FALCO

The Newsletter of the Middle East Falcon Research Group
Issue No. 24 August 2004 ISSN 1608-1544

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His Highness Sheikh Zayed bin Sultan Al Nahyan

Just as *Falco* was going to press we heard the sad news of the passing of His Highness Sheikh Zayed bin Sultan Al Nahyan, who was a firm supporter of the Middle East Falcon Research Group. A legend in his own lifetime, Sheikh Zayed saw the transition from an impoverished desert country to an oil-rich, technologically advanced one. Through all this, he never forgot his Bedouin roots and his beloved falcons. What better way to remember him than to quote from his Foreword in the ***Global Strategy Plan for the Conservation of Falcon and Houbara Resources:***

'The traditional sport of falconry was passed down to us from our fathers, from a time when we were close to nature and life was more simple. It is a constant reminder to us of the forces of nature, of the inter-relationships between living things and the land they share, and of our own dependence on nature. Falconry depends on healthy populations of the quarry, such as the Houbara, and they in turn depend on the continuing health of their breeding and wintering grounds. Falconers thus have a concern for natural habitats and for the sustainable use of resources.

During my own lifetime I have seen many remarkable changes and achievements occur in the Middle East. Oil has brought immense benefits for the welfare of our people. But progress can also pose problems for nature – pollution of land and sea, unwanted development and spoiling of natural areas, and disturbance of quiet places which once gave refuge to wildlife. Some of the prey species have suffered from loss of habitat, and from persecution or over-hunting. It is important for us to take steps to turn the tide before it is too late, in order to safeguard the future.

All of us share a common goal: the sustainable, balanced use of resources. We wish to leave the Earth as good, or better, than we found it.'

Falconry and falcon research has lost a Friend in Sheikh Zayed.

MEFRG Objectives:

To provide:

A central body for the co-ordination of research activities related to falcons and falconry.
A common forum for the exchange of information and for promoting collaborative research programmes.

To promote:

Research on health and disease in falcons, falcon moulting in the Middle East, falcon nutrition, domestic breeding.
Field studies on falcon migration, taxonomy, morphometrics, reproductive biology and behaviour.
Improved management conditions for captive falcons through educational awareness programmes.
Greater understanding of falconry as a part of Arab cultural heritage.

To Hold:

Regional and International workshops and conferences on veterinary aspects, falcon biology topics, falconry and conservation issues.

To publish:

Papers on aspects of falcon conservation, falcons and falconry.
A biannual newsletter/journal containing contributions on medical. biological and conservation topics of common interest, new developments and recent medical advances.

Membership:

Membership is open to any veterinary surgeon, biologist, conservationist or falconer working in the Middle East or any other person interested and contributing in the fields of medical, biological and conservation aspects of falcons and falconry worldwide.

FALCO online

Previous issues of **FALCO** as well as instructions for authors can be downloaded from:

http://www.falcons.co.uk/default.asp?id=131

also see new Saker Conservation information portal:

www.savethesaker.org


Photo by E. Potapov

FALCO is published biannually and contains papers, reports, letters and announcements submitted by Middle East Falcon Research Group Members. Contributions are not refereed: although every effort is made to ensure information contained within FALCO is correct, the editors cannot be held responsible -for the accuracy of contributions. Opinions expressed within are those of the individual authors and not necessarily shared by the editors.

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Editorial

This issue celebrates the tenth anniversary of the **Falco** newsletter. We are ten years old! The first **Falco** was produced in summer 1994 by Jaime Samour for the Middle East Falcon Research Group (MEFRG) – a brainchild, as the editor has put it, of Nick and Barbro Fox. The group's original purpose was to link up Veterinary Surgeons, Biologists and Conservationists working in the Middle East and Central Asia regions. The Group intended to bring together the expertise already in existence in these different countries and to enlist valuable support from experts from around the world in subjects related to falcons and falconry. Now, looking back over the past decade, it is possible to conclude that the initial goal has been achieved with success. Above all, the MEFRG has organised 2 International Conferences on the conservation of the Saker Falcon and Houbara Bustard and has published proceedings.

In May 2004 members of the MEFRG participated in the CITES meeting on the Saker falcon. The meeting was hosted by the Environmental Research and Wildlife Deverlopment Agency (ERWDA), the scientific authority of CITES-UAE. Proceedings of the meeting one can beseen at the CITES web site (www.cites.org/.eng/prog/falcon.htm).

One of the recent highlights of the MEFRG work is the web site www.savethesaker.org – an information portal, which contains all up-to-date information on the research and conservation of the Saker falcon. The MEFRG is a non-subscription body and we cannot afford to circulate **Falco** in hard copy to everybody. But now **Falco** is available online and is freely available to all thanks to hard work by Eugene Potapov.

It was Nigel Barton who suggested the name "**Falco**" for the newsletter. In the early days Jaime and Merle Samour used to spend the evenings at NARC wearing out the photocopier into the early hours of the morning, now the newsletter is produced in Wales and is a full colour ISSN registered periodical.

The houbara bustard programme of the National Avian Research Center has come a long way over the past decade and this season the project bred more houbara bustard chicks than ever. These 200+ chicks represent a great landmark for the project. It is to be hoped that the success of NARC may act as a regional catalyst, promoting the establishment of more houbara projects in the Gulf. Congratulations to the persistence of HE Mohammed al Bowardi and NARC for the hard work over the past decade. The ability of captive breeding projects to produce birds that can be used to train falcons locally is a step in the direction of reducing the illegal importation of wild-caught houbara bustards into the region. Just as 10 years ago visitors to falcon hospitals would have seen mostly wild-caught falcons, the proliferation and success of regional, North American and European falcon captive breeding projects means that today the visitor to a falcon hospital sees almost exclusively captive bred falcons. In the same manner, perhaps the next decade will see the widespread availability of captive bred houbara bustards for falconers.

At the same time we are concerned to ensure that captive-breeding is not percieved as the total solution. Efforts to conserve wild populations of falcons and houbara must be stepped up. Systems need to be developed that conserve wild populations in accordance with CITES criteria for sustainable use.

The year 2004 has bought new developments to the falcon health scene in the Middle East. A new falcon hospital is shortly opening at Nad al Shiba in Dubai under the guidance of Chris Lloyd, while Peter McKinney has moved into a new facility, also in Dubai. Antonio Di Somma from Dubai Falcon Hospital has been conducting clinical trials on the new antifungal drug voriconazole which has made a positive impact in the treatment of aspergillosis. The flip side of finding a better drug to treat aspergillosis has been hearing reports of the widespread mis-use of this medicine by non-veterinarians as an aspergillosis prophylaxis. It will not be long before birds arriving at falcon hospitals with aspergillosis will be unresponsive to voriconazole. Dr Miriam Hampel operating from the Central Veterinary Research Laboratory, (CVRL) has completed an in-depth investigation into falcon amyloidosis, an emerging falcon disease, and we look forward to reporting her findings once her dissertation is written up. Congratulations are also in order for the CVRL team and Jaime Samour who have produced a new book on falcon medicine.

The Arab Hunting Exhibition has become a feature of the start of the falconry season in the Middle East. To quote H.H. Sh. Hamdan bin Zayed al Nahyan, Chairman of the Emirates Falconers Club – "*the sport of falconry has played an essential part in the culture and legacy of the Arabian peninsula and stands as a testimony to the strong bond of this region with nature, its love and commitment to sustainable wildlife utilisation and conservation.*" In other parts of the world field sports are coming under pressure from urban anti-hunting groups. Because of the relationship between man and bird, falconry is different from other 'field' sports. At its best, falconry is a sport that connects the falconer with the falcon and the environment. As long as falconry opens people's eyes to the wonder of the natural world and fosters a caring attitude to the environment then it will deserve to continue. Those in positions of authority and leadership in the falconry world have a special responsibility to promote responsible falconry practices, for if they do not, future generations will not be able to enjoy this special pastime.

The newly-formed Emirates Falconers' Club was accepted into the International Association of Falconry last year. This year the EFC hosted all the delegates of the IAF for their Annual General Meeting. This was a chance for falconers from many other countries to visit and gain a deeper insight into Arab falconry and have a good exchange of views and information. Gradually communication links are improving for the Arab falconer, and with improved communications, such as Al Saggar, the journal of the EFC, comes a better understanding of the issues faced by falconry. This is the way forward for a sustainable future.

So, ten years on, falconers, veterinarians and biologists have a forum for a frank exchange of views and information on Arab falconry issues. **Falco** has stayed the course and is here as a service to you – feel free to use it!

Status of the Saker in Russia and Eastern Europe

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This review is based on all available publications as well as internet and personal information provided by researchers of the Saker in Russia over the last 20 years, including the majority of authors from the list of references.

Shrinkage of the Saker range

Monitoring of the Saker in Northern Eurasia, including the most intensive surveys in 1997-2002 run by the Falcon Research Institute (IWC Ltd) and financed by NARC and ERWDA (Abu Dhabi, UAE) and other sources, has shown a clear shrinkage and fragmentation of its range (Figure. 1). Even in recent handbooks (Hoyo et al, 1994; Tucker and Heath, 1994; Snow and Perrins, 1998) the Saker range covers over 3,000,000 km^2 of almost the entire countries of Ukraine, Moldova and southern Russia. However in these countries it now occupies 2-3x less area of about 1-1.5 mln. km^2 mostly within Asiatic Russia.

In Europe there are 3-5 fragments of the former Saker range with a few solitary pairs between them. Almost 150 pairs nest in Hungary where the Saker population is growing (in 1980 only 8 pairs were known) thanks to effective conservation measures, including artificial nests (Bagyura et al., 1994, 2003; Dudas et al., 2003). In Slovakia, Bulgaria and some other Balkan countries probably over 100 pairs live with increasing populations (Baumgart, 1991, 2000; Tucker and Heath, 1994; Stoyanov and Kouzmanov, 1998; Fox et al., 2003). Therefore, despite the high degree of Saker range fragmentation in Southern, Central and Eastern Europe the population outside Russia and Ukraine consists of about 250-300 pairs. The population is relatively stable or even increasing.

In the first half of 20th century the Saker range covered almost the entire Ukraine, Moldova and Southern European Russia (Dementiev and Gladkov, 1951; Averin et al., 1971; Zubarovsky, 1977). However, it shrank rapidly and at the beginning of 21st century turned into two enclaves isolated by some 2000 km. One is southern Ukraine including Crimea (Piluga, 1999; Vetrov, 2001) and probably Moldova with about 10 pairs at the end of 1980s (Ganya and Zubkov, 1989; Red Book of Republic of Moldova, 2001). The other is a south-eastern part of European Russia close to the Southern Ural mountains (Galushin and Moseikin, 1998, 2000; Galushin et al., 2001; Galushin, 2003; Fox et al., 2003; Karyakin et al., 2004). The last nesting areas between the Don and Volga rivers were deserted by 1990s. For example the very last Saker brood was seen about 50 km south of Moscow in 1996 (N.Sanin, pers. comm.). In the middle of 1990s a nest on a pole of a high voltage powerline run through agricultural landscape west of the Don river valley in the Lipetsk region (Sarychev, 1993) was deserted. At the end of 1990s no sakers have been noted along the Upper Don river and other areas where falcons had been numerous in the middle of 20th century; like the small "Tul'skie Zaseki" forests about 200 km south-west of Moscow (Likhachev, 1957; Solovkov et al., 1999), northern parts of the Orel region (Kharuzin, 1926) and Voronezh region (Barabash-Nikiforov and Pavlovsky, 1948). One nesting area at the Volga river bank that had been occupied by sakers for almost 20 years (Chernobai and Nikitina, 1990) up to 1998 (Lukyanov, 1999) was also deserted in 1999.


Photo by E. Potapov

The disappearance of the Saker nesting populations from European Russia is predictable: it had either already happened at the very beginning of 21st century (personal oppinion of V. Moseikin) or would happen in the coming years.

The Saker breeding range in Asiatic Russia looks like a relatively large enclave south of the Ural mountains with a chain of small fragments or isolated nesting areas along the state border with Kazakhstan up to the most solid and vast part of the range embraced the Altay-Sayan mountains and surrounding lowlands near the Baikal lake, in Khakassia, Krasnoyarsk Kray and Tuva, as well as its continuation in Mongolia, eastern Kazakhstan and probably north-western China. Changes in the Siberian part of the Saker range analyzed recently (Karyakin et al., 2004) were not so drastic as in Europe.

Decrease of Saker populations in Ukraine and Russia

In the past the quantitative characteristics of the Saker population trends were uncertain because population assessment in large areas, including entire countries was seldom calculated before the 1990s. However, analysis of local population changes allows us to suppose that in general they were relatively stable or slightly increasing during the first half of the 20th century. They began to decrease in 1950s – 1960s due to wide-spread use of DDT and other toxic chemicals, eradication of their principle food namely sousliks (*Citellus spp.*) and mass persecution of raptors. Despite the fact that the anti-raptor campaign stopped at the end of 1960s (Galushin, 1980) the Saker population decline continued and even accelerated in 1970s – 1980s up to an almost total crash in the Ukraine and European Russia in 1990s.

In southern Ukraine one enclave with about 80 Saker pairs at the beginning of 1990s was known in the Odessa District (Piluga, 1999). They changed their breeding habits from raptor's nests in trees to raven's nests on powerline poles (Piluga and Tille, 1991; Kostyushin and Miroshnichenko, 1995). This population continues to decline (V.Vetrov, pers. comm.). Another group of Sakers

nest on cliffs along the Crimean mountains and the Black Sea coast. It is relatively stable on a level of 40-50 pairs (Prokopenko, 1986; Klestov and Tsvelykh, 1999; Vetrov, 2001). East of the Crimea along the Azov Sea northern coast about 10 isolated pairs still occur (Beskaravayniy, 1996, 2001; Andryushchenko et al., 1998; Vetrov, 2001). Therefore, a total Ukrainian population of the Saker consisted of 120-140 pairs at the end of 20th century (Vetrov, 2001), but it is likely to decline to less than 100 pairs (V.Vetrov and Yu. Milobog, personal comm.).

The Saker population decline in European Russia was previously discussed and showed that soon there will be nothing to discuss, because the Saker has almost disappeared there. Between the Don and Volga rivers the last breeding areas were deserted in 1990s. Some sightings of sakers in summer time (but not active nests) have been recorded at the North Caucasus: above the Ergeny Hills along an administrative line between the Rostov region and Kalmykia (Belik, 1999) and in Dagestan, where 5-6 pairs are assumed to live (Vilkov, 2001). East of the Volga river the last nesting pairs continue to disappear. For example, in the well studied Saratov region some areas like the Dyakov forest in 1930s were densely inhabited by Sakers with only 1-2 km apart (Volchanetsky and Yaltsev 1934). However, at the end of 1990s the Saratov region (101,000 km^2) had from 10-15 to 35-40 breeding pairs (Moseikin, 1991; Zavyalov et al., 1999), while at the very beginning of the 21st century only 5-10 pairs remained (Antonchikov and Piskunov 2003). The total number of nesting sakers in European Russia (mostly within the Volga-Ural enclave) at the end of the 1980s and early 1990s was 100-150 pairs (Galushin and Moseikin, 1998, 2000; Red Data Book of Russian Federation, 2001; Galushin et al., 2001), while at the beginning of the 21st century it was estimated to be 2x-4x less with the total number from 30-50 pairs (Galushin, 2003) or not more than 25 pairs (Karyakin, 2004a, Karyakin et al., 2004) or, in opinion of V. Moseikin (personal comm., 2004) already extinct. Despite very fragmented old data on the Saker numbers, their changes during 20th century can be roughly reflected on the graph (Figure 2).

So in Russia, Sakers only continue to breed regularily in Asiatic Russia. The Saker has been studied intensively there and in neighbouring countries from the beginning of the 20th century. A review of available information was published recently (Karyakin et al., 2004). The most populated enclave, namely the Altay-Tuva-Sayan area (over 450,000 km^2) is inhabited by 1600-2100 pairs. At the neighboring Baikal lake area (c. 400,000 km^2) 300-500 pairs live. A northern part of the third enclave namely the Ural-south-western Siberia area (over 250,000 km^2) supports another 200-300 pairs in Russia. The latter number is close to populations in west-northern Kazakhstan (Bragin, 2001; Karyakin, 2004b).

The total Saker numbers in Russia are estimated as 2000-3000 pairs (Galushin, 2003), which continue to decrease almost everywhere. In some areas less than the half pairs are successful in breeding (Karyakin et al, 2004) and only 1000-1500 Saker pairs successfully nest in Russia annually.

Major threats to the Saker in Russia

The most dangerous threats to and causes of Saker population decline are well known and have been discussed in publications, and at various meetings and Internet discussion lists by B. Abdunazarov, A. Abuladze, J. Bagiura, N. Barton, V. Belik, E. Bragin, A. Davygora, C. Eastham, I. Fefelov, V. Flint, N. Fox, V. Galushin, S. Gombobataar, I. Karyakin, A. Kovshar, E. Kreuzberg-Mukhina, A. Kuchin, A. Levin, Ma Ming, V. Moseikin, E. Potapov, V. Ryabtsev, O. Shagdarsuren, E. Shergalin, E. Shukurov, S. Sklyarenko, A. Sorokin, D. Sumiya, V. Vetrov and many other specialists.

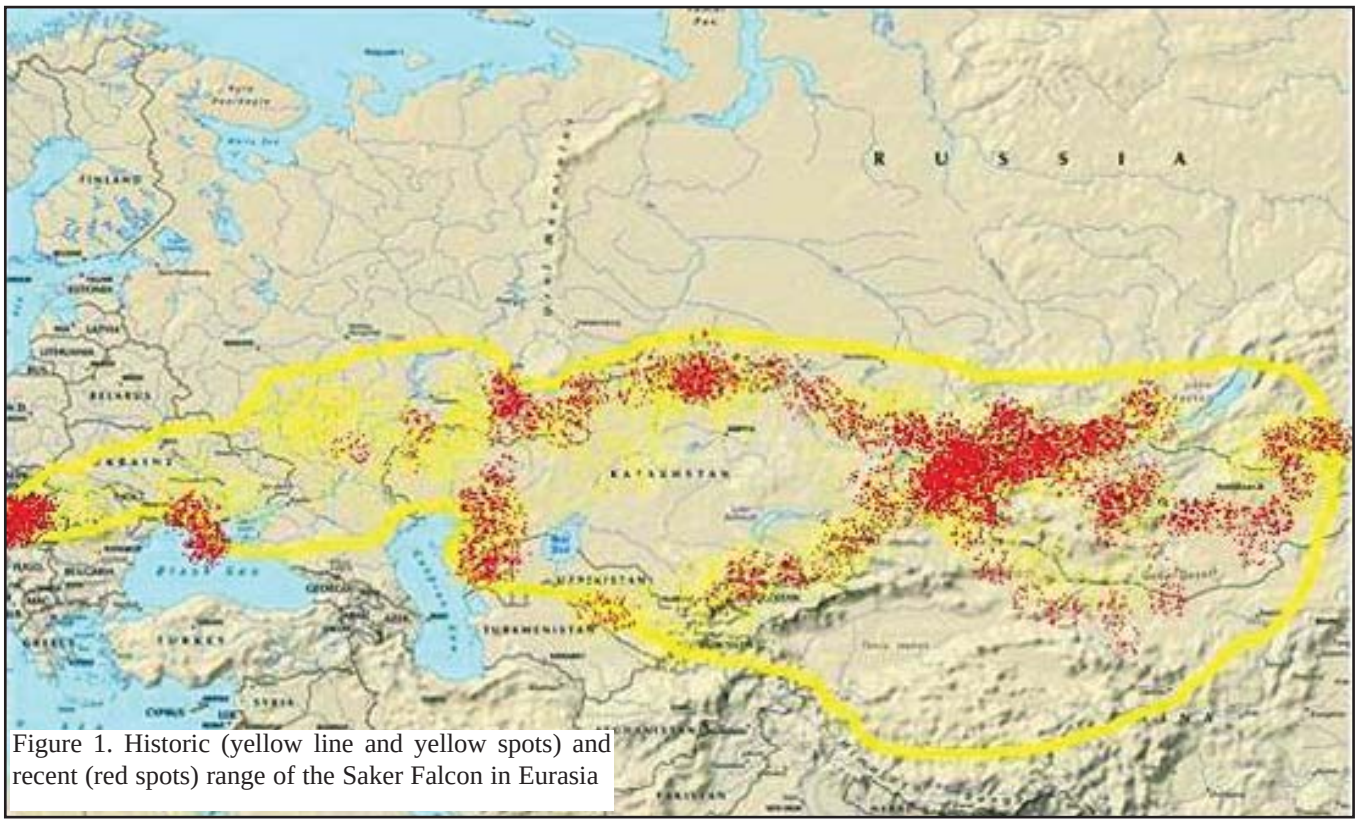

Figure 1. Historic (yellow line and yellow spots) and recent (red spots) range of the Saker Falcon in Eurasia

The major threats in European Russia are habitat changes, human disturbance and robbing of the last saker nests. The cause of the Saker decline in Eastern Europe was food shortage due to total disappearance of sousliks caused by attempts of their eradication in the middle of 20th century. Warmer climate and lack of grazing resulted in the grass growing denser and taller than 20-30 cm which is no longer acceptable both for the European (*Citellus citellus*) and most of all for the Little (*C. pygmaeus*) sousliks. At the end of 20th century a collapse in agriculture led to sharp decrease of live-stock and grazing pressure on pastures which, together with warmer climate triggered the pastures to be rapidly overgrown with tall dense grass and shrubs which accelerated further shrinkage of souslik habitat. This phenomenon deserves regular monitoring (Galushin and Zubakin, 1998; Moseikin and Belyanin, 2001; Galushin et al., 2001).

A shortage of particular nesting habitats including suitable cliffs and ready-made nests of other raptors and ravens also limited the Saker breeding chances in forestless areas. However falcons have adapted to use man-made structures like powerline poles, bridges, ruins, etc. (Sarychev, 1993; Piluga and Tille 1991; Ellis et al., 1997; Potapov et al., 1999, 2003). In this respect a unique record of the Saker recent nesting on the ground amidst flat grasslands in Mongolia is quite indicative (Potapov et al., 2001). In Hungary the Sakers readily occupy artificial nest trays (Dudas et al., 2003).

A new danger for all rodent-eating raptors including the Saker has been reported in Mongolia where a highly toxic chemical bromdialon started to be used against the Brandt's vole (*Microtus brandtii*) in 2002 (Fox et al. 2003). It is important to mention that these abundant rodents together with the Pikas (*Ochotoma spp.*) are the principal food of the Saker there.

In Asiatic Russia and neighboring countries threats for the Saker are more direct and heavy: namely illegal taking for trade. Therefore, not without reasons the highest density of the Saker nesting was found in the most remote areas of the Altay mountains (Moseikin, 2000, 2001), Tuva semi-deserts (Karyakin, 2000, 2002, 2003) and Tibet Highlands (Potapov and Ma, 2004). Various assessments show that in 1990s 6,000-8,000 female Sakers have been taken annually in the Asiatic part of its range. This removal is comparable to the estimate of the total world Saker population of 5-8 thousand breeding pairs and could cause species extinction in the coming decades (Fox 2002; Fox et al., 2003; Potapov et al., 2003). This threat demands great attention and urgent radical measures are needed.

An indirect threat is presented by popular mass media that fiercely defends falcons. They often declare exaggerated cost of $50-100 thousands or even an unbelievable $ 1 mln for one Saker or Gyrfalcon. The actual prices for legal trade approved by state authorities in Mongolia (Badam, 2001) or Kazakhstan (Sklyarenko, 2001) were $2-3 thousand, while illegal buyers pay much less for each falcon. Not to provoke mass removal of falcons and other raptors from their nests by local people journalists should to be more careful with figures and facts concerning rare vulnerable bird species so as not to promote the temptation to get rich quickly at the expense of the wild birds.

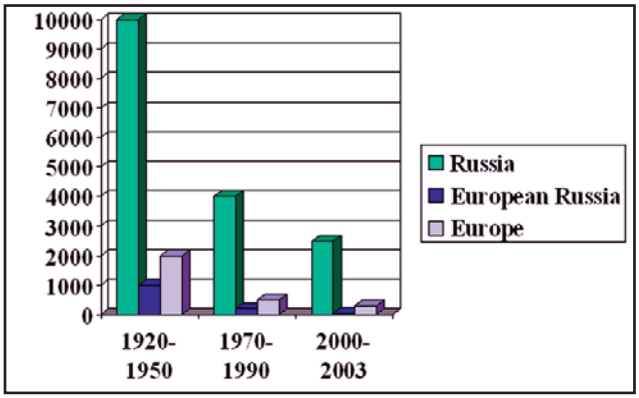

Figure 2. Numbers of Sakers in Northern Eurasia, breeding pairs.

Necessary actions

The popular slogan "Save the Saker!" has to be urgently interpreted into effective and realistic conservation actions.

First of all there is national and international legislation . The Saker has been upgraded from the previous third to the second category of threatened species (Red Data Book of Russian Federation. 2001). The 4th Conference on Eurasian Raptors (Penza, Russia, 2003) and Russian Bird Conservation Union proposed to incorporate the Saker into the list of Globally Threatened Species to IUCN and BirdLife International as a first step for changing its current CITES listing.

Regular monitoring of Saker populations with attention to specific groups like large "Altay falcons", which are attractive for smugglers, and some local populations which either demonstrate relative stability like in the Crimea (Ukraine), southern Ural mountains (Russia), Naurzum Forest and Ust-Urt Plato (Kazakhstan) or disappearing ones like in European Russia. Restoration of East European and West Siberian populations aimed at returning wintering falcons to the Gulf region is a possible project that can be implemented with the substantial support from Arab countries. Regular exchange of information and opinions at the Saker Conferences and Symposia have proved to be useful.

During Internet discussions concerns have been raised regarding the release to the wild of captive bred Sakers and their hybrids. Information on the ability of hybrids to breed successfully with wild falcons is required in order to assess their potential threats to the genetic sustainability of wild Saker. At the same time a ban on the release of hybrids into the wild (International Hybrid Committee, 1999) has to be observed.

Securing strict control over the national and international trade of falcons through quotas, the use of microchips, closed rings, DNA fingerprinting, and falcon registration schemes with individual passports for every bird used in falconry, such as the one being introduced in UAE, have important value in reducing threats to the Sakers. Though illegal trade still continues, its volume is likely to be decreased in recent years thanks to more effective efforts of customs, local inspections and conservation NGOs. However, national and international inspection of the breeding centers has to be introduced on a regular basis preventing their role as illegal "roofs" for the trade of wild Sakers. More field guides have to be


Photo by E. Potapov

developed and produced including special ones for customs identification of the Saker and other rare birds.

The working Group on North-Eurasian Raptors and Russian Bird Conservation Union strongly supports the principle policy and practical measures proposed at various national and international meetings like the 4th Conference on Eurasian Raptors (Penza, Russia, February 2003) and Symposium "Saker Falcon status in the range countries" (Abu Dhabi, UAE, September 2003) and CITES meeting on Saker (Abu-Dhabi, UAE, May 2004) directed at saving the wild Sakers including measures to reduce the pressure caused by illegal trade. It also focuses on recent trends in the UAE and other Arab countries to import birds from well known legal breeding centers with a good reputation which provide healthy captive bred Sakers and hybrids of high hunting quality for sustainable falconry.

Only united and well coordinated efforts of all the parties concerned will offer a reliable basis for effective action to save Sakers in the wild and support sustainable falconry.

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Photo by E. Potapov

Artificial nests experiment in Mongolia 2004: success again.

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As was reported in a previous issue of Falco (Potapov et al. 2003) in 2002, 98 artificial nest platforms were established in the Central Mongolian Steppe. The habitat is flat Mongolian steppe surrounded by mountains on one side and undulating steppe on the other. An additional 20 nests were set in the experimental study area in the autumn of 2003 and the replacement of 5 platforms destroyed by vandalism (1) and by livestock (4) bringing a total of 118 active platforms in 2004 with expansion of the area from 490.84 km^2 to 540.25 km^2. The platforms were established in the year of the Brandt's vole (*Microtus brandtii*) plague of 2002. The vole population was monitored by counting the number of vole burrows and colonies within 100 m diameter around 13 nest platforms selected at more or less even distances from each other. In 2003 the vole population collapsed (see Figures 1, 2), but nevertheless the Sakers, as well as Upland Buzzards started to occupy nest platforms. In 2003 a total of 4 pairs of Sakers and 29 Buzzards produced 10 (out of 10 eggs) and 41 fledged young respectively. In 2004 the voles further decreased in numbers. Instead some Daurian Sousliks and Mongolian Gerbils started to be registered in small numbers. The total numbers of colonies of voles have increased in 2004 compared to 2003, but the number of active burrows per colony went down, i.e. the vole population became less concentrated. Nevertheless the Saker and Upland Buzzard numbers increased to a total of 5 pairs of Sakers and 27 pairs of Buzzards producing 8 (out of 21 eggs) and 48 fledged young respectively. The relative low breeding success of the Sakers was reported due to strong cold winds at the end of May-June, resulting in 2 deserted clutches (total 6 eggs), one un-hatched egg and 1 dead chick. Causes of loss of 3 eggs or chicks are unknown.

The breeding density of Sakers increased from 0 in 2002 to of 8.1 pairs per 1000 km^2 in 2003 and in 2004 reached 9.25 pairs per 1000 km^2. **This is unprecedented figures in terms of density. No such density was ever reported before in un-managed habitat.** This by far **exceeds** the figure 2.5 pairs per 1000 km^2 - the average density for Mongolian typical steppes measured in several study areas monitored in 1998-2004 (Shagdarsuren et al. 2001). It is also surprisingly higher than the density recorded in an adjoining study area in 2003 – below 1.3 pairs per 1000 km^2 and in 2004 - 1.8 pairs per 1000 km^2. Buzzards increased in density from 8.1 pairs per 1000 km^2 in 2002 to 59.1 and 50.0 pairs per 1000 km^2 in 2003 and 2004 respectively. It appears that the number of Upland Buzzards reached its carrying capacity levels at the bottom level of numbers of voles.

It is evident from the experiment that the providing of artificial nest substrates is beneficial to both Sakers and Upland Buzzards, and it also appears that both species are

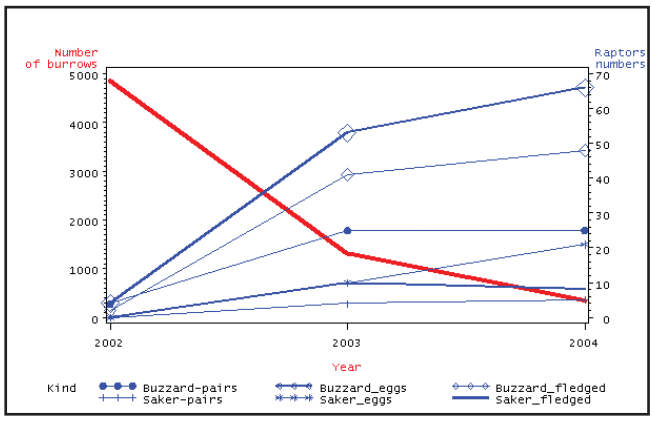

Figure 1. Number of vole burrows in 100 m circle and number of breeding Sakers and Upland Buzzards in the study area.

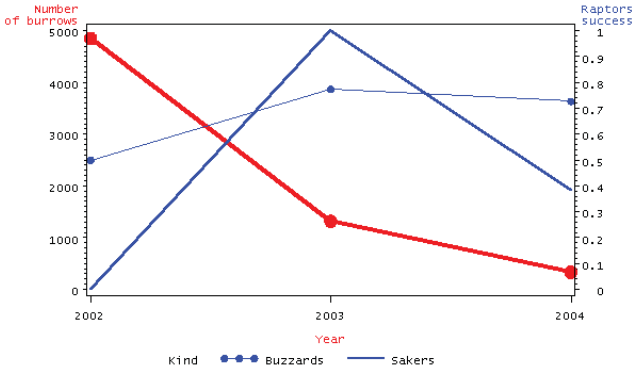

Figure 2. Breeding succes of Sakers and Upland Buzzards and the number of active vole burrows in 100 m circle accross the years.

nest site limited in the flat steppe landscape. Providing that the vole population decreased almost to zero, the resulting density is probably the actual limit, which is determined not by food supply, but by intrinsic behavioural mechanisms. Low food supply is probably the reason why the breeding success of the Sakers breeding in such density at nest platforms was lower than that of the surrounding area.

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Photo by S. Gombobaatar

Control of Airborne Infections

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Airborne infections in falcon facilities

Airborne infections are an increasingly important factor in veterinary centers, quarantine units and breeding facilities. The air that we breathe is one thing that humans and falcons have in common, and it means that we are susceptible to some air-borne infections caused by pathogens carried in that air.

Aspergillosis, mycoplasmosis, chlamydophilosis and Newcastle disease are common airborne infections of birds, including falcons. Airborne infections, like invasive aspergillosis, contribute tremendous health risks to humans as well as falcons and despite treatment, can result in a high mortality-rate for animals with damaged or impaired immune systems.

Many of the airborne pathogens develop inside facilities and the problem is that airborne infections are difficult to control. Indoor air knows no boundaries and traditional infection control procedures such as sterilisation of surfaces and hand-washing do not present barriers to the airborne pathogen. Sources of indoor airborne pollution come in many forms; from the birds themselves, the facility's staff, the facility itself and even from built-in air-conditioning systems.

In the medical world, indoor airborne infections have been proven to be the main source of Hospital Acquired Infections (HAIs) and they cost healthcare facilities world-wide billions of dollars every year. Expensive, integrated ventilation systems, even those with adequate filters, sometimes have little effect on the number of pathogens within the facility. Since veterinary centres, quarantine units and hospital wards are handling sick birds, contamination by pathogens in these environments can originate from sick birds and that pathogens can be transmitted to other hospitalised birds. *Aspergillus* spores are highly airborne and can be readily transmitted to healthy birds. In hospitals, many of the sick birds hospitalised for treatment also have low immunity so there is a real risk of secondary infections caused by airborne pathogens including *Aspergillus* sp, *Chlamydophila* sp, *Mycoplasma* sp and viruses.

Indoor air-cleaning

As the majority of airborne infections develop inside a facility there is a need for scientific air-cleaning through an Infection Control Unit, thoroughly tested by medical science. A new mobile air-cleaning device - infection control unit - is now available to the falconry world from the company MedicCleanAir. This device, which features Hepa-filtration and activated carbon-filtration, has already proven to be very effective at reducing airborne pathogens in healthcare environments. A number of scientific studies (Mahieu et al, 2000; Mordini et al, 2002; Mattei et al, 2002) have shown that under 'extreme' (renovation of medical departments) as well as 'regular' conditions (normal hospital ICU working conditions), there is a significant reduction in and even a total elimination of airborne contamination. The significant result is that no patients have been infected with secondary airborne infections in those departments where these units are installed.

	Air cfu / M^2	Furniture cfu / M^2	Dust cfu / M^2	Number of infected patients
Year 2000 no MCA	1	51	140	5
Year 2001 with MCA	0	3	0	0

Table 1. Reduction in aspergillosis colony-forming units from environmental screening samples and invasive aspergillosis cases in a Bone Marrow Transplant Department in Italy after introduction of a MedicCleanAir infection control unit (N. Mordini, et al 2002). Cfu - colony forming units of aspergillosis.

This and other studies on these infection control units/air-cleaning devices have been published in international medical publications (Hospital Infection Society and Bone Marrow Transplant Society) and presented at various symposia (Stockholm, Montreux, Brussels) demonstrating that there is a workable and feasible preventive solution to eliminate airborne pathogens contaminating the air that both ourselves and falcons breathe.

The practical preventive measure

The mobile unit weighs only 14kg is easy to install (220V) and comprises a filter-cartridge with 3 filter systems (préfilter / activated carbon filter / Hepa-14type filter). More information is available from www.mediccleanair.com

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Saker in the North-Western Kazakhstan: results of the 2003-2004 surveys.

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The Saker falcon is one of the most threatened species of falcons in Northern Eurasia. In Kazakhstan its numbers was thought to be critical (Levin 2001). In 2003 an expedition by the Center of Field Studies found a large population of Sakers. Preliminary estimates of this population have changed our view on the species state in the region and in Kazakhstan in general (Fox et al. 2003). In 2004 we continued surveys started in 2003. The total length of survey routes was 3,832km in 2003 and 5,975km in 2004.

In 2003 we set 11 study areas for long-term monitoring with total area of 2,195km^2. Three additional study areas were 'linear' plots along power lines in the Caspian lowlands and in the Northern Aral Sea regions totalling 316km. In 2004 we re-visited 6 study areas set in 2003, out of which 3 where totally surveyed. The surveyed study areas of 2003 together with the new 2004 study areas have a combined area of 8,163 km^2. Two linear study areas set in the Emba river basin had a combined length of 135km. In total for the two years we have surveyed 25 study plots with a total area of 9,807km^2 and 5 linear study areas of total length of 451km (Figure 1).

The total length of cliffs in the region measured 7,290.6km, the lengths of the cliffs within the study areas was 2,111.6km. We classified all groups of the cliffs into 10 categories (namely cliffs of the Shagyrai plateau, Northern face of the Usturt Plateau, Western cliff-faces of Usturt, southern (chalky) cliffs of the Usturt Plateau, Karatup peninsula cliffs, chalky cliffs of the Aktau range, Aral cliff-face of the Usturt, Mangushlak peninsula cliffs, cliffs of the depressions in the Kinderly-Kayasan plateau (Karagie, Kaundy, Barsguly, Zhazguly), northern-eastern cliff-face of the Kinderly-Kayasan plateau, cliffaces of Kolenkely and Zheltau. The study areas were set so as to cover all cliff types in the region. Extrapolation of the Saker numbers was made using the same types of cliffs in the region.

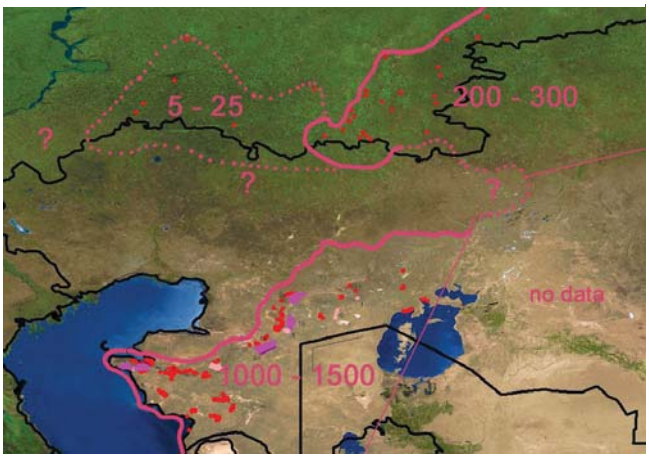


Figure 1. Location of study areas of 2003 and 2004 field seasons (pink) and range of sakers in NW Kazakstan (numbers show number of territorial pairs).

The total length of the powerlines in the region was 11,675.1km. We consider all safe types of powerlines suitable for nesting. The lengths of such powerlines were 5,306.1km.

In total, in the season 2004, we found 255 breeding territories of Sakers, including 245 within study areas, 4 along powerlines and 6 on transit routes. We also revisited 30 breeding territories found in 2003, 23 of which are located in the surveyed territories.

Nesting on cliffs dominates in Kazakhstan – 98.4% out of total records. The maximum local density of Sakers was recorded in the chalky cliffs of the southern Usturt, Aktau and Kinderly-Kayzsan plateau. Here the nearest neighbour distance was 2.91±3. km (average ± SD), N=135, range 0.25 to 25.5km. In large cliffs inter-nest distance 0.5-1km is a norm. However such cliffs are also good habitat for other predators, which limit Sakers (Golden Eagle and Eagle Owl). Their presence was the reason for Saker absence in some cliffs. The Sakers tend to breed densely on the cliffs facing north and less densely on those facing south. The cliffs facing the Caspian Sea have low numbers of Sakers – about 2.9 pairs per 100km, the lower the cliff, the fewer the Sakers. Cliffs lower than 10m do not attract Sakers at all. Perhaps the high density of the Eagle Owl is to blame. For example in the chalky cliffs of the Kinderly-Kayasan plateau along the Caspian (68.4km) we located 2 Saker breeding territories and 14 Eagle Owl territories. At the time we did not put much effort into locating all Eagle Owl territories, so its numbers are severely underestimated. On similar cliffs of the Kinderly-Kayasan Plateau (39.1km), 85km away from the sea, we found 18 Saker territories (13 occupied nests) and only 4 Eagle Owl territories.

Another type of cliffs is made of shell-stone. The breeding density on such cliffs is lower, and their distribution is highly irregular. It appears that the reason for a lower density of Sakers in such places is a corresponding high density of other raptors, as well as a lack of vertical cliff-faces. The density of Sakers in shell-stone cliffs varied from 3.7 to 20.2 pairs per 100km, with average 14.6 pairs/100km of cliffs. Cliffs of the depressions in the Kinderly-Kayasan plateau is an exception: the height of cliffs exceeds 25m. In such cliffs the density reaches 44.2 pairs per 100km, but the length of such cliffs is limited, hence the density is high.

Clay precipices of the Northern Usturt, Shagurai and Karatup have even lower density of Sakers, varying from 1.5 to 5.6 pairs/100 km of cliff-faces. An exception amongst clay cliffs are the ones at the Aral Sea depression (eastern cliff of the Usturt, Karatup). Here the clays are high (up to 50m), very dense and form many niches. Hence the density here is higher (15.6 – 23.0 pairs/100km) and the nearest neighbour's distance is 4.85±2.1km (range 2.1-8.1km; N=8).

On average the Saker density in the cliff-faces of the Usturt Plateau is 14 pairs per 100km with the average inter-nest distance of 3.9±5.15 (0.25-51.3; N=259) km. The total numbers of Sakers in the cliffs of this region is estimated as 1,021-1,216 pairs (estimated average 1,119 pairs).

The largest nesting groups of the Sakers are in the Usturt plateau (extrapolated as 626 pairs), and Kinderly-Kayasan Plateau (307 pairs), where the breeding density varied between 13.2 to 24.1 paris/100km. The surveys of the 2004 field season and GIS approaches based on cliff length corrected our estimation for 2003 (545 pairs for Usturt and 685 pairs for entire Kazakhstan (Karyakin 2004a) into the projected figure of 1,165 pairs for Kazakhstan.

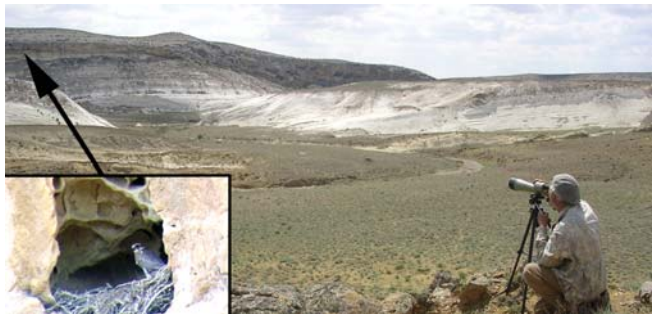
Besides cliff-faces, the Sakers also nest on pinnacles and in ravines. The first is rare and sparse, and has negligible influence on the extrapolation. The latter are not marked on 1:500.000 scale maps and therefore cannot be precisely used in extrapolation. We know of 5 Saker nests and 2 breeding territories in such types of nesting habitats, thus making only 2.8% of all known nests. Thus we extrapolate a minimum of 29-34 pairs breeding outside the cliff-face systems.

The powerline breeding was recorded only in the Aral Sea region in the Bolshie Barsuki sands. Here we found 4 breeding territories of Sakers on a decommissioned powerline (182km long). We also surveyed 43.6km of powerlines with metal utility poles in the eastern Usturt, 134.7km of decommissioned powerlines with concrete poles in the Emba basin, and 90.7km of active powerlines with metal poles; all lacking Sakers. However every third pole of the surveyed powerline had a nest of raptors (mostly steppe or imperial eagles, and buzzards). The extrapolated number of Sakers breeding on powerlines in the Bolshie Barsuki sands is 10-12 pairs.

The Mugodzhary mountains and Mangistau range disappointed us with their lack of sakers, the reasons for which are difficult to understand. Mugodzhary has enough food supply (sousliks) and many nests of buzzards available, but is located too far north from the main core of the Sakers population. However a lack of Sakers in Mangistau (Eastern and Western Kara-tau), located in the center of densely populated by Sakers Magishlak peninsula, is difficult to comprehend. We did not find any sakers here in 2003 and in 2004, despite a thorough checking of the study area of 113.8km^2.

A lack of Sakers in the Mugodzhary Range means that it is possible that there is a gap between the breeding groups of the Sakers of the Caspian-Aral population and the population of the Guberlinskiy hillocks (north of the Aktubinsk District of Kazakhstan and Orenburg District of Russia), as well as the Southern Urals populations. The gap is 300km wide and covers forestless Mugodzhary, which also lacks good cliffs, as well as southern part of the Turgay depression, thus dividing the Saker range in Western Kazakhstan into 2 comparable parts.

Extrapolating surveys of Sakers in the Guberlinskiy hillocks made in the Orenburg District of Russia we estimate 40 tree-nesting and 30 cliff-nesting pairs for this ecoregion, 35 and 25 of which live in the Kazakhstan territory. It is possible to assume that the Sakers



also live in the Ori basin, with the total number being not more than 10 pairs. The numbers of Sakers breeding in the steppe pine tree forest patches and deciduous tree patches along the Tobol river in Kazakhstan is 80-90 and 20-30 pairs respectively (Bragin 2001, Karyakin 2004b). Thus the total number of the Northern Saker population in Kazakhstan is 145-165 pairs.

The total numbers of the Sakers in the Western Kazakhstan is 1204-1427 (median 1316 pairs), 88.2% of which breeds in the Caspian-Aral population and 11.8% in the Northern population. The average clutch size was 4.6±0.89 (3-6 eggs, N=16), average brood size was 4.1±0.82 (2-6 chicks, N-77).

During 2 years of surveys we found 194 active nests of Sakers (73.8% of all nests) on 176 breeding territories and 49 occupied, but empty nests on 40 breeding territories. The figures of occupancy project 836-943 (856 – median) breeding pairs in an average year, total number of adults 2119-2525 individuals, 1674-1886 of which take part in breeding. In autumn the total number of Sakers reaches 5558-6401 individuals.

Relatively high breeding rate appears to be a characteristic of the Southern population. The Northern population appears to be less productive. Occupancy rate is 55%, which is still higher than for Southern Russia – 41% (Karyakin 2003, Karyakin et al. 2004). The average brood size in the Northern population is 2.9±0.88 young per successful nest (N=24). This gives an estimated total of 517-589 individuals at the time of brood dispersal.

It appears that the newly discovered population is the largest in Middle Asia, and the Sakers' survival depends on its state. However there are real threats to Sakers in this region. There were several incidents of arrests of groups of Syrian trappers with packs of Sakers in 2002-2003. A lot of 12 females was confiscated by customs officials in the Aktau regional airport from illegal trappers from Arabian countries (Gubin 2002). In our surveys we saw several nests with the remains of climbing equipment left at the cliff-face. It seems that the surveyed population of Sakers suffered less as the nests are less noticeable, and the territory is less accessible in general. In addition the poorly designed powerlines could contribute to the Sakers mortality. The intensification of oil exploration in the past decade is a foundation for such fears. Most of newly built powerlines are not 'safe' for birds and do not have any breeding birds. The worst situation is at the Zhanaozen town, where there are 0.8 'unsafe' powerlines per 1km^2.

The Sakers' range experiences a high rate of fragmentation, and the total numbers are plummeting (Fox et al. 2003). The population in the Western Kazakstan suffered most. In the past 50-60 years the Sakers

disappeared from the forests along the Urals and Emba rivers, where it was numerous (Dementiev and Gladkov 1951). The Sakers of the Mugodzhary range had a similar fate, despite the fact that in 1940-50s it was considered as the only tree-less area with breeding sakers (Dementiev and Gladkov 1951). It is worth noting that the catastrophic decline was experienced by a population that is truly migratory, and thus are more susceptible to various threats. Also it is possible to hypothesise that the Sakers were badly influenced by overgrowing of the steppe and desert plants reacting to lack of grazing. The latter happened in large areas as a reaction of the collapse of animal husbandry in Kazakhstan in 90s. The collapse made the border between steppe and semi-desert biome to shift far south. Tall grass is also susceptible to fires and re-emergence of pyrogenic communities resulting in a decline of the sousliks and gerbils – the food base of the Saker. Indirectly this hypothesis could be supported by the fact that in low-grazing areas the numbers of Steppe and Imperial Eagles is lower than in the high-grazing areas.

So, internationally the problem is illegal smuggling; domestically, changes of traditional grazing levels. If the first problem has been addressed by the International bodies such as CITES and is recognised by the Kazakhstan Government, the second problem is not recognised and is largely unsolved.

The authors thank Andrey Semenov for his contribution in transportation, Ilya Smelyanskiy and Andrey Korolyk for help in the field, and the Falcon Research Institute, IWC/ERWDA for financial help.

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Diagnostic Investigation of Vulture Mortality: The Anti-inflammatory Drug Diclofenac is Associated with Visceral Gout

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Since 2000, white-backed vultures (*Gyps bengalensis*) in the Punjab Province of Pakistan have experienced significant population declines due to high mortality rates associated with the clinical syndrome of visceral gout (Gilbert et al., 2004; Gilbert et al., 2002). Histopathology has shown that the visceral gout is due to acute kidney failure in which the lesions were primarily characterized as severe, acute tubular necrosis, with minimal inflammatory infiltrates. These lesions are most compatible with an acute toxic etiology.

Toxicologic investigations ruled out toxic levels of heavy metals known to be associated with renal failure in birds, including cadmium, lead and mercury (Furness, 1996 Pain 1996; Thompson 1996). Although not classically recognized as nephrotoxic, toxic or deficient levels of other heavy metals, including arsenic, copper, iron, manganese, molybdenum and zinc also were not detected. Similarly, there was no evidence of acute intoxication by organophosphate, carbamate, or organochlorine pesticides. Virus isolation results were negative. Molecular biology (PCR) studies for avian influenza and infectious bronchitis virus, two viruses recognized as renal pathogens in poultry (Swayne 1994; Ziegler 2002) were negative.

With the exclusion of known causes of renal disease and/or acute death in birds, the studies were directed at novel toxins. Since the primary food source for the vultures in Pakistan are domestic livestock, we

hypothesized that veterinary drugs used to treat these livestock may be associated with kidney disease in the vultures. Surveys of regional veterinarians and veterinary drug retailers identified the non-steroidal anti-inflammatory drug diclofenac (Todd 1988) as a drug that was commonly used, absorbed orally and known to be nephrotoxic in other birds or mammals (Murray 1993). In addition, other related anti-inflammatory drugs such as indomethacin and flunixin have been shown to cause renal failure and visceral gout in other bird species (Nys 1983; Paul-Murphy 2001).

Kidney samples from 23 vultures with renal failure and 13 vultures without renal failure (control birds which were known to have died of other causes such as trauma, lead poisoning and intestinal foreign bodies) were tested by high performance liquid chromatography and mass spectroscopy for residues of diclofenac. All of the renal failure cases were positive for diclofenac, while none of the non-renal failure cases had diclofenac residues (Oaks 2004a; 2004b). To verify the toxicity of diclofenac for white-backed vultures, two non-releasable juvenile vultures were orally administered 2.5 mg/kg of veterinary diclofenac (the standard veterinary dose recommended for mammals) and two were administered 0.25 mg/kg. Both of the high dose birds and one of the low dose vultures died with visceral gout and the same histologic lesions as the field cases within 58 hours post-administration (Oaks 2004a; 2004b). These data and experiments strongly implicate diclofenac as the cause of renal failure and the population decline of white-backed vultures in Pakistan. Similar findings have also been recently reported from India (Schultz 2004), indicating that diclofenac is also responsible for the decline of vultures in this country as well.

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A Practical Technique for Fieldworkers Interested in Serological Testing Populations of Wild Raptors

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Veterinary issues in free-living raptor populations are becoming increasingly important to biologists and conservationists. The use of the anti-inflammatory drug, diclofenac in livestock has caused a devastating decline of vulture populations in India (Meteyer et al, 2004); indiscriminate application of the rodenticide bromdialone in Mongolia has caused massive declines in saker falcons (see Falco 23), while West Nile virus has been associated with an increase in raptor mortality in the USA (Joyner et al, 2004).

It is possible to collect and even analyse many veterinary samples during fieldwork if you are properly equipped with a generator and portable, robust equipment (e.g. freezers, centrifuges, and microscopes). However, such equipment is, unfortunately, not available to the majority of field biologists.

We report an easy, practical technique that could be used by our biologist colleagues who handle wild birds of prey and who are interested in collecting samples, but who do not have the luxury of being able to take a vet and his or her field equipment along with them.

This method has been used on samples collected from wild houbara bustards during hunting trips in Pakistan that have been subsequently analysed in a laboratory to check for antibodies against a selection of viral diseases (Wernery et al, 2001). The technique is simple and involves placing 2-3 drops of whole blood onto a filter paper strip (Scheicher and Schuell, Germany, H 740-E, 203x254mm). The filter paper is dried for several hours to avoid bacterial and fungal growth and then kept in a closed box until the field work is finished. In the study by Wernery et al (2001) the filter papers were tested at the Central Veterinary Research Laboratory in Dubai for antibodies against Newcastle disease and avian influenza using standard methods. It is probably possible to test for other avian diseases using this method (Wernery et al, 2003).

Serological surveys are an important tool for assessing the range of diseases and their prevalence that a wildlife population is exposed to and surveys have been conducted in European raptor populations (Schettler et al, 2001). To our knowledge, no surveys have been performed on raptor populations in Central Asia, although it is likely that wild raptors increasingly come into contact with feral or domestic birds and hence may be exposed to many important viral diseases of domestic birds. For example, over the last year avian influenza has been reported on many veterinary internet discussion groups as causing mortality in both captive and wild raptors in Asia.

This simple technique could be readily used by raptor biologists, because other than the filter paper and box for samples, no expensive or bulky equipment is needed. Please contact us at the address above for further information.

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Photo by S. Gombobaatar

Treatment of Lead Poisoning in Hunting Falcons

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Summary

An article summarising clinical experience with treating lead poisoning in hunting falcons used in Middle East falconry. This condition was an important phenomenon in the past, when birds killed with a shot gun were the main source of falcon food (Molnar, 2001). Occasional cases still occur, but the commercial availability of processed frozen falcon food has markedly reduced the incidence of this condition. Lead poisoning is still frequent in wild eagles and scavenging raptors (Kramer, 1997; Saito, 1997). Between 1999 and 2000 eighty-five falcons, suspected to have been exposed to shotgun lead pellets, were tested for lead poisoning. Tested falcons included saker falcons *(Falco cherrug*), peregrine falcons *(F.peregrinus*), gyr falcons *(F.rusticolus*) and their captive bred hybrids. Positive cases were confirmed by

1) the presence of radiodense heavy metal particles in gastro-intestinal tract.

2) elevated whole blood lead levels.

3) inhibited delta-aminolevulinic acid dehydratase (ALAD) activity.

Thirty-two percent of all tested falcons were test-negative for lead poisoning. Fifty-two percent were sub-clinical cases with elevated whole blood lead level or decreased ALAD activity. Sixteen percent of the falcons had severe symptoms of lead poisoning. Radiographs from only seven falcons (8.5%) showed heavy metal particles in ventriculus. Successful treatment was achieved with a repeated (2-3 times) regime of 5% Ca EDTA (Calciumedetate), ANIMALCARE (35 mg/kg TID or 50 mg/kg BID) for 5 days. In very severe cases when ALAD activity was 100% inhibited and blood lead levels exceeded 100 ml/l, 80-100 mg/kg EDTA i.v. with 20 ml Lactated Ringers solution markedly reduced the blood Pb levels and the clinical symptoms. The falcons fully recovered and subsequently performed very well as a falconry birds.

Toxic effect of lead

Lead is not a biogenic element. It is considered to be hemotoxic, neurotoxic, nephrotoxic and imunotoxic. In organisms lead inhibits different enzymes by its binding affinity to sulfhydryl (SH-) groups. From the clinical point of view the main diagnostic value is its haematotoxic abilities (Scheuhammer, 1987). Lead causes microcytic hypochromic anaemia in chronically exposured cases. The following enzymes incorporated to the cascade of haemoglobin synthesis are inhibited (Pagliuca et al., 1990):

d-ALAD (delta-aminolevulinic acid dehydratase),
ferochelatase,
uroporfyrin and protoporfyrindekarboxylase,
pyrimidin-5-nukleotidase.

As an effect of lead, the activity of d-ALAD is decreased and its substrate, ALA (aminolevulic acid), concentration is increased in the blood. The enzyme ferochelatase is also inhibited. Ferochelatase is responsible for incorporation of iron molecule (Fe^{3+}) into porphyrin cycle. As result of this inhibition in the acute cases the concentration of Fe^{3+} and also free porfyrins increase in the blood.

Materials and methods

Tested falcons were presented for routine clinical examination with different complaints. Most often the owner noticed decreased performance, muscle weakness, reduced appetite or constant weight loss even during excess feeding. In severe cases greenish discoloration of urine, crop stasis and seizures were presented. The CNS symptoms manifested usually after short-term exercise for only 0.5-2 minutes. The most typical symptom of acute lead poisoning with markedly increased blood lead levels was dysvocalisation. The falcons during exhalation vocalised a “ka-ka-ka-ka” –like voice. Endoscopic examination of the trachea revealed a narrowed lumen of the syrinx due to decreased tension of the external tympanic membrane. In cases where radiologic examination showed metallic, radiodense particles in the ventriculus the falcon was anaesthetised with isofurane and the particles were flushed out using a 5mm in diameter and 30 cm long gastric tube and 60 ml warm water. From all falcons with these

Clinical symptoms	0	+	++	+++
Pb (µg/dl)	0-5	5-15	15-40	40<
ALAD (U/dl)	50-30	30-10	10-2	2-0

Table 1. Correlation of blood Pb2+ level and ALAD activity with the clinical symptoms.

symptoms 1-1.5 ml whole blood was collected from the metatarsal vein. The blood tubes contained Ca EDTA as anticoagulant, because 90% of circulating lead is in the red blood cells. 0.5 ml unclothed blood was sufficient for blood Pb^{2+} detection using GFAAS (graphite furnace atomic absorption spectrometry) techniques. As additional tests CBC, RBC, Fe, Hb and d-ALAD activity tests were conducted. For the determination of ALAD activity using the method of Moder (1983) 0.3 ml of whole blood was essential. The test is based on the reaction of haemolysed blood and aminolevulinic acid (ALA) as substrate. The product of the reaction is porphobilinogen which is detected by a spectrophotometer. ALAD is a very unstable enzyme and fast detection of its activity is necessary. Pb^{2+} and ALA are very stable substances in the blood and samples can be stored for a long time. In cases positive for lead poisoning, treatment was initialised with 50 mg/kg of 10% Ca EDTA i.v. mixed in 20 ml LRS. In very severe cases even an increased dose of 100 mg Ca EDTA mixed in LRS was well tolerated and markedly reduced clinical symptoms. Next doses were reduced to 35 mg/kg i.m. TID or 50 mg/kg i.m. BID for 5 days. In all treated cases daily 60 ml oral fluids were administered. Two to three weeks after 5 days detoxifying treatment regime the patient was re-evaluated. If the blood lead level was still high and ALAD activity did not increased markedly, the CaEDTA treatment regime was repeated.

Results and Discussion

Blood lead level and activity of ALAD were used as indicators of lead poisoning as well as markers of efficiency of detoxifying treatment. In falcons with known histories that were never exposed to lead, blood lead level was very low 0.5-2 mg/dl (0.005-0.02 ppm) and ALAD activities were in range 30-50U/dl. If lead exposure had occurred, ALAD activity was inhibited within 2-3 days. In most severe cases activity were 100% inhibited (0 U/dl detected level) and correlated with 60 mg/dl Pb level and above. The highest detected blood levels were 308 mg/dl, 240mg/dl and 172 mg/dl. In our experience blood Pb^{2+} level did not correlate with the clinical symptoms of lead poisoning in all treated cases and did not reflect the whole body Pb^{2+} content. A single injection of Ca EDTA can significantly reduce the blood Pb^{2+} levels. This decrease is temporary and lead levels will rise up again within few days. The inhibition of ALAD activity correlates with clinical symptoms. In our clinical experience the blood lead level did not correlated with total amount of absorbed lead. Ten to forteen days after the termination of Ca EDTA treatment the blood lead level rises again. The reason is that Ca EDTA chelates the lead only from the blood and lead is released from organs and interstitial tissues. A good indicator of recovery is when ALAD activity rise above 20-25 U/l and with it blood lead level simultaneously decreases. Other haematological indicators as Hb, RBC indices show changes only after chronic, high dose exposure and are not suitable to monitor sub-clinical patients. The absorbed lead circulates in the blood for about 25-30 days. Then starts a slow deposition into the bones.

In three cases after a long period of sub-clinical lead exposure, falcons started to show symptoms similar to lead poisoning (vocalisation, seizures, reduced ALAD activity). All three falcons had a history of being fed with mutton and goat meat, which are low in calcium. We think that a long-term low calcium diet can induce calcium release form the bones and the same time release of Pb^{2+} deposits can cause recurrent lead poisoning. Repeated intravenous administration of Ca EDTA even in higher dose (80-100 mg) did not have any nephrotoxic side-effects, especially if sufficient rehydratation was provided. If treatment is repeated 2-3 times it is a very effective way to treat lead poisoning in falcons. The birds can fully recover and well perform. The parallel blood sampling for detecting blood Pb level and ALAD activity provides more exact prognostic information to evaluate the patient and monitor efficiency of treatment. The exposure time and the total amount of absorbed lead are factors considered to be responsible for the sudden onset of clinical symptoms related to lead poisoning in falcons.

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A New Public Hospital in Dubai for Falcons and Exotic Species

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In October 2004 a new purpose built veterinary hospital opened in Dubai, United Arab Emirates, for the treatment of avian and exotic species. The 'Nad Al Sheba Veterinary Hospital' is closely associated with the Nad Al Shiba Avian Reproduction and Research centre, a large falcon captive breeding facility in the Emirate. The hospital hopes to target the large population of falconers who do not qualify for treatment in the Royal family falcon clinics. The hospital will also provide a service for exotic animal collections and the camel racing industry.

The hospital was converted from an existing majilis and thus incorporates both modern facilities with elements of traditional architecture. Double electric sliding doors allow 'hands free' access to the reception area, which leads directly to the examination room. From this point the radiology, endoscopy, imping, surgical suites and intensive care unit are all directly accessible. A separate room for each of these purposes allows them to be fully utilised during busy periods. Staff living on site will provide 24-hour emergency cover.

An in-house laboratory with dedicated staff is incorporated into the hospital. This will provide rapid results for haematology, cytology, parasitology, microbiology and biochemistry in the hope of providing a quick diagnosis, whilst improving client convenience.

A separate facility has been built for the quarantine of newly imported birds that incorporates its own examination and post-mortem facilities. Each room within the quarantine block individually ventilated with no recirculation of air inside the building.

Other facilities include a central anaesthetic gas and scavenging system, nebulising chambers, Idexx external fixation equipment, electrosurgery, pharmacy, high frequency X-ray machine with floating table and automatic film processor, Storz^{TM} AIDA endoscopy with image capture system and holding pens for up to 10 hospitalised birds.

The close link between the Nad Al Shiba Avian Reproduction and Research Centre and the hospital will ensure that each bird is given a full veterinary health screen before sale and that all new breeding stock are screened before introduction into the breeding population. The hospital and breeding facility will share access to closed flocks of quail ensuring, as much as possible, a disease free source of food for breeding and hospitalised birds.

The computer program has been modified specifically for the hospital, but is also used in a number of other falcon clinics in the region, which should facilitate the transfer of data between clinics. Our program has been modified to include species in addition to falcons and has also been developed with a research capability in mind. This will allow searches of archived data by whichever criteria the veterinary surgeon chooses. The computer system is able to store digitalised images of radiographs, endoscopic procedures, clinical / laboratory images and ECG traces. This will enable us to produce a complete report for clients who require a pre purchase check or general health examination of their bird.

The Nad Al Shiba veterinary hospital hopes to provide a quality veterinary service whilst filling a gap in the market in Dubai. We are also aware of the responsibility veterinary hospitals have in furthering the advancement of avian medicine within the region and feel that our large potential client base coupled with our links to a breeding facility put us in a unique position in this respect.

Update on past Falco contributors.

Dr Michael Lierz, formerly from Al Khazna Falcon Hospital, Abu Dhabi, is currently working at the Institute for Poultry diseases at the Free University of Berlin. Michael has helped to establish a bird hospital at the university. He sees mainly birds of prey and parrots, some racing pigeons and a few zoo birds and ornamental poultry. Michael is still working on Mycoplasmas and avian pox.

Congratulations to Dr Kate Oddie who has just married the celebrated past Falco editor, Dr Nigel Barton! They have just had a little baby girl called Pepita. Nigel and Kate are working in Mongolia on a Darwin Initiative and Zoological Society, London sponsored project and are also doing part-time work for the Wildlife Conservation Society.

What's new in the literature

Krone, O., Essbauer, S., Wibbelt, G., Isa, G., Rudolph, M. and Gough, R.E. 2004. Avipoxvirus infection in peregrine falcons (*Falco peregrinus*) from a reintroduction programme in Germany. Veterinary Record. 154: 110-113.

Poxvirus infections are common in domestic birds in Germany, but are rare in birds of prey. Only species of falconidae imported from Arabian or Asian countries have so far tested positive for poxvirus, and, among these, only raptors kept for falconry. As part of a re-introduction program in the northern county of Mecklenburg-Western Pomerania, which is located adjacent to the Baltic Sea, 21 peregrine falcons were released into the wild; six of them died and one was examined postmortem, its tissues being examined by light and electron microscopy. In addition, an ELISA for fowlpox, pigeonpox and canary pox was applied. No virus could be isolated and propagation in culture failed, but virus particles were detected by electron microscopy in lesions from its skin and tongue.

Peregrine falcon with advanced poxvirus infection characterised by proliferative dermatitis of nares, beak and eyelids, the latter severely disabling the sight of the bird's left eye. Digitalised photograph from a video film from June 2000 (courtesy of H. Voigt).

Di Somma, A., Bailey, T.A., Silvanose, C., Garcia-Martinez, C. 2004. The use of voriconazole for the treatment of aspergillosis in falcons. Proceedings of SIVEA, Rome, Italy.

The objective of this study was to evaluate the clinical efficacy and safety of voriconazole in the treatment of aspergillosis in falcons. From January 1, 2003 to March, 1, 2004, a total of twenty-five falcons, including 5 gyrfalcons (*F. rusticolus*), 14 gyrfalcon hybrids, 1 lanner (*F. biarmicus*), 1 red-naped shaeen (*F. babylonicus*), 1 saker (*F. cherrug*) and 3 peregrines (F. peregrinus), were admitted to Dubai Falcon Hospital for treatment of aspergillosis with voriconazole. Affected falcons showed general clinical signs including loss of weight, inappetance, dyspnea, inspiratory stridor, tachypnea and biliverdinuria. The diagnosis of aspergillosis was made from clinical signs, hematogic evaluation, radiographic features, endoscopic examination of the lower respiratory tract, cytological observation of typical Aspergillus conidiophores on surgical samples from air sacs and positive fungal cultures. Therapy consisted of oral administration of voriconazole by crop gavage twice a day for 3 days (loading dose) and then once a day for other 15-105 days (median treatment duration 49 days). Treatment with voriconazole resulted in successful clinical response, good survival rate and few side effects. Complete clinical resolution occurred in 76% (19/25) of the cases, a partial response was observed in 16 % (4/25) of cases and only 2 individuals failed to respond to treatment (8% of failure). To further document the in vivo- in vitro correlation of antifungal activity, the Minimum Inhibitory Concentration (MIC) of voriconazole was compared to the

Famous falcon from Dubai in 2004 that had new aspergillosis treatment, voriconazole, and recovered and went on a hunting trip in Pakistan.

MIC of 2 major antifungal drugs: amphotericin B and itraconazole. The in-vitro tests showed that all the Aspergillus strains were susceptible to voriconazole activity, whereas many strains were resistant to itraconazole and amphotericin B activity.

Lindberg, P., Sellstrom, U., Haggberg, L. and de Wit, C.A. 2004. Higher brominated diphenyl ethers and hexabromocyclododecane found in eggs of peregrine falcons (*Falco peregrinus*) breeding in Sweden. Environmental Science and Technology. 38: 93-6.

Several brominated flame retardants (BFRs) were analyzed in peregrine falcon eggs collected in 1987-1999, including the constituents of the technical polybrominated diphenyl ether (PBDE) products Penta (BDE-47, -99, -100, -153, -154), Octa (BDE-183), and Deca (BDE-209), hexabrominated biphenyl (BB-153), and hexabromocyclododecane (HBCD). The eggs represented females from three different breeding populations, northern Sweden, southwestern Sweden, and a captive breeding population. All BFRs analyzed for were found, including BDE-183 and -209, and concentrations were much higher in wild falcons (geometric mean sigmaPBDE, BB-153, and HBCD for northern/southern populations of 2200/2700, 82/77, and 150/250 ng/g lw, respectively) than in captive falcons (39, 8 ng/g lw, and not detected, respectively). This is the first time, to our knowledge, that BDE-183 and -209 have been quantified in high trophic level wildlife.

Wienburg, C.L. and Shore R.F. 2004. Factors influencing liver PCB concentrations in sparrowhawks (*Accipiter nisus*), kestrels (*Falco tinnunculus*) and herons (*Ardea cinerea*) in Britain. Environmental Pollution. 132: 41-50.

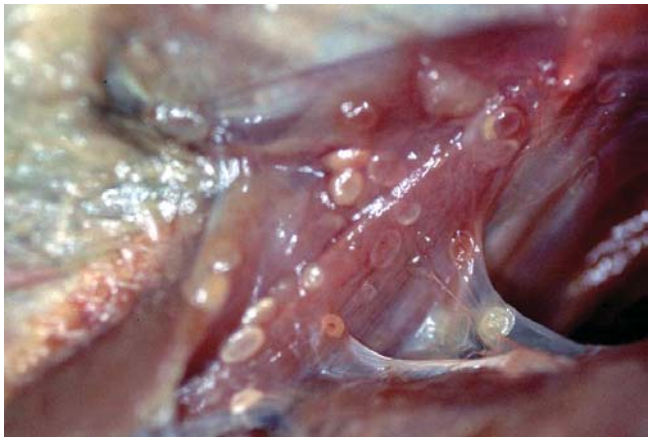
Large scale temporal and spatial changes in the exposure of terrestrial vertebrates to PCBs have been monitored in the UK by measuring liver residues in sparrowhawks (*Accipiter nisus*), kestrels (*Falco tinnunculus*) and grey herons (*Ardea cinerea*) from throughout the country. Residues in the three species are typically characterised by large intra- and inter-specific variation. Data for 306 sparrowhawks, 186 kestrels and 47 herons collected between 1992 and 1997 as part of a national Predatory Bird Monitoring Scheme were examined to determine how much of this variation was explained by body condition, age and sex, rather than other factors. In all three species, body condition was the single most important factor and accounted for up to 49% of the variation in PCB liver residues; starved birds had the highest liver concentrations. Age and sex were also significant but of lesser importance. Adult sparrowhawks and kestrels had liver PCB residues that were 2 to 10-fold higher than in first-year birds. Sex did not affect residue magnitude in a consistent manner. PCB concentrations in the liver were higher in males than females in both first-year and adult kestrels and in first-year sparrowhawks, but adult female sparrowhawks had similar PCB residues to adult males. Liver residues also varied seasonally. PCB concentrations in first-year sparrowhawks increased during the first year following fledging and a similar pattern was detected in adult female sparrowhawks following egg laying. When these physiological factors were taken into account, it was evident that while kestrels with high fat scores had significantly lower PCB concentrations than either sparrowhawks or herons, liver residues were similar in all three species when birds were in a starved condition. Overall during 1992-1997, the combined influence of body condition, age and sex explained more of the variation in liver PCB concentrations than species differences or other factors, such as geographical variation in exposure.

Cunningham, A. A.,Prakash, V.; Pain, D.; Ghalsasi, G. R. ; Wells, G. A. H. ; Kolte, G. N. ; Nighot, P. ; Goudar, M. S.; Kshirsagar, S.; Rahmani, A.. Institution Wildlife Epidemiology, Institute of Zoology, Regent's Park, London, NW1 4RY, UK. Title Indian vultures: Victims of an infectious disease epidemic? Source Animal Conservation. 6(3). August 2003. 189-197.

During the 1990s, populations of two species of griffon vulture, the Indian white-backed Gyps bengalensis and the long-billed Gyps indicus, declined by more than 90% throughout India. These declines are continuing and are due to abnormally high rates of both nesting failure and adult, juvenile and nestling mortality. Affected birds exhibit signs of illness (neck drooping syndrome) for approximately 30 days prior to death. Epidemiological observations are most consistent with an infectious cause of this morbidity and mortality. To investigate the cause of these declines, 28 vulture carcases, including adults and juveniles of both species, were examined in detail. Significant post-mortem findings included visceral gout, enteritis, vasculitis and gliosis. Although we have not yet been able to identify the causative agent of the declines, the results of our pathological studies are most consistent with those for an infectious, probably viral, aetiology. We examine hypotheses for! the cause of the declines and, based on our epidemiological and pathological findings, we show infectious disease to be the most tenable of these.

Gibbons, L.M., Nicholls, P.K., Bailey, T., and Samour, J. 2004. *Paraspiralatus sakeri n. g., n. sp.* (Nematoda: Spiruroidea, Spirocercidae) from saker falcons, *Falco cherrug* in Saudi Arabia and the first report of larvae from the subcutaneous tissues of houbara bustards, *Chlamydotis undulata macqueeni* in Pakistan. Journal of Helminthology. 78: 33-40.

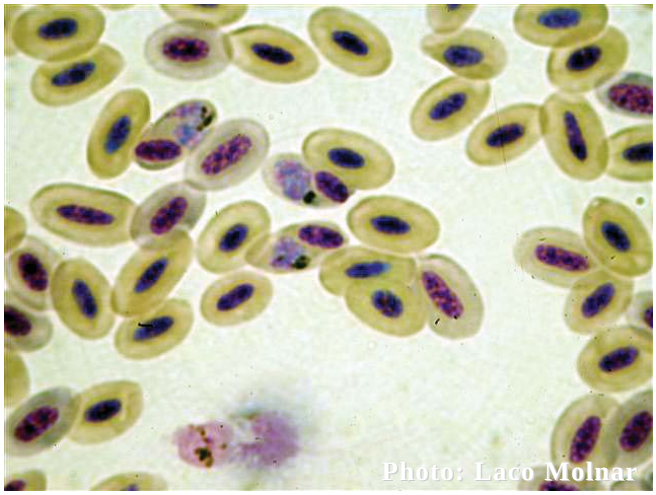
A new nematode genus and species, *Paraspiralatus sakeri* (see below), is described from the stomach of a wild-caught, female saker falcon in Saudi Arabia. This spirurid differs from the nearest genus and



species Spiralatus baeri Chabaud, Brygoo & Durette, 1963 in the shape of the pseudolabia, shape of the buccal capsule and absence of a large cephalic vesicle. In addition, third stage spirurid larvae were recovered for the first time from subcutaneous tissues of two houbara bustards. These had died in the Rahim Yar Khan Rehabilitation Center (Houbara Foundation International, Lahore, Pakistan) in Pakistan and were examined at the National Avian Research Center in the United Arab Emirates. The morphology of the larvae and host pathology are described. Comparative studies with the adult spirurids from the saker falcon showed each to have similar cephalic and pharyngeal morphological features to the adults described indicating they are probably the same species. Spirurid nematodes of the suborder Spirurina normally have an arthropod intermediate host. In view of the host, the site from which the larvae were recovered and the fact that this is a rare occurrence, the houbara bustard is considered to be a paratenic host.

Molnar, L. and Molnarova, M. Avian malaria in imported gyr falcons in the United Arab Emirates. Proceedings of the Association of Avian Veterinarians and European College of Avian Medicine and Surgery, Tenerife. 2003.

The authors reviewed the clinical history of avian malaria cases in gyr falcons (*Falco rusticolus*). In 2001 and 2002 seasons an infection caused by *Plasmodium relictum* was diagnosed in 7 captive-bread gyr falcons admitted for general examination in the Abu Dhabi Falcon Hospital and the H.H. Sh Sultan Bin Zayed Al Nahyan Falcon Hospital. The falcons were shipped to Middle East in autumn 2001 and 2002 from North America for traditional falconry purposes. Neat's stain of blood smears of these falcons showed high (44% and 36%) parasitaemia in two cases, two moderate, (18% and 16%), and three cases of low parasitaemia, (<10%). Clinical examination of the individuals with high parasitaemia revealed an acute onset of severe dehydration, (PCV 55-58%), reduced performance, decreased appetite and thickened - grey discoloration of the urine part of the faecal. Radiological examination showed splenomegaly, nefromegaly and hepatomegaly. Treatment consisted of primaquine - PRIMAQUINE PHOSPHATE, (0.75 mg/kg SID) and chloroquine MALAREX, (25 mg/kg SID initial loading dose continued with 15 mg/kg) at 0-12-14 and 48 hours. In two cases relapses occurred. Repeated treatment with increased dose of primaquine (1.9 mg/kg) and chloroquine (37.5 mg/kg) resulted in another relapses of parasitaemia. Treatment regime with pyrimethamine-DARAPRIM (12 mg/kg) and sulphadiazine-DUPHATRIM (25 mg/kg SID) for four days cleared the parasitaemia. Three months after treatment initial body weight was reduced by 12% and *Plasmodium* parasites appeared again in the peripheral blood, but with no clinical symptom. Mefloquine –MEPHAQUIN (25 mg/kg SID) 0-12-14-48 hours apart continue with 25mg/ kg once a week for next 4 weeks was used for treatment. From all treated falcons a blood sample for hematology and biochemistry examination was collected twice a week during the whole treatment regime. In 2002 one falcon died due to *P. relictum* infection from the same breeder, in which case an above mentioned mefloquine treatment regime was used. Histopathology



revealed large amounts of malaria pigment in the liver and kidneys. The falcon died due to parenchymatic organs damage caused by the extra-erythrocyte stage of parasite development. The presence of the vector species in Middle East and large number of imported captive-bred falcons are questioning the importance of malaria screening in birds traded from North America.

Editors note: *We saw two cases of avian malaria at Dubai Falcon Hospital in the 2003 season. One case was in an imported gyrfalcon from the USA, the second case was in a locally bred gyr hybrid that had been kept in the same room as the USA bird. Although it was not possible to determine the vector for the parasite, these cases indicate that malaria does have the potential to be introduced into the region from imported birds.*

Book Review

Colour Atlas of Falcon Medicine. Renate Wernery, Ulrich Wernery, Jorg Kinne and Jaime Samour. Schlutersche Verlagsgesellschaft, Hannover. 2004. 134 pp. $120, GBP76

Reviewed by: Dr Tom Bailey, Dubai Falcon Hospital, PO Box 23919, Dubai, United Arab Emirates**.** tom.bailey@dfh.ae

This is a pictoral atlas of the diseases occurring most commonly in falcons. The book is divided into nine chapters: Falcons and Falconry in the Middle East; Haematology and Blood Biochemistry; Viral Diseases, Bacterial Diseases; Fungal Diseases; Parasitic Diseases; Miscellaneous Diseases; Diseases of Unknown Aetiology and Vaccination Regime.

Undoubtedly the strength of this book are the high quality images of falconry, haematology, clinical conditions, gross pathology, laboratory techniques and histopathology. They are superb and the book is worth purchasing for the images alone. Chapter 1 sets the scene by providing the background to the book - a series of wonderful pictures of contemporary falconry in the Middle East, portraying the falcons, the falconers and the hunting parties.

Chapter 2 will be especially useful to veterinarians and laboratory technicians working with raptors. Nowhere else has the normal and abnormal haematology of raptors been so well explained through images. Anyone performing their own haematology will find this section of

the book indispensable when interpreting normal and abnormal blood films. In the tables of normal haematology values (Tables 2.4 to 2.11) it would have been useful to have conducted appropriate statistics according to the distribution of the data (parametric or non-parametric) and to have included the range and a 95% confidence interval.

I have no experience with automated haematology systems with falcons, but consider that these systems tend to overestimate the white cell count compared to manual methods. The haematology values presented in Tables 2.4 to 2.11, derived from the Cell Dyn 3500 analyser would appear to be 20-30% higher than values calculated using manual methods that are reported in the literature (Samour et al, 1996) or that are used in-house in our hospital. In the preface the authors have highlighted the need for the laboratory equipment industry to develop new technologies that can be applied to falcons and the wider field of avian medicine. This is clearly important and studies correlating manual with automated haematology results are also warranted. Like any book there will always be some areas where one has an alternative view to the authors, but these comments are minor areas that do not detract from the overall value of the book. For example, in the section on falcon leukogrammes the authors consider white cell counts above 15-17,000 are rarely exhibited in infectious diseases. In our hospital we commonly see leukogrammes in excess of 20,000, particularly in aspergillosis cases. That said I congratulate the authors for presenting their data. Tens of thousands of haematology samples have been processed at falcon hospitals throughout the Middle East over the last two decades, and it is surprising that with the exception of Samour et al (1996), not one hospital has published their data (and I am guilty too). It is amazing how much more basic research is needed in this field.

The section on biochemistry could be improved in future editions. The authors state that EDTA samples were used to derive the chemistry parameters. Chemical artefacts are reported to occur in such samples, particularly phosphorus and calcium (Hochleithner, 1994; Fudge, 1997; 2000). I could not find a legend explaining whether the parameter ranges given in Table 2.18 are ranges (maximum - minimum) or confidence intervals, I assume they are ranges. Statistical interpretation of the data would have been helpful in establishing reference intervals for the biochemistry results in Table 2.17. The use of mean and standard deviation is not appropriate for data that has a non-parametric distribution. Many recent publications presenting reference values for avian species assess whether the data for each parameter is parametrically or non-parametrically distributed and then conduct appropriate statistical tests to determine confidence intervals (Lumeij, 1987; 1993; Lierz, 2003). Likewise, as a clinician I have a tendency to be cautious of laboratory-derived normal values because laboratories can only base their assessment of normality from the clinicians specimen report. Many is the time an apparently clinically 'normal' bird that was blood sampled for a routine health check on one day, is diagnosed with a serious condition a day or so later.

Chapter 3, Viral diseases, is highly informative and very well laid out. Again the haematology pictures combined with the tables of haematology/chemistry results from falcons will be helpful to clinicians in the diagnostic front line. The sequence of images on various viral diseases in prey species (houbara, stone curlew, etc) provide the reader with an insight into why these diseases are so important in falcons in the Middle East. The gross pathology images throughout the viral, bacterial and parasitic disease chapters are excellent and will be very helpful for anyone having to conduct post-mortem examinations. Likewise, I am sure the histopathology images will be helpful to pathologists. The section on parasitic diseases will be a very handy reference to have next to your microscope because the haemoparasites and other parasites of falcons have not been as well illustrated in the other raptor texts. Future editions of this book could consider including a series of cytology images. In addition more clinical images, including radiographs and gross lesions in the disease sections, particularly bacterial diseases, would be helpful for veterinarians making clinical interpretation in a hospital setting.

The book might have been better termed *A Colour Atlas of Haematology and Diseases of Falcons*, because the emphasis on medicine is limited. That said *Colour Atlas of Falcon Medicine* is a worthy addition to the raptor and avian literature. Its greatest value is the profuse use of high quality images and this is a book that will certainly complement other more medically orientated texts on raptor medicine such as *Birds of Prey Medicine and Management* by Manfred Heidenreich or *Birds of Prey Health and Disease* by John Cooper. I congratulate the authors for this impressive atlas that shares their knowledge and experience gained over decades of work with raptors and laboratory medicine in the Middle East. To anyone with an interest in raptor health and management, this is an essential purchase for your bookshelf.

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