Chapter 4
Commodification of the Saker Falcon *Falco cherrug*: Conservation Problem or Opportunity?

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Conservation Status of the Saker Falcon

Distribution. The Saker Falcon (*Falco cherrug*) has a Palearctic breeding distribution (see map in Kovács et al. 2014), with its western limit in the lowlands of Central Europe, extending eastwards via fragmented or highly dispersed populations through Romania, Moldova, Ukraine, southwest Russia and Turkey to the open and mountainous landscapes of Central Asia. Here, breeding Saker Falcons can be found from the semi-deserts and deserts of Iran and Afghanistan, through the former Soviet Central Asian states to the southern steppes of Russia bordering Kazakhstan and Mongolia. A larger and generally contiguous population breeds throughout Mongolia, and across a large swathe of grassland and desert in China eastwards from the Qinghai-Tibetan plateau and Xinjiang to the eastern distribution limit of the species in Heilongjiang. Saker Falcons are 'partial migrants' and the proportion of birds making migratory movements differs between regions and across age classes, with birds tending to be more sedentary in the south and adults less likely to make long-distance migratory movements than juveniles (Baumgart 1978; Prommer et al. 2012). Migratory Saker Falcons typically move to more southerly wintering areas, either within the breeding distribution range of the species or beyond to North and sub-Saharan Africa, the Middle East and the Indian subcontinent (Orta et al. 2014).

Conservation status. The Saker Falcon has the dubious honour of being the only species in the genus *Falco* that is categorized as Globally Endangered on the IUCN Red Data List (Table 4.1). Following decline in the twentieth Century, the Saker Falcon population of the Pannonian Basin in Central Europe has been the focus of conservation efforts and has subsequently increased in recent decades (Chavko 2010;

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Table 4.1 IUCN Red List estimates of global population size (breeding pairs) of the Saker Falcon, median (minimum and maximum), and percentage population change over three generations, median (range)

Country (region)	Population size	% Change (range)
Mongolia	3464 (1765–5300)	−9.5 (−69.9 to +75.0)
Russia	1972 (1617–2345)	−64.7 (−73.2 to −53.9)
China	2851 (823–5262)	−38.8 (−84.6 to −48.6)
Kazakhstan	1046 (729–1370)	−75.4 (−83.2 to −66.6)
Ukraine	335 (288–383)	+128.5 (+87.9 to +175.6)
Hungary	194 (186–203)	+78.6 (+72.1 to +85.2)
Turkmenistan	125 (96–156)	0.0 (−32.2 to +47.6)
Other (Europe)	190 (119–287)	−14.1 (−49.8 to +90.4)
Other (Asia)	265 (71–725)	−60.4 (−90.3 to +58.0)
Total	10442 (5694–16031)	−47.6 (−75.2 to −2.3)

Data from the 2012 assessment by BirdLife International

Bagyura et al. 2012), whereas large-scale declines witnessed in the Balkans and Pontic-Caspian steppe have led to regional breeding extinction, e.g. Bulgaria and the Southern Federal District of Russia (Dixon et al. 2009; Ragyov et al. 2014) or diminished populations, e.g. across the steppic plains of Moldova, Ukraine and Crimea (Milobog et al. 2010). Accurate information on population status and trends is lacking for most Asian states, but there is evidence of significant declines in Kazakhstan, beginning during the Soviet-era in the west and then across most of the country following independence in 1991 (Levin 2011). Following dissolution of the USSR, similar population declines have taken place in the Russian Federation and probably also in other former Soviet states of Central Asia (Karyakin 2008). Nevertheless, large breeding populations exist in Mongolia, where numbers have probably increased, and across extensive areas of China, e.g. the Qinghai-Tibetan plateau (Dixon 2009).

The degree of spatial and temporal variation in the magnitude, rate and extent of population declines across the former Soviet states is largely unknown, as are the principal causal factors. For the observed population declines in Kazakhstan and Russia, speculation primarily focuses on the direct impact of trapping for the Arabian falconry trade and the indirect impact of electrocution at electricity distribution lines, together with wide-scale habitat change resulting from socio-economic changes in recent decades (Kenward et al. 2007; Kovács et al. 2014).

Saker Falcons and the Falconry Trade

Falconry is a deep-rooted and culturally significant practice in the Arabian Gulf, especially in Saudi Arabia, United Arab Emirates, Qatar, Kuwait and Bahrain. Falconry is recognized by UNESCO as part of humanity's 'Global Intangible Cultural Heritage' (Ceballos 2009; Wakefield 2012), and Saker Falcons are traditionally the main species used in Arabic falconry (Allen 1980; Upton 2002). Falconry is popular at all levels of society in the Gulf States and its influence extends to the wider Middle East, Central Asia and the Maghreb where hunting with falcons and trapping of falcons takes place. The demand for Saker Falcons from wealthy falconers in the Gulf States of Arabia has created a lucrative market (Seddon and Launay 2008). The demand for falcons in Arabic falconry is met by captive breeding and by harvesting from the wild, which can either be regulated and legal or unregulated and illegal (Dixon 2012). Trapping within end-user states in the Arabian Peninsula occurs but the main source of falcons comes through legal and illegal international trade (Barton 2000; Riddle and Remple 1994). The legal trade in both captive-bred and wild-harvested falcons is regulated by the Convention of International Trade in Endangered Species (CITES), whereas the extent of illegal trade is regulated by the efficacy of law enforcement.

Whilst traditional autumn trapping of 'passage' falcons for Arabian falconry has taken place for millennia the geographic scope, scale and nature of trapping has increased. However, we still have a very limited understanding of the drivers of the market resulting from the commodification of the Saker Falcon. On the supply side, the socio-economic upheaval associated with the dissolution of the Soviet Union is believed to have stimulated a surge in the supply of wild-caught Saker Falcons from Central Asian states that were formerly outside the geographic scope of the Arabian falconry market. In countries such as Kazakhstan and Kirghizstan, more people engaged in falcon trapping as a source of income and borders were opened to foreign trappers and traders (Levin 2011). The demand for wild-caught Saker Falcons in Arabian falconry was large enough to accommodate the increased supply from the newly opened source countries of the former Soviet Union. However, it is unlikely that such an illegal trade can be limited by market equilibrium because a lower price resulting from a surplus or increased supply will still be profitable when the marginal costs of trapping wild Saker Falcons are minimal and can further be absorbed by increasing supply chain efficiency. There is evidence to suggest that the illegal falcon trade has indeed evolved in such a way, becoming more organized and co-ordinated over time (Wyatt 2009). Furthermore, the trapping period has extended from the time of autumn passage when migrating birds were targeted, into the breeding season in the former Soviet states of Central Asia, and now includes the trapping of breeding birds and the removal of eggs and chicks from nests (Kenward et al. 2007).

In most range states, the trapping and trade of wild Saker Falcons is illegal under national laws (Kovács et al. 2014). Notable exceptions exist, including Saudi Arabia, which allows trapping and trade of wild Saker Falcons within the country and Mongolia, which issues permits for their harvest and international trade within CITES regulations. This legal, regulated trade involves trapping free-flying birds after the breeding season either during migration (as in Saudi Arabia; Shobrak 2014) or during post-breeding and post-fledging dispersal (as in Mongolia; Dixon et al. 2011). The development of the Mongolian Saker Falcon trade for the Arabian falconry market presents an interesting case study, providing insights into the conservation, ecological, economic and social aspects of this particular 'wildlife problem'.

Case Study I: The Mongolian Saker Falcon Trade

Transition from a National to an International 'Wildlife Problem'

The Mongolian Saker Falcon trade developed following the Democratic Revolution of 1990, when the harsh economic conditions of the early 1990s and the potential of international trade to the Gulf States provided the incentive for 'entrepreneurial' ornithologists to initiate a relatively small-scale private trade in wild-caught Saker Falcons. However, by the time the Mongolian government had become a signatory to CITES in 1996, this trade had been appropriated by the state and was controlled and regulated by government officials. Despite, or perhaps because of, governmental control together with an absence of transparency and accountability, the Saker Falcon trade became mired in controversy over issues of corruption and criminality. There were numerous media stories circulating about the trade and the issue became *cause célèbre* (Kohn 2006), where the protagonists in the debate freely exchanged a range of credible, specious and spurious accusations, making any reasonable assessment of the true position virtually impossible. This controversy resulted in the national and international conservation community looking askance at the Mongolian Saker Falcon trade (e.g. Boldbaatar 2009; Zahler et al. 2004), which no doubt contributed to its chequered history with CITES and other multilateral environmental agreements.

The CITES Review of Significant Trade

It was no mere coincidence that at its Asian regional meeting in Ulaanbaatar, Mongolia in August 2002, the CITES Secretariat proposed to organize a consultative meeting on the trade in falcons for falconry, a meeting that was subsequently held in Abu Dhabi, UAE in May 2004. At that time, the UAE had recently been subject to a CITES trade suspension, which had been withdrawn in 2002 following implementation of a series of measures, including a system of falcon registration. A heightened awareness of CITES trade issues, together with data on the scale of the falcon trade to the Gulf states and some preliminary survey data of wild Saker Falcon populations in Mongolia was the catalyst for a report from the CITES Scientific Authority of the UAE to the CITES Animal Committee in August 2003. This report resulted in the Saker Falcon immediately entering the CITES Significant Trade review process.[1] By its meeting in May 2005, the Animals Committee had provisionally categorized Saker Falcon range states as being of (1) least, (2) possible or (3) urgent concern with regard to engaging in trade that could be detrimental to the survival of the species and where monitoring of this trade may be inadequate.

[1] http://www.cites.org/eng/com/ac/19/summary_record.pdf

Mongolia was considered to be of 'urgent concern', having serious problems with regulating its trade in wild-caught Saker Falcons.[2]

Mongolia and eight other countries considered to be of 'urgent concern', were urged to suspend the issuance of export permits for Saker Falcons by September 2005 and, if they wished to resume the trade, conduct research on the distribution, abundance, population trends and threats facing the species in the country, and furthermore develop a science-based monitoring system and establish an adaptive management programme for the harvest and trade of Saker Falcons. In September 2005, the Mongolian government informed CITES that no further export permits would be issued until the problem of the Saker Falcon trade was 'resolved at the Animals Committee through the Secretariat'. Consequently, a notification was issued to all CITES Parties that Mongolia had suspended the issuance of export permits for Saker Falcons.[3] In the same year, the Mongolian government issued an order (#248) to regulate trapping and taking of wild Saker Falcons for research and scientific purposes, and to establish procedures for assessing the ecological and economic consequences of a harvest.

Meanwhile, apparently oblivious to their commitment to suspend the trade, the Mongolian government continued to issue CITES permits for the harvest and export of Saker Falcons. This dichotomous approach reflected, at least in part, a lack of capacity within the Mongolian government to adequately administer their obligations to the CITES convention and the absence of a formal structure of governance of the Saker Falcon trade. Alerted by press coverage in Mongolia, the CITES Secretariat made enquiries to the Mongolian CITES Management Authority and were informed that 167 and 407 Saker Falcons had been exported in 2006 and 2007, respectively, and that a quota of 300 specimens per year had been established based on the results of four surveys undertaken in the previous 6 years. Not satisfied that Mongolia was complying fully with the CITES recommendations, a trade suspension in relation to Saker Falcons was implemented in January 2009.[4]

A workshop meeting convened in Abu Dhabi in April 2009 at the request of CMS (see later), provided a forum where details of the Mongolian conservation management programme being developed by the Environment Agency—Abu Dhabi (EAD) could be transmitted to the CITES Secretariat. Consequently, the recommendation to suspend trade with Mongolia was withdrawn on condition that Mongolia maintained an export quota of 300 specimens in 2009 and 2010, before establishing a quota for 2011.[5] Subsequently, in July 2011, a report was presented to the CITES Animals Committee in Geneva detailing the conservation management activities being undertaken in Mongolia under an MoU between EAD and the Mongolian Ministry of Nature, Environment and Tourism (MNET), which outlined a programme for establishing a sustainable Saker Falcon harvest based on the use of artificial nest sites. CITES endorsed the positive management regime, agreed to an

[2] http://cites.org/sites/default/files/eng/com/ac/21/E21-10.1.1.pdf

[3] http://cites.org/sites/default/files/eng/notif/2006/E061.pdf

[4] http://www.cites.org/eng/notif/2009/E003.pdf

[5] http://www.cites.org/sites/default/files/eng/com/sc/58/E58-21-1.pdf

export quota of 300 Saker Falcons for 2011 and concluded the significant trade review, enabling Mongolia to set its own future harvest quotas.[6]

IUCN Red List, CMS Appendix I Listing and the SakerGAP

The document issued by the UAE in 2003 that instigated the CITES Significant Trade Review also triggered a review of the status of the Saker Falcon on the IUCN Red List of Threatened Species. Relying heavily on much of the survey data gathered and collected by the UAE, BirdLife International, the official listing authority for birds for the IUCN Red List, revised the status of the Saker Falcon from 'Least Concern' to 'Endangered' in 2004. Thus, whilst remaining on Appendix II of CITES, as a species that 'may become threatened with extinction unless trade is closely controlled', the Saker Falcon was now considered to be 'facing a very high risk of extinction in the wild' by the International Union for Conservation of Nature (IUCN).

In December 2008, there was a proposal to include the Saker Falcon on Appendix I of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), which would have the effect of prohibiting a harvest of this species in Mongolia. The proposal was not adopted, but there was a resolution recommending that the species should be listed on Appendix I if the Saker Falcon was considered to be 'Threatened' in the IUCN Red List by the time of the next Conference of Parties in 2011. The resolution further recommended that Parties to CMS should support a workshop to consider the status and conservation needs of the species, to be held in the UAE in 2009. The role of the UAE, or more specifically Abu Dhabi, in the political machinations surrounding the Mongolian Saker Falcon trade was not because they were a major market for the trade (in fact very few Mongolian birds were destined for the emirate), but because the Environment Agency-Abu Dhabi (EAD) had been engaged in research for several years to investigate the potential of developing a conservation management strategy for the Saker Falcon in Mongolia (see Dixon et al. 2011).

As the Review of Significant Trade process came to a conclusion with CITES, the issue of the Saker Falcon was still very much alive with CMS. The IUCN Red List review initiated in response to the CMS resolution in Rome resulted in the Saker Falcon being downlisted from Endangered (EN) to Vulnerable (VU) in 2010. However, this revised status didn't last long, as BirdLife International undertook another review the following year, this time as part of the mandatory IUCN review process, and restored the former Endangered status as a precautionary measure. Whether classified as EN or VU, the Saker Falcon was still regarded as Globally Threatened, thus the proposal to list the species on Appendix I of CMS was made at the Tenth CMS Conference of Parties in Bergen in November 2011. However, in order to reflect the decision of CITES a few months earlier, the proposal was

[6] http://www.cites.org/eng/com/ac/25/sum/E25-SumRec.pdf

amended to exclude the Saker Falcon population in Mongolia. The proposal was accepted after some debate and was accompanied by another resolution establishing a Saker Falcon Task Force to produce a Global Action Plan for the species. In August 2014, the CMS Saker Falcon Global Action Plan (SakerGAP) was published, a document of over 200 pages that incorporates a management and monitoring system for the species (Kovács et al. 2014).

The Mongolian 'Commercial' Trade Suspension

Having commanded international attention for several years, in 2012 attention was again focused at a national level in Mongolia. Following parliamentary elections in the summer, in November 2012 the Saker Falcon was officially declared to be the national bird of Mongolia. The Saker Falcon was selected after coming top of a poll organized by the National University of Mongolia. Shortly after, amid turbulent debate about the exploitation of national resources, the Mongolian government used the designation of the Saker Falcon as the national bird to announce that it was implementing a 5-year moratorium on the 'commercial trade' in the species. However, what exactly constitutes 'commercial trade' is unclear: in 2013 and 2014 Mongolia continued to host international falcon trappers and provide CITES permits for the harvest and export of Saker Falcons. In 2013, it was announced in the Mongolian media that the Government would permit the export of 20 falcons to Qatar and Kuwait, whilst in 2014 licenced falcon trappers were again operating in Mongolia with unconfirmed reports of at least 30 birds exported to recipients in Dubai, Kuwait and Qatar (Table 4.2).

Conservation Management and the Potential for a Sustainable Harvest of Saker Falcons in Mongolia

The intense, and sometimes rancorous, debate about the Mongolian Saker Falcon trade in national and international forums was not particularly conducive to the establishment of conservation management projects for the species. From 1994, foreign researchers conducted expedition surveys (e.g. Ellis et al. 1997, 2010, 2011) with some experimentation in the use of artificial nest structures from 1997, initially using power poles as support structures (Ellis 2010), then later specially constructed 'tripods' in flat, open landscapes (Potapov et al. 2003). Over a decade, the raw data upon which so much of the debate about the Saker Falcon trade revolved was primarily based on rather piecemeal and unsystematic surveys (Gombobaatar et al. 2007). Whilst the existing survey data was clearly inadequate, it was unlikely that accurate population estimates would ever be achieved given the logistical constraints of surveying in Mongolia, but the preliminary work on artificial nests did offer the opportunity of developing a more extensive management programme for

Table 4.2 Number of wild-caught Saker Falcons reported as exported from Mongolia (2000–2013) based on data from the UNEP-WCMC CITES Trade Database

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Kuwait	50	102	121	171	180	131	41	141	185	151	105			
Saudi Arabia			87	85	77	151	100	60	30	25				
Qatar			15	82	49	5	26	40	51	81	88		39	
Syria		10	75	54	49	73								
UAE		75		10	30					35	44			
Non-Gulf			20											
Totals	50	187	318	402	385	360	167	241[a]	266	292	237	0[b]	39	0[b]

[a] Mongolian CITES Management Authority reported the export of 407 Saker Falcons to the CITES Secretariat in 2007
[b] Exports of Saker Falcons took place but no data available on quantity

the species. Thus, over a 5-year period from 2005 to 2009, a pilot study was established by EAD to examine the potential of using artificial nests to create readily monitored breeding 'populations' in nest-site limited habitats (Dixon et al. 2011; Rahman et al. 2014).

The programme set out to create a new, managed breeding population occupying artificial nests that are amenable to monitoring, which can provide the data required to determine a sustainable harvest quota. A monitored population occupying artificial nests can provide data on breeding productivity (incorporating annual and regional variation), adult survival and breeding dispersal (based on breeding turnover), natal recruitment and dispersal, and the age composition of the breeding population. These vital statistics can be used to accurately model a sustainable harvest quota based entirely on the managed and monitored population.

The Creation of a New, Managed and Monitored Breeding Population Occupying Artificial Nests

The 2005–2009 pilot study utilized artificial nesting boxes made from metal drums that were erected on metal poles at a height of 2.5 m (Fig. 4.1). Breeding density and productivity levels recorded during this pilot study suggested that at least 5000 artificial nests would be required to create a new Saker Falcon breeding population that could contribute to a viable and sustainable falconry harvest. In 2009, work began to identify areas of the central Mongolian steppe that could accommodate 5000 artificial nests. The decision was made to allocate 250 nests to each of 20 districts across five provinces, with the precise locations being determined after field surveys and a consultation meeting with district administrators (Fig. 4.2). Each district had one or two grids of nests spaced at 1.5 km intervals in areas of open steppe where few natural nest sites existed, which limited any breeding population of Saker Falcons. Nonetheless, the selected areas held prey resources, in the form of small mammals and birds, which probably supported a pre-existing non-breeding population of Saker Falcons as predicted for nest-site limited raptor populations (Newton 1979).

The erection of 5000 artificial nests was completed in 2010 and annual monitoring began the following year to record occupancy and breeding success of Saker Falcons. The number of Saker Falcons breeding in the artificial nests increased annually over the first 4 years until 2014 (Fig. 4.3). The observed incremental annual increase during the initial 'colonization phase' is predicted when the breeding population in the artificial nests is derived primarily via 'limited' recruitment from a local non-breeding population, rather than by 'unlimited' immigration via breeding dispersal from pre-existing populations elsewhere. Saker Falcons breeding at artificial nests in the Mongolian steppe produce an average of 3.2 (±0.3) fledglings per nesting attempt (Rahman et al. 2014). In 2014, the newly created, managed and monitored population breeding in artificial nests produced in the region of 2500 fledglings; this number may increase further if the 'colonization phase' continues. The existing programme has demonstrated that Saker Falcons can be practicably managed at a scale amenable to developing a sustainable harvest.

Fig. 4.1 Pair of Saker Falcons at an artificial nest in the Mongolian steppe, Sukhbaatar province

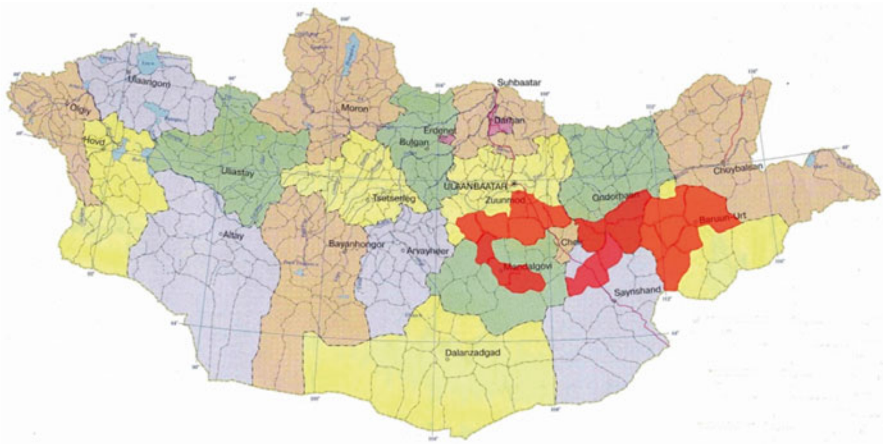

Fig. 4.2 Map of Mongolia showing districts where artificial nests were erected (*shaded red*; *N*=250 nests per district). Dornogovi province: Airag, Ikhkhet; Dundgovi province: Adaatsag, Saintsagaan/Mandalgovi, Gurvansaikhan; Khentiy province: Bayankhutag, Galshar, Bayanmunkh, Darkhan; Sukhbaatar province: Bayandelgar, Khalzan, Tuvshinshiree, Munkhkhaan, Uulbayan, Sukhbaatar and Töv province: Bayantsagaan, Bayan, Bayanjargalan, Bayanunjuul, Buren

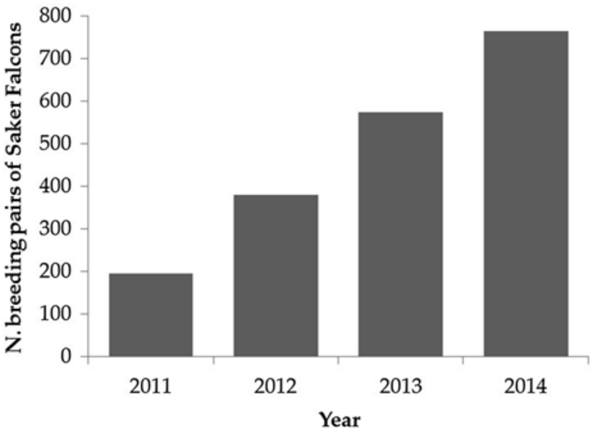

Fig. 4.3 Number of breeding pairs of Saker Falcons occupying artificial nests in Mongolia since their establishment in 2010

Saker Falcons and Electrocution at Power Lines

The expansion of electricity supply is synonymous with the socio-economic development of nations, and the last century has seen a dramatic and rapid increase in electricity infrastructure across the globe, including the erection of a vast network of electricity transmission and distribution lines. An electricity network typically comprises a series of high voltage transmission lines extending from a generation source, that then, via transformers, branches into lower voltage distribution lines that deliver power to human settlements and industrial centres. As more locations become connected to the power grid, the network of distribution lines grows, and it is these low- to medium-voltage distribution lines (≤15 kV) that pose the greatest electrocution risk to birds (Lehman et al. 2007). Birds that are large enough to span the distance between two phase conductor cables, or which are large enough to touch one phase conductor cable whilst standing on a grounded perch are electrocuted at power poles. Consequently, larger birds are more prone to electrocution than smaller birds, and the risk is higher for birds that frequently perch in elevated positions, such as raptors that use power poles as vantage points for hunting ground-dwelling prey (Bevanger 1998; Lehman et al. 1999; Janss 2000).

Medium-voltage electricity distribution lines can, where pole hardware is inappropriately configured, present a serious electrocution risk for birds of prey. The issue is considered to be serious enough for CMS to review the problem and produce guidance for mitigation (Prinsen et al. 2011a, b). Mitigation techniques are available to reduce the risk of electrocution for birds of prey at existing dangerous electricity distribution lines, which include deterrents that are designed to prevent birds perching in high-risk locations, insulation covers for live phases and reconfiguration of cable-carrying hardware. However, a lack of knowledge about the issue among executives and engineers responsible for power lines, together with the exigencies of cost efficiency has meant that in many circumstances mitigation, or even the initial deployment of raptor safe power lines, receives little attention. Furthermore, and somewhat surprisingly, the efficacy of the various mitigation techniques has received relatively little attention from researchers (but see Janss and Ferrer 1999; Guil et al. 2011), thus it is difficult for power line engineers and executives to make a cost v benefit assessment of commercially available mitigation products.

The Saker Falcon is a large bird of prey that occupies open landscapes and it often hunts small ground-dwelling mammals, using power poles as elevated perch sites in habitats where alternative perch sites for hunting are scarce. Consequently, the species is particularly at risk from electrocution at power distribution lines, and electrocution events are known to occur throughout the global breeding distribution of the species. Electrocution is highlighted as a mortality factor for Saker Falcons in Europe (Ragyov et al. 2012), whilst surveys in Russia, Kazakhstan, Mongolia and China indicate that many lines pose a significant risk and that mortality levels are high in Asia (Karyakin et al. 2008; Lasch et al. 2010; Dixon et al. 2013). The following case study reports on the scale of Saker Falcon mortality due to electrocution in Mongolia, which results in losses an order of magnitude greater than that arising from the Saker Falcon trade discussed earlier. I further discuss how the commodification of the Saker Falcon, often considered to be a ‘wildlife problem’, may in fact provide a mechanism whereby the species can generate the finances to pay for its own conservation.

Case Study II: Electrocution of the Saker Falcon in Mongolia

Factors Influencing Saker Falcon Electrocution Rates in Mongolia

Electrocution rates can be expressed in various ways, such as the number of birds killed per *N* poles or per *N* km of power line over a specified period of time. These rates can be determined by the integral structure of the power pole hardware, with some poles posing a higher risk of electrocution than others, whilst additional extraneous factors can also play a significant role such as surrounding landscape and habitat characteristics, and temporal or spatial variation in the number of birds exposed to the electrocution risk (Guil et al. 2011). Measuring these rates is further complicated by the fact that accurate quantification of electrocution events is dependent on search effort, efficacy and rates of carcass removal by scavengers (Ponce et al. 2010). Consequently, despite the geographical widespread nature of bird of prey electrocution and the large number of research studies undertaken, there are still relatively few studies that report quantitative measures for electrocution rates (Lehman et al. 2007).

Fig. 4.4 Adult male Saker Falcon electrocuted at an anchor pole with a jump wire passing over the crossarm, Mongolia March 2012

Pole design has been shown to be the main factor accounting for variation in electrocution rates between power poles, for example, grounded anchor poles with jump wires that pass over crossarms are especially dangerous for raptors (Fig. 4.4). Predictive models of avian electrocution risk at power lines typically incorporate parameters such as pole type and hardware configuration, as well as geographical location, surrounding habitat and topography, and prey availability (e.g. Tintó et al. 2010; Dwyer et al. 2013; Harness et al. 2013). However, the predictive ability of such models to identify priority high risk lines can be compromised if prey availability varies greatly in time and space. Prey abundance in the vicinity of power lines can influence electrocution rates by attracting birds of prey, where they may use the power poles as perches for hunting or loafing (Lammers and Collopy 2007). Diurnal small mammals prevalent in the Mongolian steppe, such as Brandt's Vole (*Lasiopodomys brandtii*), Mongolian Gerbil (*Meriones unguiculatus*) and Daurian Pika (*Ochotona dauurica*) exhibit large population fluctuations (Smith and Xie 2008), and their abundance can vary greatly over time and space.

Scale of Electrocution of Saker Falcons in Mongolia

How many Saker Falcons are electrocuted in Mongolia each year? This simple question does not have a simple answer. In the open steppe, the most important factor is the concomitance of abundant small mammal populations and dangerous power poles. Single-visit power line surveys targeted at 15 kV lines with poles known to be of a dangerous design, i.e. grounded steel-reinforced concrete poles

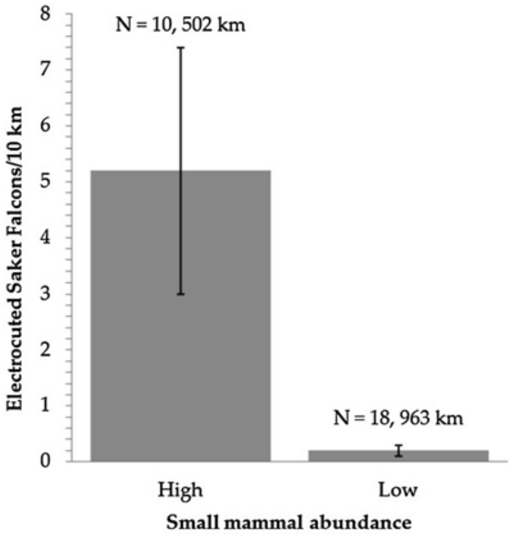

Fig. 4.5 The number of Saker Falcon carcasses found per 10 km during single-visit power line surveys across the Mongolian steppe in early autumn. Standard error bars are shown. *N* = the number of power lines surveyed, with their total distance (km). Local abundance of small mammals was assessed qualitatively as 'high' or 'low', based on the number of holes and animals seen during the survey visit

with metal crossarms, were conducted across Mongolia in late August 2014. During these surveys, 317 electrocuted carcasses of Saker Falcons were found below poles at power lines in areas of open steppe where small mammal densities were classified as high, yet just 25 were found at power lines where small mammal density was low (Fig. 4.5). Each carcass, based on its state of decay, was considered to have been electrocuted within the previous month (see Dixon et al. 2013).

Single-visit line surveys, whilst enabling extensive geographical coverage to allow comparison of power lines at a national scale, can only provide absolute minimum estimates of electrocution rates as it is not possible to take into consideration carcass removal by scavengers. However, high frequency survey visits can limit the influence of carcass removal on electrocution rate estimates. An additional study conducted over a 592 days with an average survey frequency of 1.1 days found 251 Saker Falcon carcasses at poles on a 26 km stretch of power line running through an area of the Mongolian steppe with a high density of small mammals. This survey found that in August, Saker Falcons were electrocuted at a mean rate of 8.5 (SE ± 5.2) birds per 10 km, which was within the range found for the single visit estimates (Fig. 4.6). Furthermore, there was marked variation in the number of Saker Falcons electrocuted during each calendar month of the year. Numbers increased from June to September, as fledglings dispersed from their nesting sites and aggregated in areas of high small mammal density, with a rapid decline from September to November as many birds, particularly juveniles, migrated to wintering areas in China. Electrocution rates remained low over winter but rose again in April when migrants, especially second-year birds, returned to the Mongolian steppe, with a subsequent gradual decline as the breeding season progressed.

The average length of 15 kV power lines in Mongolian is 52 km (*N* = 41 surveyed lines), and in a high density small mammal area an average line will kill an

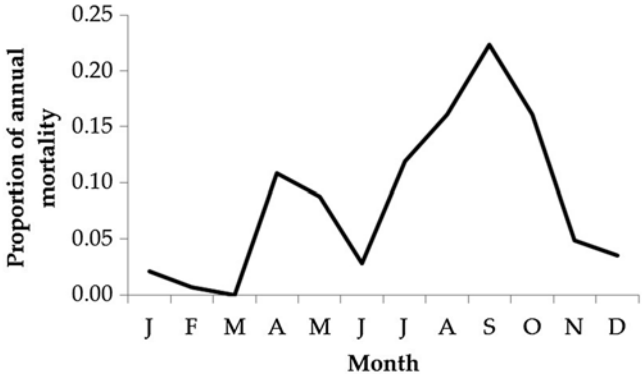

Fig. 4.6 Annual variation in monthly electrocution rates along 26 km of a power line in a region with a high small mammal density. Survey period was from 01 April 2013 to 15 August 2014, with 438 line surveys conducted at an average frequency of 1.1 day intervals. 251 electrocuted Saker Falcons were collected, equating to an average of 143 birds over a 12-month period

estimated 27 Saker Falcons per month in August (95 % CI = 5–50 electrocutions/month), compared with just 1 at a corresponding power line in an area where small mammal density is low (95 % CI = 0–3 electrocutions/month). August mortality represents ca. 16 % of annual electrocutions (Fig. 4.5), thus we can estimate that in areas of high small mammal density an average dangerous power line will kill 168 Saker Falcons (95 % CI = 31–311 electrocutions/year) and in areas with low small mammal density an average line will kill an estimated 6 individuals (95 % CI = 0–19 electrocutions/year). There are at least 65 'dangerous' 15 kV lines in Mongolia (Tserennyam 2013), with just over one-third occurring in open steppe areas with high small mammal densities (Fig. 4.5), thus an estimated 23 power lines are likely to coincide with high small mammal population areas and a further 42 are likely to traverse areas with lower small mammal densities. Consequently, the estimated number of electrocuted Saker Falcons across Mongolia over 1 year is 4116 individuals (90 % CI = 713–7951 birds). To put this in context, the mean estimate of electrocution events in Mongolia exceeds by an order of magnitude the maximum number of Saker Falcons issued with CITES permits and exported annually from Mongolia for the Arabian falconry market.

Remediation and Reducing the Risk of Electrocution for Saker Falcons

While there is, at present, no evidence to demonstrate that the existing high level of electrocution is having an impact on the Saker Falcon population in Mongolia, the number of birds killed is alarming and the scale of the problem clearly has the potential to have a detrimental impact on the species. In order to reduce the risk of electrocution for birds of prey in Mongolia, it is necessary to (1) ensure that new low- and medium-voltage power lines comprise poles that are of a safe design, and that (2) existing dangerous lines are subject to remediation to make them safer. Electrocution of birds at power lines is not a new phenomenon, it has been recorded for over a century (Lehman et al. 1999), and the designs required to make power lines safe are known, as are a range of mitigation techniques to reduce electrocution risk on existing high risk power poles. Nevertheless, electrocution continues to be a major cause of mortality for birds of prey, not just in the developing countries of Central Asia, but also in India (e.g. Harness et al. 2013), Africa (e.g. Boshoff et al. 2011; Angelov et al. 2012), Europe (e.g. Guil et al. 2011; López-López et al. 2011) and North America (e.g. APLIC 2006; Kemper et al. 2013). Clearly, impediments exist across the globe that prevents the implementation of measures that could significantly diminish the risk of electrocution to birds posed by low- and medium-voltage power lines.

In Mongolia, it is apparent that there is a lack of awareness about the issue of bird of prey electrocution among key personnel involved in planning and constructing power lines; it is a relatively recent problem connected with the use of prefabricated reinforced concrete power poles and their associated hardware rather than the Soviet-style wooden poles favoured prior to the Democratic Revolution of 1990. The concrete poles and hardware are cheaper to purchase, more resilient to steppe fires, easier to erect and offer additional benefits associated with standardization of infrastructure and economies of scale. In a rapidly developing economy with an urgent need to create a modern power network to connect communities to the electricity grid and provide a secure power supply, it is perhaps not a surprise that the potential risk of electrocution to birds of prey has been overlooked in the process of infrastructure procurement in Mongolia. Furthermore, the procedure of undertaking environmental impact assessment is not well developed in the country at present (Dondov 2010), and there is an absence of statutory regulation pertinent to the issue of electrocution of birds at power lines.

A lack of awareness does not mean complete ignorance of the problem, as several of the state-operated power companies have instigated measures in order to reduce electrocution risk at many power lines, usually in the form of perch deflectors, such a spikes and brushes, or perch deterrents such as rotating mirrors. However, their installation is often haphazard, reflecting a lack of understanding of how these deflectors and deterrents are designed to work and in what circumstances. Consequently, it is not unusual to find large brush-spike perch deflectors designed to prevent birds perching in specific locations above chain insulars on high voltage transmission lines, instead being used on the crossarms of low- and medium-voltage lines. With this inappropriate placement, such deflectors not only potentially increase the risk of electrocution as they themselves are grounded but they can also pose an entanglement risk to perching birds. When positioned correctly on a crossarm, i.e. adjacent to insulators carrying the live phase wires, insulated single-spike deflectors can reduce electrocution rates (Dixon et al. 2013), but when inappropriately positioned they may increase electrocution risk by deflecting birds to perch closer to the phase wires (Amartuvshin and Gombobaatar 2012). Perch deterrents, such as rotating mirrors, are only effective as long the equipment remains functional, but often the extreme conditions experienced in Mongolia means that devices such as rotating mirrors frequently breakdown after relatively short periods.

At least some funding to the state-operated electricity companies is evidently available for the deployment of mitigation to reduce the risk of bird of prey electrocution. Certainly, electrocution events can potentially result in power outages that require line repairs, thus there is some economic cost associated with the problem. Nevertheless, cost is also an important factor governing the scale of any future remediation and mitigation programme across Mongolia. Government instability and a roller-coaster economic cycle based on the exploitation of mineral resources has characterized Mongolia in recent years (Rolle 2014), while a myriad pressing social and economic problems requires urgent action and resources. The electrocution of tens of thousands of birds of prey each year is just one issue among many that is competing for attention and funding from government officials; to date it is not a problem that has succeeded in making much headway in this competition for resources.

The Saker Falcon as a Commodity: Can It Pay for Its Own Conservation?

Saker Falcons have a monetary value; the Mongolian government has in recent years charged fees of ca. €10,000 per bird in order for trappers to catch and export birds for Arabian falconry. The cost to the end user is higher as they also have to cover the cost of employing trappers, and cover the logistical costs of trapping and transporting the falcons. This commodification of the species can be viewed as a problem, which is driving a market demand that has fuelled an unsustainable and largely illegal harvest across Central Asia, the Middle East, Maghreb and beyond, causing large-scale regional population declines. The response has typically been to instigate trade bans and demand greater compliance and enforcement of the associated national and international regulations that have been created to support such bans. However, this approach, in the case of the Saker Falcon and several other charismatic wildlife species that have become wildlife commodities, has largely failed to reduce their exploitation or market demand (Bennett 2011).

Arabian falconers, as the end users and ultimate cause of the commodification of Saker Falcons, have no incentive to see the species decline or become extinct in the wild. Quite the opposite, a thriving wild population has advantages in securing a long-term supply of falcons that have the phenotypically diverse characteristics desired by Arabian falconers. Commodification offers an opportunity, whereby Arabian falconers can contribute directly to conservation of the species by funding the procedures required in Mongolia to generate long-term, sustainable production via artificial nests and to limit mortality rates by remediation of dangerous power lines. Depending on the type of mitigation employed, electrocution can be significantly reduced at a cost of €20 to €200 per pole, thus the income generated by a single Saker Falcon could potentially pay for the mitigation of all poles on an average 52 km long 15 kV power line. Furthermore, this funding mechanism could have associated benefits of raising awareness of conservation issues in the countries of production and consumption.

The sustainable use of biological resources is enshrined within the Convention on Biological Diversity (CBD) and the concept of conservation through use for falconry species has been developed and articulated by representatives of bodies such as the IUCN's Sustainable Use and Livelihoods Specialist Group (Kenward 2004, 2009). The recently published Saker Falcon Global Action Plan produced by CMS (Kovács et al. 2014), perhaps represents early tentative steps towards a wider recognition among conservationists and policy makers that the exploitative use of wild-sourced falcons is not simply a conservation problem that requires prohibition of trade but rather that a regulated and sustainable trade potentially provides a mechanism for generating scarce conservation resources.

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