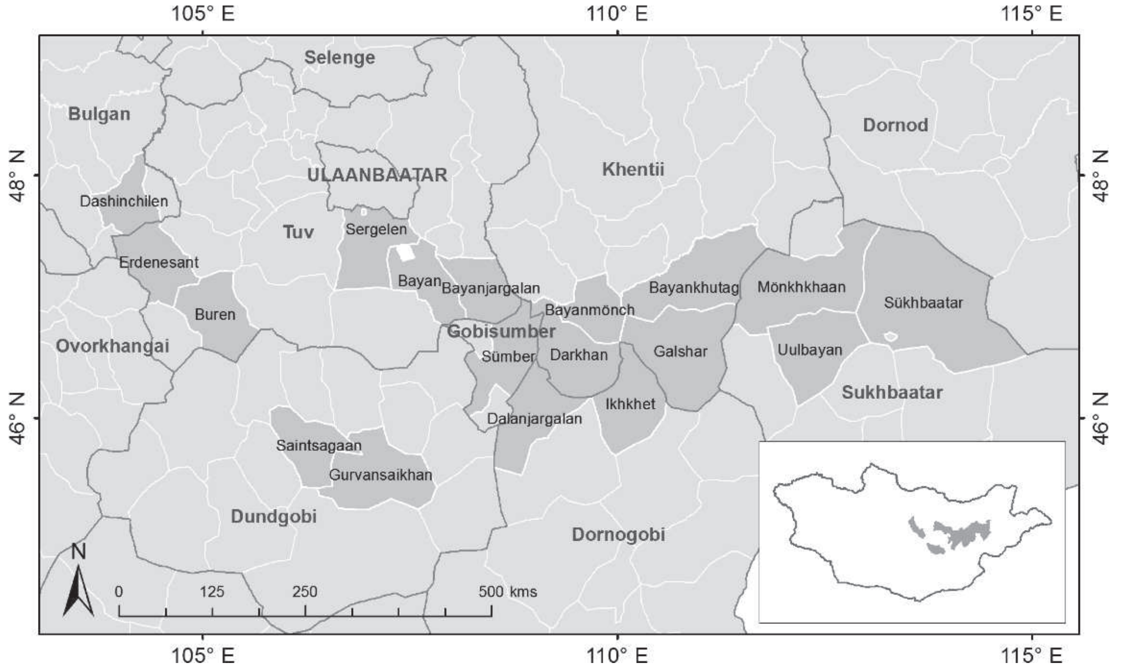

Figure 1. Map showing districts where power line surveys took place in Mongolia (dark gray).

on concrete poles; metal pylons provide more support and shelter for nests than concrete poles. The artificial nest barrels consisted of 60-cm-diameter closed-top metal barrels, ca. 60 cm deep with a side entrance ca. 40 × 30 cm. Nest barrels were lined with gravel and attached to poles and pylons by binding them with wire (Fig. 3).

The first trial (*Additional Nest Trial*) involved the erection of 25 artificial nest barrels on a 46-km section of power line, with 157 concrete poles and seven metal pylons, to assess whether the nesting density of large raptors could be increased through the provision of artificial nests. The nest barrels were affixed, with the nest entrance facing south, to concrete poles at a height of ca. 4 m and spaced at ca. 750-m intervals (i.e., every third pole; Fig. 3). In this *Additional Nest Trial,* artificial nest barrels were placed on concrete poles, thereby increasing the availability of nesting sites for falcons that do not build nests and also providing additional opportunities for nest-building species on poles where there is limited structural support and shelter for building a nest. The artificial nest barrels were placed in safe locations below the conductors, but as stick nests were so infrequent on concrete poles, their potential role in providing a safe alternative nest site for nest-building species was negligible.

The second trial (*Alternative Nest Trial*) involved erecting artificial nest barrels below the height of the aerial energized conductors on 23 metal pylons along 45 km of power line, in order to provide a safe alternative nest location for nest-building species (Common Raven [*Corvus corax*] and Upland Buzzard [*Buteo hemilasius*]) and a ready-made nest location for Saker Falcons. This *Alternative Nest Trial* differed from the *Additional Nest Trial* in that artificial nest barrels were placed on the favored metal pylons in an attempt to encourage nest-building species to use safer locations; the trial was not designed to increase nesting opportunities for nest-building species. However, artificial nest barrels could potentially increase the nesting opportunities for falcon species that do not build nests if no stick nest existed on the metal pylon; in the case of Saker Falcons this would be beneficial as their presence would deter nest-building species from using the same metal pylon and thus reduce risks of power outages associated with nest material.

Over the period 2005–09, we undertook 19 surveys along 16 power lines in May (Table 1). Surveys were conducted by travelling in a vehicle along the routes of the lines. We recorded the types of power poles, the GPS location of nest sites and deviation points (direction changes) in the course of the

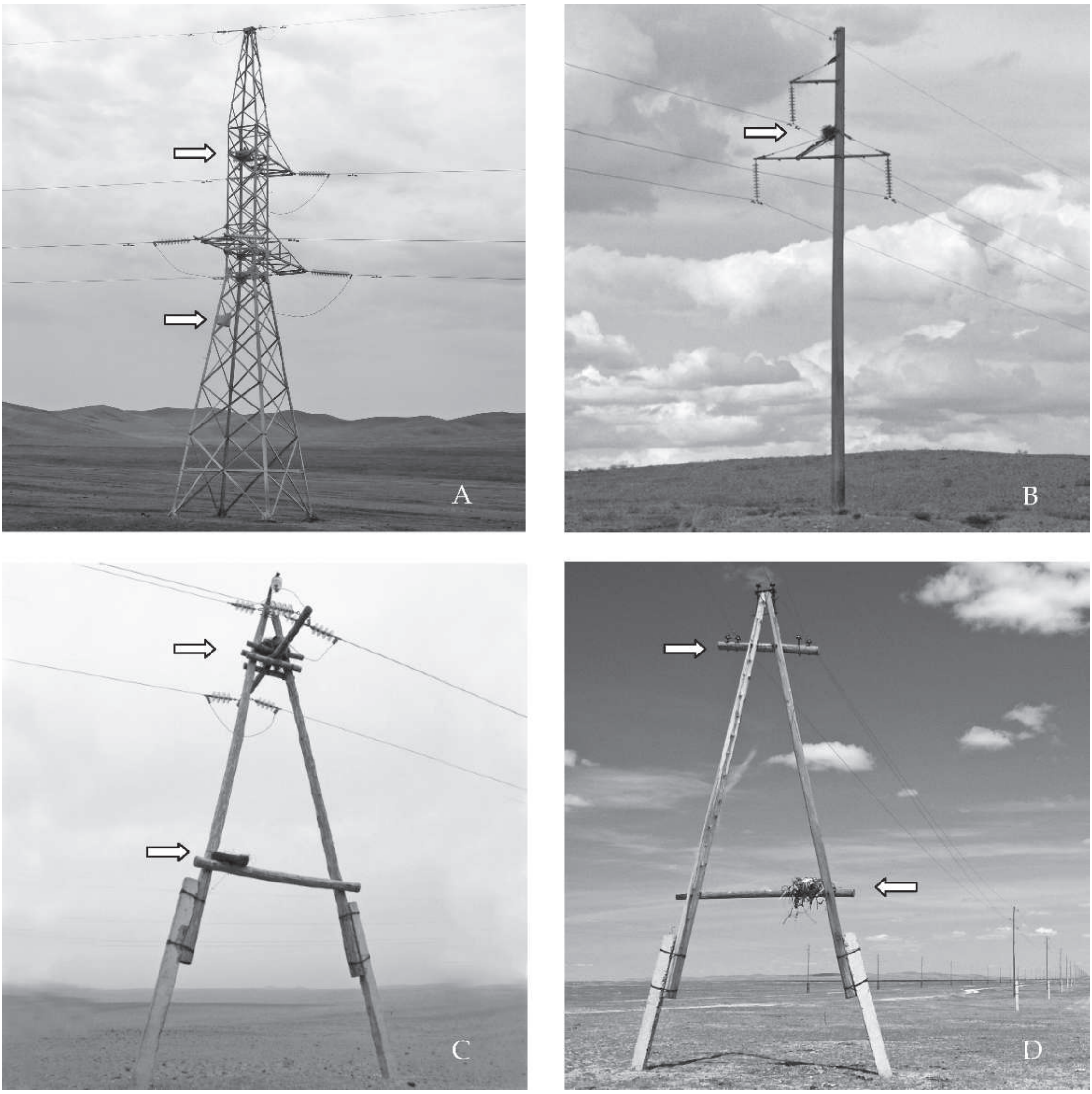

Figure 2. Illustrations of power line structures and nest sites in central Mongolia. (A) Metal pylon on 110 kV *Tall* line, showing location of Common Raven's nest on main stem at height of crossarm (upper arrow) and alternative artificial nest barrel placed in safe location below the height of the electricity cables (lower arrow). (B) Common Raven's nest (arrow) built on brace of metal crossarm of concrete pole on *Tall* line. (C) A-frame anchor pole on 35-kV *Wooden* line, showing nest site at apex built between bracing beams of crossarm (upper arrow) and location of an artificial nest platform on lower horizontal bracing beam for support struts. (D) A-frame anchor pole on 10-kV *Wooden* line, with no bracing beams for crossarm (upper arrow) and showing location of artificial nest platform on lower horizontal bracing beam for support struts.

line, and the position of nests on the power poles. We considered that a nest was active (i.e., being used by a breeding pair) if we observed eggs, nestlings, or an incubating/brooding bird, and only active nests were included in our study. We compared use of different pole types relative to availability along *Tall* and *Wooden* lines using a χ^2 test, and the breeding density of different species on these lines was compared using the Mann-Whitney test.

Figure 3. Artificial nest barrel, occupied by a Saker Falcon, attached to a concrete pole of a *Tall* line.

RESULTS

Breeding Raptors on Power Lines. We found four species breeding on electricity power poles in central Mongolia: two nest-building species, Common Raven and Upland Buzzard and two non-nest-building falcon species, Saker Falcon and Eurasian Kestrel (*Falco tinnunculus*) that utilized usurped or old nests. Of the 16 different power lines we surveyed (see Table 1 for lengths of line surveyed), Common Ravens and Saker Falcons were found breeding on 14 lines, Upland Buzzards on eight lines, and Eurasian Kestrels on only one line (Table 1). On the two power lines where no active Common Raven nests were found, all the Common Raven nests identified held breeding pairs of Saker Falcons. Saker Falcons used both old and new nests built by Common Ravens and Upland Buzzards, though it was often difficult to determine which of the two species had originally built some nests.

Nest-building species exhibited a strong preference for particular pole types (Fig. 2; Table 2). On *Tall* lines there were significantly more nests on

Table 1. Number of active raptor nests and nesting density (nests/100 km) on *Tall* and *Wooden* lines. Two lines marked * had artificial nest platforms on them, with eight and five platforms on the *Tall* and *Wooden* lines respectively.

					Saker Falcon		Upland Buzzard		Common Raven	
Type of Line	Survey	Year	Survey Length (km)	kV	*n*	Density	*n*	Density	*n*	Density
Tall Transmission and Distribution lines	Bayanmönch-Darkhan*	2005	46	110	5[a]	10.9	0	0.0	5	10.9
	Bayanmönch-Darkhan*	2006	46	110	4[a]	8.8	2[b]	4.4	5	10.9
	Darkhan spur	2005	4	35	1	24.4	0	0.0	2	48.8
	Darkhan spur	2006	4	35	1	24.4	0	0.0	2	48.8
	Borondor mine	2006	7	35	1	14.1	0	0.0	2	28.2
	Borondor-Choir	2005	86	110	3	3.5	0	0.0	8	9.3
	Baghangay-Nalakh	2009	45	110	8	17.8	7	15.6	11	24.4
	Bayanjargalan	2009	10	220	1	10.0	1	10.0	1	10.0
	Onderkhaan-Mönkhkhaan	2009	53	110	3	5.7	0	0.0	3	5.7
	Baruun Urt-Mönkhkhaan	2009	33	35	0	0.0	0	0.0	1	3.0
	Baruun Urt-Uulbayan	2009	68	35	5	7.4	3	4.4	6	8.8
	Galshar-Ikhkhet	2009	58	35	5	8.6	3	5.2	7	12.1
	Total		**460**		**37**	**8.0**	**16**	**3.5**	**53**	**11.5**
Wooden Distribution Lines	Darkhan-Borondor*	2005	36	35	3	8.3	0	0.0	4	11.1
	Darkhan-Borondor*	2006	36	35	2	5.6	0	0.0	5	13.9
	Darkhan mine	2006	14	35	0	0.0	0	0.0	1	7.1
	Bayan-Bayanjargalan	2009	57	35	10	22.8	3	5.3	0	0.0
	Mandalgovi-Gurvansaikhan	2009	66	35	2	3.0	7	10.6	5	7.6
	Büren-Erdenesant	2009	57	35	8	14.0	6	10.5	0	0.0
	Dashinchilen	2009	15	35	3	20.0	0	0.0	2	13.3
	Total		**281**		**28**	**10.0**	**16**	**5.7**	**17**	**6.0**

[a] includes two nests that were on artificial platforms.
[b] includes one nest on an artificial platform.

Table 2. Number of poles with and without active nests (Common Raven, Upland Buzzard, Saker Falcon, and Eurasian Kestrel) on different types of poles on *Tall* (n = 6 lines, 246 km survey length) and *Wooden* lines (n = 3 lines, 107 km survey length). On these lines all poles were counted, whereas on the other lines not included in this analysis only poles that held active nests were recorded.

Type of Line	Concrete Pole		Metal Pylon			Single Pole		A-frame Pole		
	No Nest	Nest (%)	No Nest	Nest (%)	P	No Nest	Nest (%)	No Nest	Nest (%)	P
Tall	643	21 (3.2)	23	41 (64.1%)	<0.0001					
Wooden						494	0 (0.0)	15	9 (37.5)	<0.0001

metal pylons than on concrete poles (χ^2 with Yate's correction = 270.1, df = 1, $P < 0.001$), whereas on *Wooden* lines there were significantly more nests on 'A-frame' poles than on single poles (χ^2 with Yate's correction = 167.2, df = 1, $P < 0.001$). Common Ravens and Upland Buzzards preferred to build their nests in situations that were both well-supported and well-sheltered. On metal pylons, nests were situated in a corner of the central stem at the height of one of the crossarms, where they were supported by horizontal metal bars and sheltered by bracing plates, which were only found at points on the stem supporting crossarms (Fig. 4). By contrast, nests constructed on the braced metal crossarms of concrete poles were extremely exposed and poorly supported; less frequently birds nested on the top of the concrete pole (6 of 21 nests on concrete poles). On the 35 kV *Wooden* lines, nests on the A-frame anchor poles were all supported on the wooden crossarm and sheltered between two bracing beams and the apex of the A-frame struts (Fig. 4).

The breeding density of raptors was broadly similar on *Tall* and *Wooden* lines, with an average of 23 and 22 active raptor nests per 100 km, respectively (Table 1). There were no significant differences in the breeding densities of any species on *Tall* and *Wooden* lines, though Common Raven breeding density tended to be higher on *Tall* lines than on *Wood-*

Figure 4. Images illustrating the sheltered positions preferred by nest-building species on metal pylons and double-braced wooden A-frame anchor poles. (A) Five Common Raven nests (arrows; active nest at top right), all built in sheltered locations in corners of main stem next to bracing plates at the height of the crossarm on a metal pylon. An artificial nesting barrel erected in a safe location below the height of energized cables is shown. (B) Saker Falcon at a nest originally built by an Upland Buzzard, which is sheltered by the double-bracing beams of the crossarm and the apex of the supporting struts on an A-frame anchor pole of a 35-kV *Wooden* line.

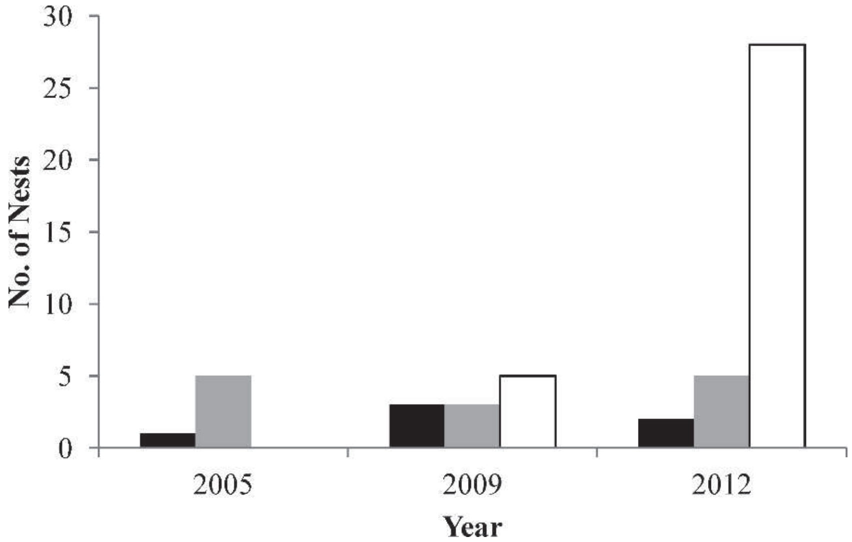

Figure 5. Number of raptors and corvids breeding on a 46-km stretch of a *Tall* line pre-(2005) and post-provisioning of 25 artificial nests (2009; 2012). Black bars = Saker Falcon, gray bars = Common Raven and white bars = Eurasian Kestrel.

en lines with nests every 8.7 and 16.5 km, respectively ($U = 18$, $P > 0.05$). Upland Buzzard breeding density tended to be lower, with nests every 28.8 and 17.6 km, respectively ($U = 26.5$, $P > 0.05$). Saker Falcon density was broadly similar on *Tall* and *Wooden* lines with nests every 12.4 and 10.0 km, respectively ($U = 28.5$, $P > 0.05$).

Artificial nest platforms were present on two of the 16 lines we surveyed (Table 1). These platforms had been erected by Mongolian researchers in previous years and included wire mesh platforms and vehicle tires that were lashed to the poles (Gombobaatar et al. 2005). On the *Tall* line, six of the eight artificial platforms were erected on metal pylons with no apparent effect on the frequency of nesting by raptors: two held breeding pairs in 2005 and one in 2006. By contrast, the two artificial platforms on concrete poles both held active nests (Table 1). On the 35-kV *Wooden* line, the five artificial platforms were all placed on 'A-frame' poles and none of the platforms held active nests; (Fig. 2C); birds preferred to use the higher, more sheltered location at the apex of the pole.

Artificial Nests as Additional Nest Sites. The provision of additional nest sites through the placement of artificial nest barrels did not increase the density of large raptors and corvids nesting along a 46-km stretch of *Tall* line, though they did enable Eurasian Kestrels to begin breeding along the line (Fig. 5).

By contrast, in an opportunistic survey along 51 km of a 10-kV *Wooden* line, 8 of 14 artificial nest platforms on 'A-frame' poles were occupied by breeding pairs compared with none of 11 similar poles without nest platforms. Apart from the artificial nest platforms, which consisted of tire rims lashed to the horizontal brace of A-frame poles, there were very few opportunities for nest-building species to construct their nests on this type of *Wooden* line (see Fig. 2D). The eight active nests on artificial platforms included four Common Ravens, three Upland Buzzards, and a Saker Falcon.

Artificial Nests as Alternative Nest Sites. The provision of alternative safe nesting sites on metal pylons, which are favored by nest-building species, had no effect on the use of stick nests in dangerous sites elsewhere on the same pylon, as none of the artificial nest barrels were used by nest-building species or Saker Falcons in 2009, the year following erection of the alternative sites. Of 23 metal pylons with alternative artificial nest barrels, 15 also held active stick nests (65%) of Common Ravens ($n = 8$), Saker Falcons ($n = 4$) and Upland Buzzards ($n = 3$), while the other eight pylons held no stick nests. In the subsequent 2012 survey, we found one of the alternative artificial nest barrels used by a breeding pair of Common Ravens and another by Saker Falcons, and 10 other metal pylons held active stick nests of Common Ravens ($n = 4$), Saker Falcons ($n = 5$)

and an Upland Buzzard, while the other 11 pylons held no stick nests.

However, in 2009 and 2012, 10 and 7 artificial nest barrels were used by breeding Eurasian Kestrels (43% and 30% respectively). Five of these were on the same pylon as a nest-building species (four with Common Ravens and one with an Upland Buzzard).

DISCUSSION

Breeding Raptors on Power Lines. The breeding densities of raptors on *Tall* and *Wooden* lines was broadly similar (an active nest every 4.3 and 4.6 km, respectively), despite the fact that there was a higher density of preferred nesting poles ('A-frame' poles every 3–4 km) on *Wooden* lines compared to *Tall* lines (metal pylons every 6–7 km). On *Tall* lines, nest-building species could also build nests on the crossarm or on top of concrete poles between the preferred metal pylons, but on *Wooden* lines there were no potential nesting places on single poles between the 'A-frames' along the lines. Common Ravens tended to breed at higher density on the taller pole structures of *Tall* lines, whereas Upland Buzzards appeared to prefer the lower and well-sheltered nesting locations at the apex of 'A-frame' poles on *Wooden* lines, though these differences were not statistically significant. For Saker Falcons the primary factor appeared to be the availability of a stick nest, built either by a Common Raven or an Upland Buzzard, rather than the type of nesting pole, as there was no significant difference in breeding density between *Tall* and *Wooden* lines.

On the favored metal pylons of *Tall* lines, shelter is clearly important as nests were only found on the main stem at the junction of crossarms where additional shelter was provided by bracing plates, whereas horizontal support was found at all heights on the main stem of the pylon. Similarly, on *Wooden* lines, shelter was an important factor as nests were found exclusively in the most sheltered position at the apex of the pole. The shelter provided by support struts and bracing beams also provided additional vertical structural support for nests.

The presence of stick nests built by Common Ravens and Upland Buzzards was normally a prerequisite for both Saker Falcons and Eurasian Kestrels to breed on the power lines we surveyed. Exceptions occurred where Saker Falcons nested in the hollow top of concrete poles on *Tall* lines ($n = 4$) and when breeding Saker Falcons and Eurasian Kestrels used artificial nesting platforms and barrels.

Artificial Nests as Additional Nest Sites. Artificial nest barrels and platforms are likely to be most effective at attracting nesting raptors when placed on power line support structures that do not already offer good substrates for nest-building species, such as concrete poles of *Tall* lines and single poles of *Wooden* lines. This was most evident on the 10-kV *Wooden* line we surveyed, where all eight raptor nests were on artificial platforms, as there were few alternative nesting locations available to nest-building species on the poles associated with this type of line. However, we were not able to increase the breeding density of large raptors through the provision of artificial nest barrels on a 46-km section of *Tall* line, presumably because the preexisting density was not limited by nest site availability, but by some other factor, such as territorial behavior determined by local food availability (Newton 1979). As a caveat, we note that our sample size was relatively small (25 artificial nest sites provided). Saker Falcons, Common Ravens, and Upland Buzzards readily occupy similar artificial nest barrels placed in open steppe habitats (Dixon et al. 2011); thus we feel confident that the artificial nest barrels placed on power lines were not unsuitable in some way.

The provision of artificial nests on power lines is a conservation management technique employed to enhance breeding populations of the globally threatened Saker Falcon in Europe (e.g., Bagyura et al. 2009), primarily by increasing breeding success (Bagyura et al. 2004, but see Klein et al. 2007, Balázs 2011). To our knowledge, the effectiveness and conservation value of this management technique in terms of artificially increasing nest site availability for Saker Falcons has yet to be evaluated in Europe, where, in some regions, the density of breeding Common Ravens on power lines can reach 2.5 pairs per 10 km of line (Agić 2006). In Mongolia, the availability of nest sites does not appear to limit nesting densities of Saker Falcons on the *Tall* and *Wooden* lines we surveyed, as they can evict Common Ravens and Upland Buzzards with apparent ease (A. Dixon unpubl. data). Thus, the provision of artificial nests on these types of power lines is unlikely to significantly increase nesting densities. However, targeted use of artificial nests on lines with relatively few suitable support structures for nest-building species, or in areas where suitable stick nests are few or lacking, could be more effective at increasing Saker Falcon nesting opportunities.

Artificial Nests as Alternative Nest Sites. In the vast unforested regions of central, southern, and eastern Mongolia, sticks for nest-building are scarce, so nest-building species such as Common Ravens and Upland Buzzards frequently use large amounts of bones and other trash in their nests (Ellis and Lish 1999). The cloth and twine trash incorporated into these nests regularly result in entanglement mortality; the metal wire brought to these nests by Common Ravens and Upland Buzzards sometimes causes power outages. Consequently, power line managers in Mongolia periodically remove nests from the power poles, usually in the breeding season when access conditions are most favorable. This very often results in the failure of nesting attempts (Gombobaatar et al. 2004). Our attempts to encourage nest-building species to use artificial nests in safe locations on metal pylons failed. Nevertheless, the technique may still have merit if the original stick nests are removed and/or the provision of alternative, safe artificial sites is combined with nest excluders in unsafe locations. Any future trials of safe artificial nest sites in conjunction with nest excluders should be carried out on metal pylons of *Tall* lines and A-frame poles of 35 kV *Wooden* lines, the most favored pole types used by nest-building raptors and corvids.

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