DEVELOPING A SUSTAINABLE HARVEST OF SAKER FALCONS (*FALCO CHERRUG*) FOR FALCONRY IN MONGOLIA

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ABSTRACT.—Arabian falconry creates a significant demand for falcons that is met through captive-breeding and wild-take. In relation to wild-take, the Convention on International Trade in Endangered Species (CITES) currently only allows the international trade of one important falconry species, the Saker Falcon (*Falco cherrug*), and this trade is effectively limited to one source country, Mongolia. Market demand for wild-sourced Saker Falcons is greater than can be supplied by Mongolia alone; consequently there is also an illegal, unregulated trade in this species along with the Gyrfalcon (*Falcon rusticolus*) and Peregrine Falcon (*F. peregrinus*). The vast majority of these falcons are sourced from Asian countries. We describe recent advances in the development of a program in Mongolia that uses artificial nests to create a demonstrably sustainable harvest of Saker Falcons for the Arabian falcon trade. The development of a credible sustainable harvest requires a sound biological basis, a transparent system of monitoring, recording and reporting together with a strong regulatory framework. The potential conservation benefits of such a system, together with the potential for developing legal, sustainable harvests in other countries for different falcon species, are discussed. *Received 9 March 2011, accepted 7 June 2011.*

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FALCONRY IS PART of the traditional cultural heritage of the Arabic people and is widely practiced in the United Arab Emirates, Saudi Arabia, Kuwait, Qatar, and Bahrain (Al-Timimi 2007). There has always been a small falcon trade associated with Arabic falconry (Bär 2006), but this has developed markedly in recent decades, driven by changing socio-economic factors in the Middle East, Central Asia and beyond. Trade in falcons to the Arabian Peninsula initially came from countries of the Middle East, the Maghreb, and Pakistan, mainly involving passage birds (Platt 1983, Riddle and Remple 1994), but since the break-up of the Soviet Union, the falcon trade has moved into the breeding distribution range of

the Saker Falcon (*Falco cherrug*) in Central Asia, including Mongolia and China (Flint 1995, Zahler et al. 2004, Yi-Ming et al. 2000). Uncontrolled and unregulated trapping of Saker Falcons is thought to be the main cause of rapid and extensive population declines in parts of Central Asia, particularly in the countries of the former Soviet Union (BirdLife International 2011).

In Russia and the former Soviet States of Central Asia, trade in wild Saker Falcons is illegal, but enforcement is limited and the illicit trade can be associated with corruption at various levels of administration (Wyatt 2009). In contrast, the Mongolian government oversees a harvest and trade of Saker Falcons within the framework of the Convention on International Trade in Endangered Species (CITES), though an additional illicit trade also occurs in the country (Wingard and Zahler 2006). The Saker Falcon is listed under Appendix II of CITES, i.e., a species for which trade must be controlled in order to avoid utilization incompatible with its survival.

A CITES Review of Significant Trade in 2005 highlighted a number of 'urgent concerns' relating to the Saker Falcon trade in Mongolia[1]. One of the problems faced by the Mongolian government was to demonstrate to CITES that their harvest had no detrimental impact on the wild Saker Falcon population. Accurate data on the size of the Saker Falcon population in Mongolia does not exist, nor is there any information recorded on the age and sex of Sakers caught, making it impossible to assess the impact of a harvest. Nevertheless, Mongolia continued their harvest through 2008, despite assuring CITES that "no further export permits would be issued" in a 2006 communiqué[2]. By February 2009, this 'non-compliance' led to a CITES recommendation that countries should suspend trade in Saker Falcons with Mongolia[3].

At this point, there was a risk that the Saker trade in Mongolia might follow the same path as that of Kazakhstan and other former Soviet states to become illicit and unregulated. Consequently, in 2009, we proposed a potential solution to the problem of demonstrating a 'sustainable harvest', which was based on our experimental work with artificial nests for Saker Falcons. This 'conservation through sustainable use' initiative was supported by the Environment Agency-Abu Dhabi (EAD) and was adopted by the Mongolian Ministry of Nature, Environment and Tourism (MNET) and CITES as a potential means of resolving the problem. Subsequently, for 2009 and 2010, CITES imposed a maximum annual quota of 300 birds on Mongolia, which is to be reviewed in 2011 pending satisfactory development of the artificial nest program described here[4].

The artificial nest program is designed to create a new breeding population of Saker Falcons in nest site-limited habitats, which will produce sufficient offspring to compensate an annual harvest of up to 300 birds. The program comprises (1) biological field research to measure vital rates to develop a model for an age and sex specific harvest level of Saker Falcons, (2) the development of an administrative protocol to control and monitor trapping and trade, and (3) the development of a policy framework to ensure that the Saker Falcon trade meets international criteria for sustainable use and provides national and regional benefits for Mongolia.

1 www.cites.org/eng/com/AC/21/E21-10.1.1.pdf
2 www.cites.org/eng/notif/2006/E061.pdf
3 www.cites.org/eng/notif/2009/E003.pdf
4 www.cites.org/eng/com/SC/58/E58-21-1.pdf

Table 1. Numbers of Saker Falcons exported annually from Mongolia and the recipient countries.

Year	Saudi Arabia	Kuwait	Qatar	UAE	Syria	USA	Germany	Total
1997	116	29	0	5	0	0	0	150
1998	0	25	0	0	0	0	0	25
1999	0	40	0	21	0	0	0	61
2000	0	50	0	0	0	0	0	50
2001	0	102	0	75	10	0	0	187
2002	87	121	15	0	75	5	15	318
2003	85	171	82	10	54	0	0	402
2004	77	180	49	30	49	0	0	385
2005	151	131	5	0	73	0	0	360
2006	100	41	26	0	0	0	0	167
2007	60	141	40	0	0	0	0	241
2008	30	185	51	0	0	0	0	266
2009	25	151	81	35	0	0	0	292
2010	0	105	88	44	0	0	0	237
Total	731	1472	437	220	261	5	15	**3,141**

The Mongolian Saker Falcon Trade

The capture and international sale of Saker Falcons in Mongolia began after the 1990 Democratic Revolution, during a period of economic and social upheaval following the collapse of the Soviet Union. As far as we can determine, the trade began in 1993 and was operated by private individuals who established commercial companies to export Sakers, mainly to Middle Eastern countries (Badam 2001, Boldbaatar 2009). Control of the trade was gradually removed from these private companies and by the time Mongolia became a party to CITES in 1996, it was wholly controlled by the government. From 1997–2010, Mongolia exported a total of 3,141 Saker Falcons, ranging from 25 to 402 birds per annum (Table 1, CITES Trade Database, UNEP-WCMC[5], MNET Mongolia). However, there are discrepancies in the published figures for the numbers of Saker Falcons exported and it is not known how many falcons were illegally trapped in Mongolia each year, but it is thought to number at least 300 per annum (Zahler et al. 2004).

Mongolia has exported an average of 286 Saker Falcons per year over the last decade (Table 1), with 99% of these birds destined directly for the Arabian falconry market. In 2010, the price for a single Saker Falcon export permit was set at US$11,760, with US$10,800 going to the state budget and US$960 going to the regional 'aimag' administration. At present, no money goes to the local 'soum' administrations. Thus, the sale of 237 Saker Falcons in 2010 (Table 1) generated an income of US$2.79 million for Mongolia, which is relatively insignificant in relation to an estimated GDP of at least US$4 billion. The real benefit of the Saker Falcon trade to Mongolia is the connection it brings to leaders in Arabian states and the inward investment that can be derived from these relationships.

5 www.cites.org/eng/resources/trade.shtml

ARTIFICIAL NESTS FOR SAKER FALCONS

The Saker Falcon is a widespread breeding species occurring across the whole territory of Mongolia in a variety of landscapes and land cover types, including mountainous areas, forest steppe, steppe, desert steppe, and desert. Sakers do not build nests and they normally use structures built by other species for breeding. Saker Falcons very rarely nest on flat ground and generally prefer elevated nest sites on trees, cliffs, rocks, buildings, and power poles. Accurate data on the size of the breeding population is lacking, but it is estimated that 2,000–5,000 pairs breed in the country, with the highest densities found in the central steppe zone (Dixon 2009). The central steppe zone is characterized by extensive, flat or rolling plains with scattered blocks of hilly country that provide pockets of potential nesting habitat for Sakers in a landscape that is otherwise largely devoid of nesting sites. Consequently, a lack of suitable nest sites limits the breeding population of Saker Falcons across a vast area of the Central Mongolian plains.

Saker Falcons and other raptorial species such as Upland Buzzards *Buteo hemilasius* and Ravens *Corvus corax,* frequently resort to using anthropogenic structures, such as buildings, bridges, and power poles in the prey-rich but nest-site limited steppe grasslands of Central Mongolia (Ellis et al. 1997). Saker Falcons readily adopt artificial nests erected on the poles and pylons of electricity lines for breeding (Ellis 2010) and where such support structures for artificial nests were lacking in Mongolia, Sakers, together with Upland Buzzards and Ravens, also readily took to breeding on especially created 'tripods' with a platform on top (Potapov et al. 2003). We have further developed these early initiatives to design artificial nests that are suitable for use by these raptorial species, inexpensive to produce (ca. US$50 per nest), simple to erect, and extremely durable.

Over the period 2006–10, we studied occupancy levels, nesting success, and post-fledging survival of Saker Falcons breeding at artificial nests erected in two experimental areas, 130 km apart, in the steppe zone of Central Mongolia. One experimental area (Darhan) consisted of 100 artificial nests of four different designs, erected in a grid at 2 km intervals in an area with a low rodent density. The second experimental area (Bayan) consisted of 150 artificial nests, erected in six grids of 25 nests, placed at 1 km intervals in an area with a high rodent density. Small rodents (especially Brandt's Vole *Lasiopodomys brandtii* and Mongolian Gerbil *Meriones unguiculatus*), whose populations vary both spatially and temporally in irregular cycles (Zhang et al. 2003), are an important food resource for raptors in the Central Mongolian steppe (Gombobaatar et al. 2006). Saker occupancy increased year by year, for at least the first three years after establishing the artificial nest grids, suggesting that there was a finite number of potential colonists in the artificial nest experimental areas each year. The breeding density of Saker Falcons was greater in high than in low rodent population areas (Table 2).

Our nest monitoring revealed that laying dates were earlier, clutch sizes larger, and nesting success better at artificial nests in the experimental area with higher rodent abundance (Table 3).

PROJECT TO DEVELOP A SUSTAINABLE HARVEST OF SAKER FALCONS

In autumn 2009, we began a large-scale project to erect a further 5,000 artificial nests in Central Mongolia. By autumn 2010, in each of 20 administrative districts (soums), we had erected 250 artificial nests in grids with nest-spacing intervals of 1.5 km. A mean breeding density of 5.3 pairs/100 km^2 across these grids of artificial nests would result in a pop-

Table 2. Saker Falcon breeding density at artificial nest grids in the Darhan and Bayan experimental areas with low and high rodent abundance respectively. Breeding density in adjacent natural nesting areas is shown for the years when surveys were undertaken. Darhan natural sites A and B are mountain blocks 9 and 27 km from the Darhan artificial nest grid respectively, and Bayan natural is a mountain block 18 km from Bayan artificial nest grid.

Experimental Area	Area (km^2)	Breeding Pairs/100 km^2 (N)					
		2005	2006	2007	2008	2009	2010
Darhan grid	324	na	0.6 (2)	2.8 (9)	3.7 (12)	5.2 (17)	6.5 (21)
Darhan natural A	36	19.4 (7)	16.7 (6)	na	na	na	na
Darhan natural B	236	4.2 (10)	5.1 (12)	na	na	na	na
Bayan grid	96	na	na	5.2 (5)	11.5 (11)	16.7 (16)	15.6 (15)
Bayan natural	240	na	na	4.6 (11)	6.3 (15)	5.8 (14)	na

Table 3. Saker Falcon mean laying date, clutch and fledged brood size, and percentage of nests that successfully fledged at least one chick at artificial nest grids in the Darhan and Bayan experimental areas in 2007–10.

Experimental Area	Mean Laying Date (N)	Mean Clutch Size (N)	Mean Chicks Fledged (N)	% Successful Nests (N)
Darhan grid	05 April (38)	4.1 (58)	2.3 (22)	77.3 (22)
Bayan grid	01 April (47)	4.7 (46)	3.3 (47)	87.2 (47)

ulation of 500 breeding pairs of Saker Falcons, producing an estimated 1,150 to 1,650 fledglings per annum. The results of our experimental study indicate that this level of occupancy and productivity is achievable, and provides a potential basis for a sustainable Saker Falcon harvest.

Recording Saker Falcon Productivity, Survival and Harvesting.—Over the five-year period 2011–15, we shall monitor the 5,250 artificial nests that have been erected (i.e., including the 250 artificial nests in the pre-existing experimental areas) to determine occupancy levels. All the artificial nests will be initially visited in May (when most Saker Falcon nests should contain eggs or chicks), with at least two further visits made to the occupied nest sites to implant microchips in the chicks (at age 21–35 days old) and to determine fledging success.

We shall also collect samples of plucked feathers from the chicks during microchipping and molted adult feathers from around the nest sites during monitoring visits. These feather samples will be used as a source of DNA to individually identify and sex each bird, and to undertake genetic population analyses. Through the genetic identification of individuals we can determine the turnover rate of breeding adults, the extent of breeding dispersal across our network of artificial nests, and recruitment to the breeding population. Since 2007, we have been able to identify individuals breeding at our Bayan artificial nest experimental area using both genetic and visual markers. This process will be continued and expanded to provide data on breeding adult turnover as a proxy measure of survival (thus any breeding adult dispersal away from the study area will be included in our mortality estimates).

Measuring the survival rates of Sakers from fledging to breeding age is more problematic, as we do not currently know the extent of natal philopatry (though over the period of the study

we will be able to obtain genetic measures of gene flow across our network of 5,250 artificial nests). Juveniles that survive to breed outside our study area are unlikely to be detected and we are reluctant to undertake further satellite telemetry as a means of tracking these Sakers, as our experience suggests that this technique significantly increases mortality rates (unpublished data). Consequently, we propose to use a conservative measure of juvenile survival by using breeding recruitment at our artificial nests as an indicator of survival from fledging to breeding. Furthermore, microchip recoveries from birds harvested by falcon trappers will provide additional data to estimate pre-breeding survival rates.

Productivity and survival data from Sakers breeding at our artificial nests can be used to model a sustainable harvest quota. The aim of the project is to set a harvest quota that is determined solely from the Saker population breeding at the artificial nests. The quota derived from our model will compensate for the annual harvest; however, it should be noted that not all of the birds that are harvested will have been produced at the artificial nests. Sakers are mostly trapped from July to December, after breeding dispersal, thus the birds that are harvested will include a proportion that has not been produced at the artificial nest sites. We can determine the proportion by scanning all Sakers for the presence of microchips prior to export (at this point all birds destined for export will be implanted with microchips and the number recorded on the CITES export permit).

In addition to recording the natal origin of harvested Sakers (i.e., from within or outside the managed artificial nest population), we shall also record the age and sex of the falcons that are destined for export. The size of the annual harvest quota will not only depend on occupancy, productivity, and survival rates of birds from the artificial nests, but also on the age and sex ratios of the harvested birds. Currently, no information exists on the age and sex of trapped Sakers, as only the number of exported birds is recorded. A harvest that is significantly biased towards one sex and comprises a significant proportion of older birds will have a greater impact on Saker populations than one where the sex ratio is more evenly balanced and comprises mainly juvenile birds. Consequently, a sustainable quota will vary according to the age and sex ratios of the harvest.

Protocols for Trapping and Trade of Saker Falcons.—Previously, there was little regulation to govern the way falcon trappers operated in Mongolia, but in June 2010, the Environment Minister introduced a preliminary system of regulation[6]. The trade process currently involves a buyer purchasing permits from MNET that allows them, or their agents, to trap and export, with CITES permits, a fixed number of Saker Falcons (depending on how many permits are purchased). The regulations introduced in 2010 determine *inter alia* where and when the trappers can operate and the number of persons allowed to participate in trapping, and provides rules for displaying permits in vehicles and co-ordination with local administrators.

In 2011, we shall work with MNET and the falcon trappers to introduce a microchipping program. All trapped falcons, prior to export, will be scanned for the presence of microchips to detect birds that have fledged from the artificial nests. Any birds that do not have microchips will be implanted and the microchip number recorded on the CITES export permit, which can be used by the purchaser as proof of wild Mongolian origin. Falcon hospitals in the Middle East will be provided with all the microchip numbers used in Mongolia and any Sakers detected during admission to hospital can be reported via the

6 Ministerial Order of Nature, Environment and Tourism of Mongolia #A-205, 30th June 2010.

Middle East Falcon Research Group. In this way, we can determine whether or not the microchipped individuals have arrived in Arabia via the CITES regulated trade route or not, which will enable us to estimate the scale of any illicit trade from Mongolia.

Policy Development.—To facilitate their development of a policy and regulatory framework for the Mongolian Saker Falcon trade, MNET (with support funding from EAD) has provided a member of staff on secondment to undertake a Ph.D. at Leicester University, UK, to examine how the Saker Falcon trade can be implemented to meet Mongolian environmental obligations at international, national and regional scales. A key aim of this study is to provide guidance on how government policy can be developed at these various scales in order to ensure that the Saker Falcon trade is ecologically sustainable, meets Mongolian obligations under international conventions such as CITES, the Convention on Migratory Species (CMS), and the Convention of Biodiversity (CBD), and provides socio-economic benefits at national and regional levels. Over the three-year period 2010–12, this project will provide an appraisal of what policy developments are required to establish a transparent and verifiable CITES regulated trade.

Discussion

The use of artificial nests to underpin a sustainable Saker Falcon harvest in Mongolia is based on the premise that the Sakers occupying these artificial sites are additional to the existing population breeding at 'natural' nest sites. However, we do not know the origin, age or prior breeding experience of the Sakers that occupy our artificial nest grids. It is possible that the birds at our artificial nests do not represent a new breeding population but instead comprise experienced breeding birds that have relocated to the artificial nests (breeding dispersal) and/or new breeders that would have otherwise bred elsewhere. This requires a strong preference for breeding at artificial nests over natural sites, perhaps as a response to prey abundance. Potentially, Sakers could abandon natural breeding sites with low prey density to breed at artificial nests in areas with a higher prey density. However, we found no tendency for Sakers to abandon breeding sites with a low local prey density; on the contrary, the numbers increased each year (Table 2). In addition, there has been no reduction in the breeding population at natural sites in hills adjacent to our artificial nest grids (Table 2) and Sakers show territory fidelity within the grids, which indicates that breeding dispersal is limited (unpublished data). Furthermore, we know that at least one young Saker reared at an artificial nest subsequently bred in a natural nest site.

It seems plausible, therefore, that the majority of Saker Falcons breeding at our artificial nests are likely to have come from an existing non-breeding population inhabiting the prey-rich, but nest-site limited, habitat of the central Mongolian steppe (Newton 1979, Kenward et al. 2000). The grids of artificial nests create new breeding opportunities and the Sakers that colonize these grids represent an expansion of the Mongolian breeding population in terms of numbers and spatial distribution. The management of bird populations through the provision of artificial nest sites is well established (Newton 1994); for example, the erection of artificial nests for Barn Owls (*Tyto alba*) in palm oil plantations in Malaysia and agricultural fields in Israel have resulted in dramatic population increases (Hafidzi and Mohd 2003, Meyrom et al. 2009). Our aim is to manage the breeding Saker population at artificial nests to provide a demonstrably sustainable harvest for the falconry trade, which in turn will provide the income for the Mongolians to maintain and monitor the nests in order to determine the annual harvest quotas.

The determination of an annual harvest quota depends on the survival and productivity of Sakers at the artificial nests and the age and sex of the Sakers harvested by the falcon trap-

pers. This creates a logistical difficulty as ageing (even sexing) of Sakers can be problematic and can only be determined when the birds are presented for microchipping prior to export. In autumn it is possible to assign a sex to most birds based on size and to categorize them as juveniles (1st calendar year) and adults (≥2nd calendar year) based on plumage, leg and cere coloration. Effectively, this means that key parameters (i.e., age and sex) required to determine the harvest quota can only be obtained after the trapping has taken place. There are two potential solutions to this dilemma: (i) set quotas for each category of age and sex, such that there is a permitted harvest of juvenile and adults based on their sex, and any individuals that are presented for export once this allowable limit has been reached must be released or (ii) set quotas based on the age and sex of the birds removed in the harvest of the previous year. There are logistical and biological implications with both, but we believe that the latter option offers the most practical solution as it enables potential purchasers to know what quota is available prior to embarking on an expensive and time consuming trapping effort. Furthermore, by informing and educating trappers about sustainable harvests, we hope, over the course of the project, to be able to direct trapping efforts towards juveniles with an evenly balanced sex ratio.

There is a further potential conservation issue relating to the natal origin of the Sakers trapped for export in that the harvest will include birds from outside the artificial nest project areas, even from outside Mongolia. The impact on breeding populations elsewhere of harvesting falcons that originate from outside the region covered by our artificial nests is not known. If Sakers exhibit a strong degree of natal philopatry then the birds produced at our managed population in central Mongolia will not necessarily compensate for trapping losses that affect regional breeding populations elsewhere. A better understanding of Saker dispersal is required to address this issue and careful targeting of trapping efforts in artificial nest areas or limits on the number of birds originating from outside the managed population may be required.

In order for a legitimate Saker Falcon harvest to exist, it is necessary to control the illicit trade. In Mongolia, there are social and economic benefits of maintaining the CITES regulated trade at local and national levels. Illegal falcon trappers operating in Mongolia will be in direct competition with legal trappers who have purchased permits. Consequently, legally permitted trappers will have an incentive to prevent illegal trappers operating in the same areas. In addition, socio-economic benefits to local communities of having artificial nests and/or legally permitted trappers operating in their district means that they also have an incentive to prevent illicit trapping. To distinguish legal and illegal trappers, MNET has now introduced a regulatory system where permitted trappers register with local authorities in each area where they are operating and all their vehicles are clearly marked with an official sticker. In a vast, sparsely populated country where there are logistical constraints to law enforcement, such incentives for locals and permitted trappers to 'police' their own areas are an important way to restrict the activities of illegal trappers.

The project outlined here is an attempt to approach Saker conservation in a pragmatic manner through the concept of sustainable use, which is a key element of the Convention of Biological Diversity. At present we are only able to report on the early stages of its development and to address some of the foreseeable practical and biological issues that may arise. We recognize that this scheme is ambitious and that there are likely to be many unforeseen difficulties to overcome in its implementation, but at present there is an opportunity to adopt such a conservation strategy in Mongolia whilst there is still a relatively large and healthy Saker Falcon population. In our opinion, the alternative approach of relying on strict protection is unlikely to succeed, as

Mongolia does not have the capacity to enforce protective legislation against illegal trapping, and this approach has failed in neighboring countries such as Russia and Kazakhstan, where illegal trapping is believed to be the main cause of rapid population declines.

The principle of managing a falcon population so that it can support a sustainable harvest can be applied to other species elsewhere. Management can be the protection of the birds and their habitats and/or the manipulation of factors that limit population growth such as nest site availability, predation, or food supply. In the USA, management has involved the re-establishment of Peregrine populations through reintroduction, together with the introduction of legislation to restrict the types of pesticides that caused the initial population decline and strict protection coupled with effective enforcement (Cade and Burnham 2003). This management has contributed significantly to the current healthy state of the Peregrine Falcon population in North America and has enabled a limited sustainable harvest for falconry to be permitted (Millsap and Allen 2006). International trade in wild-taken Peregrines and Gyrfalcons is not allowed at present as they are both Appendix I-listed species under CITES. In such cases, it may be possible to apply appropriate management to support a sustainable harvest for captive propagation within the source countries, so that subsequent captive-bred generations can be traded internationally. Trappers who currently operate illegally could potentially become engaged in the legal management and harvest of falcons, and the supply of legitimate falcons may help reduce the demand for illegally traded birds, particularly in the Arabian states.

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Literature Cited

Al-Timimi, F. 2007. Falconry and Hunting in Arabia. Gulfosaker Canada Inc.

Badam, K. 2001. CITES and sustainable use of Saker Falcon in Mongolia. Pages 202–208 *in* E. Potapov, S. Banzragh, N. Fox, and N. Barton (Eds.). Saker Falcon in Mongolia: Research and Conservation. Ulaanbaatar, Mongolia.

Bär, N. 2006. Falkenfang und Falkenhandel in der Arabischen Republik Syrien. Mitt. Mitteilungen der Fränkischen Geographischen Gesellschaft 44:191–223.

Boldbaatar, S. 2009. Influence of commercial activity on number and condition of population Saker Falcon (*Falco cherrug* Gray, 1834) to Mongolia and problems of its protection. Pages 32–38 *in* T. F. Andreeva, T. A. Vershinina, N. V. Karpov, and L.V. Kuzmina (Eds.). Birds of Prey and Owls in Zoos and Breeding Stations: 18th issue. Moscow, Russia.

BirdLife International. 2011. Species factsheet: *Falco cherrug*. [Online.] Available at http://www.birdlife.org/datazone/speciesfactsheet.php?id=3619

Cade, T. J., and W. Burnham. 2003. Return of the Peregrine: A North American Saga of Tenacity and Teamwork. The Peregrine Fund, Boise, Idaho, USA.

Dixon, A. 2009. Saker Falcon breeding population estimates. Part 2: Asia. Falco 33:4–10.

ELLIS, D. H. 2010. The Institute for Raptor Studies expeditions in Mongolia, 1994–2000. Erforschung Biologische Ressourcen der Mongolischen Volkrepublik (Halle/Saale) 11:189–212.

ELLIS, D. H., M. H. ELLIS, AND P. TSENGEG. 1997. Remarkable Saker Falcon (*Falco cherrug*) breeding records for Mongolia. Journal of Raptor Research 31(3):234–240.

FLINT, V. E. 1995. Recent threats to large falcons *Falco* sp. in Russia and neighbouring countries. Acta Ornithologica 30(1):23–24.

GOMBOBAATAR, S., C. UUGANBAYAR, D. SUMIYA, E. POTAPOV, AND N. FOX. 2006. Diet studies of breeding and wintering Saker Falcons *Falco cherrug* in Central Mongolia. Populationsökologie Greifvogel und Eulenarten 5:203–214.

HAFIDZI, M. N., AND N. MOHD. 2003. The use of the Barn Owl, *Tyto alba*, to suppress rat damage in rice fields in Malaysia. Pages 274–276 *in* G.R. Singleton, L.A. Hinds, C.J. Krebs, and D.M. Spratt (Eds.). Rats, Mice and People: Rodent Biology and Management. ACIAR Monograph No. 96, Canberra, Australia.

KENWARD, R. E., S. S. WALLS, K. H. HODDER, M. PAHKALA, S. N. FREEMAN, AND V. R. SIMPSON. 2000. The prevalence of non-breeders in raptor populations; evidence from rings, radio tags and transect surveys. Oikos 91:271–279.

MEYROM, K., Y. MOTRO, Y. LESHEM, S. AVIEL, I. IZHAKI, F. ARGYLE, AND M. CHARTER. 2009. Nest-box use by the Barn Owl *Tyto alba* in a biological pest control program in the Beit She'an Valley, Israel. Ardea 97(4):463–467.

MILLSAP, B. A., AND G. T. ALLEN. 2006. Effects of falconry harvest on wild raptor populations in the United States: Theoretical considerations and management recommendations. Wildlife Society Bulletin 34(5): 1392–1400.

NEWTON, I. 1979. Population Ecology of Raptors. T. & A. D. Poyser, Berkhamsted, UK.

NEWTON, I. 1994. The role of nest sites in limiting the numbers of hole-nesting birds: A review. Biological Conservation 70:265–276.

PLATT, J. B. 1983. Pakistan hawk bazaars and Arab falconers. Hawk Chalk 22(3):38–42.

POTAPOV, E., D. SUMYA, O. SHAGDARSUREN, S. GOMBOBAATAR, I. KARYAKIN, AND N. FOX. 2003. Saker farming in wild habitats: Progress to date. Falco 22: 5–7.

RIDDLE, K. E. AND J. D. REMPLE. 1994. Use of the Saker and other large falcons in Middle East falconry. Pages 415–420 *in* B-U. Meyburg and R. D. Chancellor (Eds.). Raptor Conservation Today. WWGBP/The Pica Press, UK.

WINGARD J. R., AND P. ZAHLER. 2006. Silent Steppe: The Illegal Wildlife Trade Crisis in Mongolia. Mongolia Discussion Papers, East Asia and Pacific Environment and Social Development Department. World Bank, Washington DC, USA.

WYATT, T. 2009. Exploring the organization of Russian Far East's illegal wildlife trade: Two case studies of the illegal fur and illegal falcon trades. Global Crime 10:144–154.

YI-MING, L., G. ZENXIANG, L. XINHAI, W. SUNG, AND J. NIEMELA. 2000. Illegal wildlife trade in the Himalayan region of China. Biodiversity and Conservation 9:901–918.

ZAHLER, P., B. LHAGVASUREN, R. P. READING, J. R. WINGARD, S. AMGALANBAATAR, S. GOMBOBAATAR, N. BARTON, AND Y. ONON. 2004. Illegal and unsustainable wildlife hunting and trade in Mongolia. Mongolian Journal of Biological Sciences 2 (2):23–31.

ZHANG, Z., W. ZHONG, AND N. FAN. 2003. Rodent problems and management in the grasslands of China. Pages 316–319 *in* G. R. Singleton, L. A. Hinds, C. J. Krebs, and D. M. Spratt (Eds.). Rats, Mice and People: Rodent Biology and Management. ACIAR Monograph No. 96, Canberra, Australia.