

## Part 3

# Falcons in Asia and the Middle East

*Shikra Accipiter badius*



Conveners:

Nick Fox & Vladimir Galushin



# Saker *Falco cherrug* and Peregrine *Falco peregrinus* Falcons in Asia: Determining Migration Routes and Trapping Pressure

C.P. Eastham, J.L. Quinn and N.C. Fox

## ABSTRACT

New information on the migration routes of Saker Falcons *Falco cherrug* and Peregrine Falcons *Falco peregrinus* in Asia is presented using satellite tracking, recoveries of Passive Integrated Transponders (PITs or microchips) and recoveries of ringed birds. Traditionally both species are trapped whilst on migration for use in Arab falconry. Migration data reveal populations that are potentially under threat from over-trapping although more intensive studies are required to quantify this accurately. This information is essential for the conservation action plan - *Global Strategy for the Conservation of Falcon and Houbara Resources*.

Over the last five years fieldworkers have been microchipping and ringing populations of Sakers in Kazakhstan, Mongolia, Kyrgyzstan, Russia, and Peregrines in the Taymyr Peninsula, Russia. Recoveries of microchips and rings have been made in the falcon markets of Pakistan and the falcon veterinary hospitals of the United Arab Emirates.

Using 30g satellite transmitters the migration routes of six Peregrines on the Taymyr Peninsula, Russia, and one Saker in the Russian Altai Mountains were recorded. The Peregrines started their migration from Taymyr in mid September, travelling south through Russia, Kazakhstan and into south-central Asia and Arabia. The Saker migrated a total distance of 4750km from her breeding grounds in the Altai Mountains, into central China, and back to the breeding grounds in the Altai Mountains by 12 March.

## INTRODUCTION

The Peregrine Falcon *Falco peregrinus* has a world-wide distribution with nineteen recognised subspecies (White & Boyce, 1988) while Saker Falcons *Falco cherrug* breed in central Asia and eastern Europe and have six subspecies (Dementiev, 1951). In the northerly parts of their range both species are migratory but are resident in the south. Sakers in the Kustany region of Northern

Kazakhstan, for example, tend to be migratory whilst those in southern Kazakhstan tend to be sedentary (Kenward & Pfeffer, 1995).

The migration routes of both species and the locations of their wintering areas are poorly known. Some Peregrines migrate into Africa, India, south-east Asia, and the Middle East. Peregrines from northern Siberia and north-east Europe (*F. peregrinus calidus*) winter as far south as South Africa (Cramp & Simmons, 1982; Stephenson *pers. comm.*). Some northern Sakers migrate into southern Asia, the Middle East, north-east Africa and southern Europe. However, very little is known about migration routes of different populations, migration speeds and the length of time spent at resting sites and on the wintering grounds.

Sakers and Peregrines have traditionally been trapped in autumn and winter and used in Arab falconry (Remple & Gross 1993) but the origins of these birds are not well known. Recently, trappers have started to move into the breeding grounds, trapping falcons earlier in the season. This has meant that even the most remote breeding grounds are now under possible threat.

It is not known whether current trapping pressure is sustainable. The National Avian Research Center (NARC) aims to answer these questions by satellite tagging and marking adults and chicks throughout their ranges, both in the wild and in captivity. NARC currently co-ordinates projects in Kazakhstan (since 1992), Mongolia (since 1994), Russia (since 1997) and the Kyrgyz Republic (1998) for Sakers, and the Taymyr Peninsula, Northern Siberia (since 1996) for Peregrines. Here we present preliminary information from some of these on-going studies.

## METHODS AND MATERIALS.

Fieldworkers and biologists from the falcon-range countries were trained in ringing and microchipping techniques through workshops, videos and using the *ERWDA* (Environmental Research and Wildlife Development Agency) *Handbook of Falcon Protocols* (Fox *et al.* 1996). Rings were normally obtained through the ringing organisation of each country and ringing returns are reported through the Moscow Bird Ringing Centre and the British Trust for Ornithology.

Passive Integrated Transponders (PIT's), commonly termed microchips, were purchased from AVID PLC and inserted subcutaneously above the pectoral muscle. Each microchip has a unique number that is read using a hand-held scanner. Details are stored on the Middle East Falcon Research Group (MEFRG) microchip database. Falcon veterinary hospitals in the Middle East use the same microchips and most falcons visiting a hospital for medical treatment are routinely scanned and fitted with a new microchip if none is already present. Using data gathered from ring and microchip recoveries, with a large enough sample size, it should be theoretically possible to estimate the harvest rate from a given population. The validity of this approach is discussed below and is dependent on the assumption that the proportion of the total number of birds originally marked and subsequently detected at hospitals or elsewhere is directly related to the number actually trapped.

A small number of falcons were fitted with satellite transmitters, also called platform transmitter terminals (PTT's). Transmitters were mounted on the back between the wings at the front end using an individually fitted harness made from Teflon ribbon and bungee cord. The harness consisted of loops directly attached to the PTT, one made of Teflon positioned around the neck, and a second made from Teflon and elastic bungee cord placed around the body in front of the legs. After fitting the harness to the bird, the two loops were joined together by sewing them to a strip of Teflon lying along the sternum. The neck loop was attached to the PTT in such a way that it lay on top of the furculum and did not interfere with the bird's crop. Details of the harness design are found in the *ERWDA Handbook of Falcon Protocols* (Fox *et al.* 1996). Information from satellite tracking was gathered using the Argos Data Collection and Location System. Details of how the accuracy of a transmitter location was ensured are found in the Argos User Manual (1996). The battery life for each transmitter was approximately six months.

The NARC field-team in Russia trapped two adult female Sakers in the Altai Mountain range. One falcon was trapped near the town of Maralikha, close to the Kazakhstan border and the other one in the Kosh-Agach region near the Mongolian border. Both were ringed, microchipped and fitted with 30g transmitters before being released. Each transmitter represented 2.2-2.9% of the falcon's body-mass.

In late July/early August 1996, two adult female Peregrines were trapped using dho-gazza nets along the Pura River on the Taymyr Peninsula, Russia, and fitted with 30g satellite transmitters. The adults were trapped at their nests containing half-fledged chicks. In 1997 satellite transmitters were fitted to two adult females and two almost-fledged young females on Taymyr.

## RESULTS

### Saker Falcons

#### *Ring and PIT recoveries*

Saker Falcons were first microchipped or ringed in Kazakhstan in 1993, through a collaborative project between NARC and ITE (Institute of Terrestrial Ecology). Since then biologists from other parts of the Sakers' breeding range have become involved in the programme (Table 1).

**Table 1. Ring and PIT recoveries of Saker Falcons since 1993.**

| <i>Country/region</i> | <i>Year</i> | <i>Sakers marked</i> | <i>Recoveries</i>                                                                                                                                 |
|-----------------------|-------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Northern Kazakhstan   | 1993        | 26                   | 1. Four juvenile females - location unknown.                                                                                                      |
|                       | 1994        | 31                   | 1. Juvenile male trapped in Saudi Arabia.                                                                                                         |
|                       | 1995        | 36                   | 1. Juvenile female recovered at the Dubai Falcon Hospital.                                                                                        |
|                       | 1996        | 24                   |                                                                                                                                                   |
|                       | 1997        | ?                    | 1. Juvenile female trapped south of Jeddah, Saudi Arabia.                                                                                         |
| Eastern Kazakhstan    | 1993        | 4                    |                                                                                                                                                   |
|                       | 1994        | 20                   | 1. Juvenile female trapped in China and recovered at the Dubai Falcon Hospital.                                                                   |
|                       | 1997        | 32                   | 1. Juvenile female trapped in China and recovered at the Dubai Falcon Hospital.<br>2. Two juvenile females trapped in Mongolia and then released. |
| Central Kazakhstan    | 1993        | 10                   | 1. Juvenile female - location unknown                                                                                                             |
|                       | 1994        | 10                   |                                                                                                                                                   |
| South-east Kazakhstan | 1993        | 19                   | 1. Two juvenile females - location unknown                                                                                                        |
|                       | 1994        | 13                   |                                                                                                                                                   |
|                       | 1995        | 16                   |                                                                                                                                                   |
| Kyrgyzstan            | 1998        | 15                   |                                                                                                                                                   |
| Russia                | 1997        | 3                    |                                                                                                                                                   |
| Mongolia              | 1994        | 43                   |                                                                                                                                                   |
|                       | 1995        | 84                   | 1. Juvenile female recovered at the Dubai Falcon Hospital.                                                                                        |
|                       | 1998        |                      |                                                                                                                                                   |

Of the 30 juvenile female Sakers marked in Kazakhstan in 1993, the British Trust for Ornithology reported five returns from captive female Sakers in Iraq, Pakistan, Syria, Turkey, and Yemen (Kenward & Pfeffer, 1995). Three additional microchip returns came from Sakers checked in falcon hospitals in the U.A.E., two checked in Dubai and the third in Abu Dhabi. The microchip return in Abu Dhabi corresponded to a ring return in Syria. The capture locations of these falcons are uncertain. A total of seven females captured represent 23% of the 30 marked females. Kenward & Pfeffer (1995) also give a record of one male trapped in central Kazakhstan and released again.

Only two microchip recoveries were made in 1994. One female marked in eastern Kazakhstan close to the Chinese border had reportedly been trapped in China and was subsequently recovered at the Dubai Falcon Hospital. Another male originally marked in northern Kazakhstan was trapped in Saudi Arabia. This male had also been fitted as a nestling with a radio transmitter by Robert Kenward.

Two microchip returns from female Sakers marked in 1995 were made at the Dubai Falcon Hospital. One female was microchipped in northern Kazakhstan and the other in eastern Mongolia.

In 1996 twenty-four Saker chicks in northern Kazakhstan were microchipped through Robert Kenward's study. To our knowledge no returns were made.

In 1997 four Saker returns were made, three from juvenile females marked in eastern Kazakhstan (Watson, 1997) and one from a juvenile female marked in northern Kazakhstan. The latter was trapped 100 km south of Jeddah, Saudi Arabia. Of the three Sakers marked in eastern Kazakhstan, one was recovered at the Dubai Falcon Hospital and had supposedly been trapped in China. The second was trapped by an Arab falconer in Mongolia and then released again (Upton pers. comm.). The third Saker was also trapped in Mongolia, north-east of the Hangayn Nuruu Mountains, and then released again. The two Sakers trapped in Mongolia were siblings ringed as nestlings in eastern Kazakhstan. Of the 21 females marked in eastern Kazakhstan, 3 were trapped, suggesting a harvest rate of 14.3%. However, two of these females were released.

#### *Satellite telemetry*

The transmitter fitted to the Saker Falcon trapped near Maralikha never moved and its fate is unknown. The second falcon was tracked from 12 October 1997 to 20 June 1998 (Fig. 1) and migrated a total distance of 4750km, excluding local movements.

After her release, the falcon remained in the Kosh-Agach region until 17 November 1997, occasionally moving south-east into Mongolia and returning to Kosh-Agach.

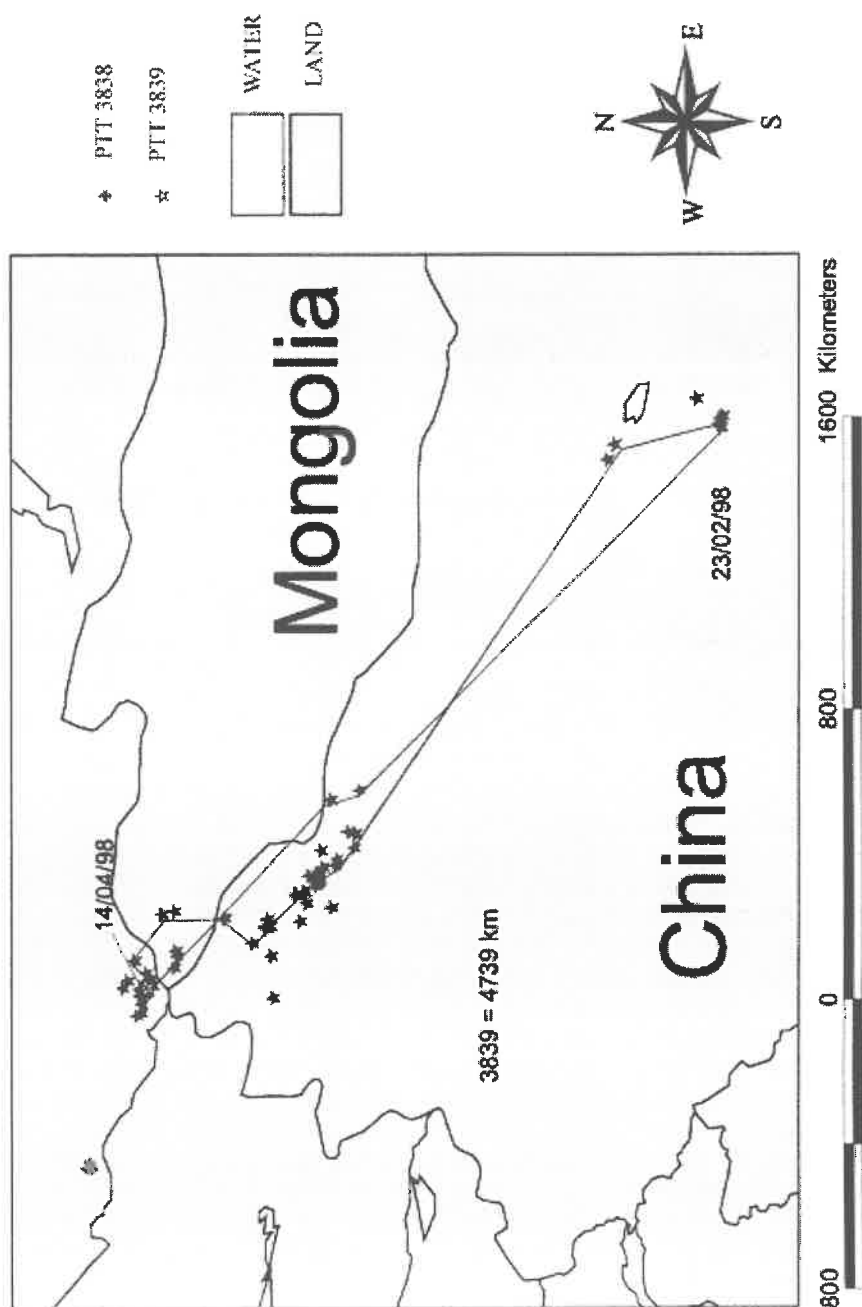
The Kosh-Agach region is a high altitude plain, approximately 2,000m above sea level and 50km<sup>2</sup> in area, surrounded with mountains. Over five days, fifteen adult Sakers were seen in this region where they were believed to be feeding on the Daurian Pika (*Ochotoma daurica*) which does not hibernate and so provides food throughout the winter.

After 17 November the Saker began moving south through the Altai Mountain chain in western Mongolia and then into north-west China near the river Ulungur He. She remained in this region until 3 January 1998, moving slowly south into the Dzungaria region. The Saker then travelled approximately 1200km in six days, south-east across the Gansu plains in central China to the Datong Shan mountain range, north-east of lake Quihai Hu.

She remained in this area for two weeks before moving 350 km further south into the Bayan Har Shan and A'nyemaqen Shan range, on 25 January. She stayed here until 27 February and then moved north-west 1400 km to the Baytik Shan mountain range situated on the Chinese Mongolian border, on 8 March.

By 12 March she had travelled another 600km north-west through the Mongolian Altai back to the breeding area of Kosh-Agach, Russia. She remained in this region until the last signal was received on 20 June, 1998.

Figure 1. Movements of two adult female Sakers plotted using PTT data (1997)



## Peregrine Falcons

### *Ring and PIT recoveries*

A total of 75 Peregrine Falcons have been ringed and/or microchipped in Taymyr since 1996 of which seven were adults. There have been no recoveries from those birds ringed in 1996 and, at the time of writing, it is too early to expect returns from the 1998 season. Two of the 17 juvenile females marked in 1997 were recovered in the UAE (see Table 2) suggesting a harvest rate of 11%. One falcon was brought to the Dubai Falcon Hospital (trapping location unknown), and Arab falconers on Qarnein Island, Abu Dhabi, trapped the other.

**Table 2. Ring and PIT recoveries of Peregrine Falcons from the Taymyr Peninsula, Russia.**

| <i>Year</i> | <i>No. ringed/chipped</i> |                     |                      |                        | <i>Total</i>          | <i>Recoveries</i>                                                                                    |
|-------------|---------------------------|---------------------|----------------------|------------------------|-----------------------|------------------------------------------------------------------------------------------------------|
|             | <i>Adult Male</i>         | <i>Adult Female</i> | <i>Juvenile Male</i> | <i>Juvenile Female</i> |                       |                                                                                                      |
| 1996        | 1                         | 2                   | 8                    | 5                      | 19                    | 0                                                                                                    |
|             |                           |                     |                      |                        | (3 juveniles unsexed) |                                                                                                      |
| 1997        | 2                         | 2                   | 5                    | 17                     | 26                    | 1. Dubai Falcon Hospital,<br>UAE. January, '98.<br>2. Qarnein Is., Abu Dhabi,<br>UAE. November, '97. |
| 1998        |                           |                     |                      |                        | 30                    | 0                                                                                                    |

### *Satellite telemetry.*

Falcon A migrated a total distance of 5,500 km (see Fig.2 and Table 3) from 30 July 1996 until 15 January 1997, excluding local movements. In three days she travelled 800km south-west to the Pur River. By 2 October she had travelled a further 1400km in the same direction close to a settlement named Odesskoje on the Russian Kazakhstan border, making several prolonged stops on the way. On 8 October she was in the centre of the Betpak-Dala, a large desert in central Kazakhstan. By the 18th the bird had moved a further 1800km south to the Afghanistan/Pakistan border, possibly travelling over the Hindu Kush mountain range. Shortly after she was trapped in Pakistan near Quetta.

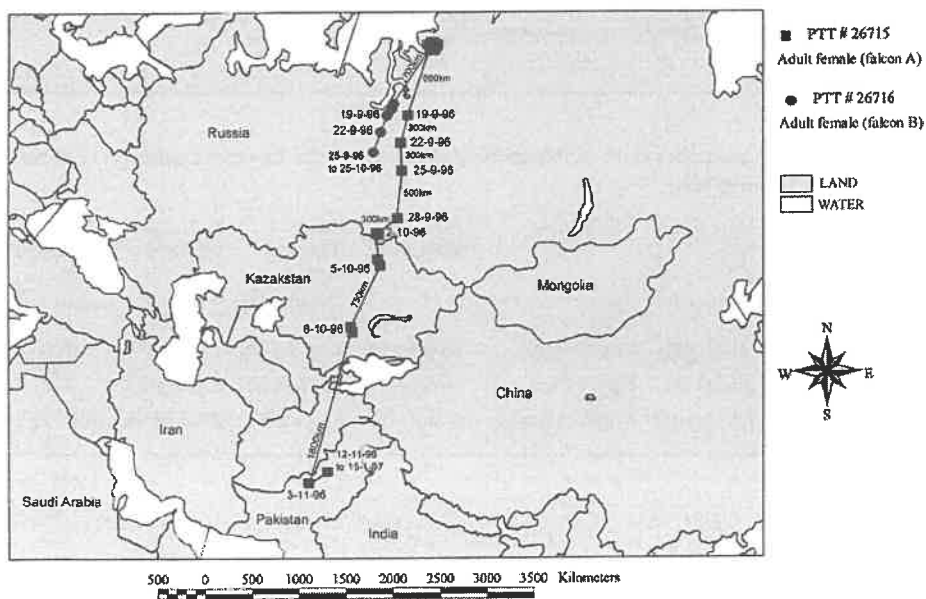
After her release, Falcon B remained in the breeding area until 16 September. She then moved 700km south-east to the Ob Delta and reached the River Ljamin by 25 September, 800km further south. The last transmission was received from this area on 25 October (Fig.2).

The second breeding adult female, Falcon C, was tagged on 13 August 1997. She then moved 800km SSW to the settlement Tarko Sale on the Pur River. After remaining here for 11 days until 15 September, she moved south-east approximately 700km across the Tyumenskaya Oblast' on 24 September. She then travelled south-east approximately 250km on 25 September, went back north-west to almost the same previous location and then back south-east again on 27 September. The falcon changed direction moving south-west approximately 650km past Omsk and into northern Kazakhstan on 29 September. Next she moved west into the southern Ural Mountain chain, spending approximately six days on the Russian Kazakhstan border. By 13 October she had moved south approximately 1000km to the southern shores of the Aral Sea, Uzbekistan. From there she moved south-east, approximately 180km, close to the city of Tashauz on the Uzbekistan/Turkmenistan border on 15 October, after which the signal remained in the same general location.

Falcon D was trapped on 29 July 1997 at her nest site. The previous season this same territory had been occupied by a female wearing sabooks (Arab jesses) on her legs, indicating that she had previously been a falconer's bird. The bird trapped in 1997 had no jesses but did show some sign of minor scale damage on one of the legs and is thought to have been the same bird. The eyrie was checked one week after fitting the transmitter and both adults and all of the young were still doing well. Despite this the signal from this transmitter remained roughly in the same position, and we must conclude that either the falcon died or the transmitter fell off the bird.

The signal from the first juvenile, Falcon E, started transmitting on 15 August 1997 from her nest site on the banks of the Pyasina River. This falcon was approximately 40 days old when fitted with the transmitter and only a few days from fledging. She remained in the nesting territory until 19 September. The next accurate signal was received on 29 September, 750km south-west on the Ob Delta. The falcon remained in this place for two weeks until 12 October, and then travelled 400km south by 14 October. On 19 October she had travelled a further 600km, changing direction and heading south-west. The signal remained at this location, close to a settlement named Serginskiy.

**Figure 2. Migration routes of two female Peregrines plotted from PTT data (1996/7)**



The second juvenile female (Falcon F) was tagged on 13 August. This bird had already fledged from a different nest to Falcon E when the transmitter was fitted. She remained in the nesting territory until 16 September and then travelled approximately 700km south-west to the Ob Delta where she remained from 26 September to 13 October. She then travelled approximately 2500km in a southerly direction before reaching the northern shores of the Aral Sea in Kazakhstan eighteen days later on 1 November. The signal did not change position after this date.

Figure 3. Migration routes of four female Peregrines plotted from PTT data (1997/8)

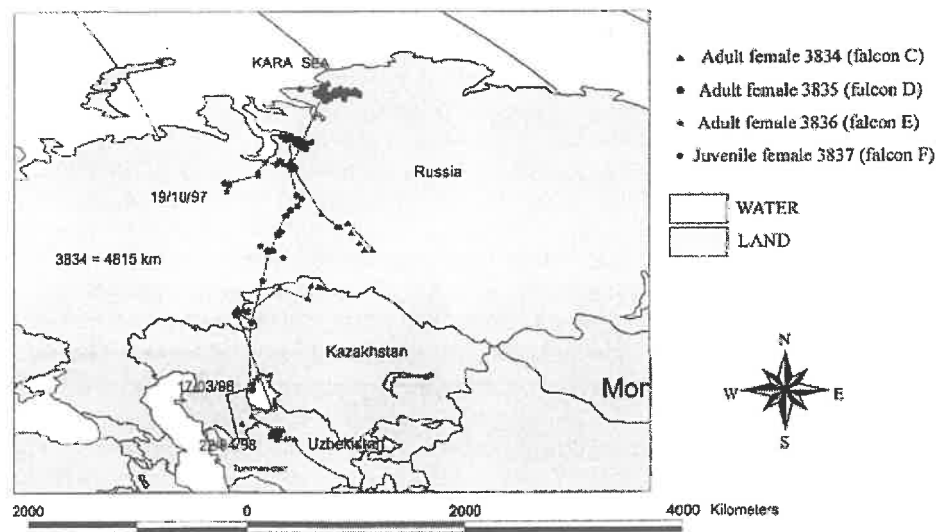


Table 3. Satellite telemetry data of Peregrine Falcons from the Taymyr Peninsula, Russia.  
\* indicates a juvenile bird.

| Falcon | Transmitter no. | Date fitted | Place fitted   | First day movement | Last detected day of movement | Last date transmitted | Distance travelled (km) |
|--------|-----------------|-------------|----------------|--------------------|-------------------------------|-----------------------|-------------------------|
| A      | 26715           | 30-Jul-96   | Lower Pura     | 16-Sep-96          | 12-Nov-96                     | 15-Jan-97             | 5,500                   |
| B      | 26716           | 29-Jul-96   | Upper Pura     | 16-Sep-96          | 25-Sep-96                     | 25-Oct-97             | 1,500                   |
| C      | 3834            | 13-Aug-97   | Middle Pyasina | 4-Aug-97           | 15-Oct-97                     | 27-Apr-98             | 4,815                   |

## DISCUSSION

### Falcon harvest rates

#### Saker Falcons

The number of marked Sakers detected was low in most years. As estimates of harvest rates, the accuracy of these values is very likely to be poor and most potential sources of error would lead to an underestimate of the harvest rate. For example, we have no knowledge of juvenile falcon mortality before they reach those areas in which they are likely to be trapped. Such mortality would effectively increase the estimated harvest rate. The method also assumes that all of the marked falcons that are trapped are brought to hospitals, identified and finally reported to the MEFRG. This is likely to be the most serious source of error leading to an underestimation of harvest rate because 1) many trapped birds are never brought to hospitals or detected; 2) some trapped birds pass through the falcon hospitals undetected; 3) some young falcons are likely to die before being sold at falcon markets; and 4) ringed birds are less likely to be brought to a hospital by a suspicious owner. Although

it may well be possible to determine the actual number trapped, it would be extremely expensive and logistically difficult to do so since this would require monitoring numbers of falcons offered for sale at markets throughout the Far and Middle East. The second point could be tackled in the long-term by gaining the participation of all falconry hospitals. It would be difficult to estimate what proportion die before reaching the markets, but in the meantime NARC is working towards improving handling practices in the Far and Middle East. The fourth point could be partly alleviated by only using microchips and discontinuing the use of metal rings.

Some falcons undoubtedly escape or are released into the wild and this is probably the only source of error that could lead to an overestimate of the harvest rate. In the case of Peregrines, for example, one of the 12 wild adult females observed on the Pura River in Taymyr in 1996 had jesses. A goose biologist reported a similar sighting in eastern Taymyr the following year (T Aarvak, *pers. comm.*). Similar records undoubtedly exist for Sakers. It is sometimes thought that the constant annual demand for new falcons is primarily a result of birds being lost or returned to the wild. The general feeling amongst concerned delegates at the current conference is that high demand is caused by high mortality amongst captive birds, especially during the summer months when falcons first arrive in the Middle East and their training begins. Clearly more information is needed to determine annual survival and release rates of captive falcons.

So far this project has concentrated on migratory Saker populations in a few areas. Obviously any harvest rate estimate that is eventually calculated will still be valid only for those populations actually marked. From a global point of view, nothing is known about trapping pressure or population size in other more remote areas where many Sakers are resident, for example in China, south-eastern Russia and Mongolia. To combat these, and other problems a conservation action plan called the *Global Strategy for the Conservation of Falcon and Houbara Resources* is being developed by NARC. This conservation plan aims to ensure the future of falcons, other species affected by falconry and the habitat in which the falcons and prey species live.

### *Peregrine Falcons*

Data from microchipped and ringed Peregrines suggested an apparently low trapping rate amongst juveniles. For the same reasons given for Sakers, the net impact trapping has on the population is likely to be many times higher than the tagging data suggest. Even with a very low tagging effort, it was still possible to show that a minimum of 11% of tagged young females were trapped and it is suggested that over-trapping could be having a potentially wide-ranging impact on the falcon population. It is not known whether the size of the breeding population is affected by trapping or whether the effective mortality is compensatory. Quinn *et al.* (this volume) suggest that the recovering population in Taymyr is probably well below carrying capacity. In addition they found no evidence of a surplus breeding population in 1996 or 1997 which would otherwise have indicated competition for nesting sites and, hence, a population at carrying capacity.

Exposure to pesticides can probably be ruled out as being a major limiting factor because breeding success was high in 1996 and 1997. Mean organic residue levels in blood samples also suggested the population was not adversely exposed to pesticides although the sample size was small and some individuals had apparently high levels (Quinn *et al.* this volume). Trapping on migration, therefore, may well be one of the main factors preventing a complete recovery of the Peregrine breeding population in the Taymyr.

Satellite tagged birds were not included in the harvest rate estimate. We know that at least one of the six Peregrines tagged was trapped for falconry in Pakistan, but it is also quite possible that the other two birds that had apparently stopped moving when they reached Turkmenistan and Uzbekistan had actually been trapped. Birds with satellite tags are undoubtedly stressed to some degree and thereby more likely to be tempted by a trapper's bait. Nevertheless the fact that at least one of four tagged adult falcons was trapped supports the suggestion that the population suffers high trapping pressure.

## Satellite telemetry

### *Saker Falcons*

Sakers in the eastern part of their breeding range are either transitory or resident, depending on whether prey species, such as pikas and Brandt's voles (*Microtus brandtii*), are active throughout the year. Populations of Sakers marked in eastern Kazakhstan migrated east into China and Mongolia where they were trapped by Arab falconers. In Kyrgystan, Uzbekistan, Turkmenistan, and southern Kazakhstan, populations of the Saker subspecies *F. c. coatsi* are believed to be resident and remain in their nesting territories throughout the winter (Baumgart, 1991). In the Tibetan highlands Sakers are also resident due to minimal snowfall and constant availability of food (Baumgart, 1991).

Very little is known concerning the migratory behaviour of Sakers from the Altai Mountains. The female Saker tagged near Kosh-Agach showed transient migratory behaviour. She remained in the Altai Mountain chain until late November, but then moved further south, probably due to a lack of food and to cold weather.

We can conclude that the migratory behaviour of eastern Sakers is dependent on local conditions and varies from year to year. It is not known whether these Sakers follow any common migratory routes, or share wintering grounds. Satellite tagging of larger numbers of eastern Sakers would reveal more information concerning their migratory behaviour, which could be possibly explained by linking with weather patterns for central Asia.

### *Peregrine Falcons*

All birds began their migration in mid-September, about three to four weeks after the young birds had fledged. All of the five falcons that began migrating moved approximately 700km south-west to the shores of the Ob Delta, an extremely important staging area for the migrating waterfowl on which they feed. Scott & Rose (1996) give maximum counts of 810,000 Pintail (*Anas acuta*) and 165,000 Wigeon (*Anas penelope*) alone in this area. Undoubtedly the Ob is a crucially important staging area for young falcons in particular because in September most of their main prey has left the tundra breeding grounds. In late September and October the falcons passed through Russia and into Kazakhstan. Three of the six falcons moved as far as 40° S between the Caspian Sea and Kyrgystan and one of these reached 30°S in Pakistan, where it was trapped.

It is difficult to say for certain whether the latter three falcons had reached their intended wintering grounds. Certainly *calidus* winters in these areas (Dementiev & Gladkov 1951; Roberts 1991) but it is also possible that they had been either trapped in these areas or died prematurely before they had finished their migration. This is possible because the transmitters continued working for several months with no further movement.

None of the birds tagged, microchipped or ringed were detected in Africa or India. One ringed juvenile was trapped, however, on the Arabian Gulf in November, presumably on its way to Africa. In another study a female *F. p. calidus*, satellite tagged in Saudi Arabia in autumn, moved as far as Cape Town, South Africa (P. Paillat, *pers. comm.*). Jenkins (1994) considers *F. p. calidus* to be a rare migrant to South Africa but Alan Stephenson has trapped *calidus* Peregrines on the south-east coast regularly and considers them to be reasonably common there. Jerdon (1877) says of *F. p. calidus* in India, "The Bhyri does not breed in this country, nor even, I believe, in the Himalayas but migrates to the North in April and returns about the 1<sup>st</sup> week of October". Clearly larger numbers need to be marked in different areas to determine the relative importance of India, Africa and the Middle East to *calidus* Peregrines.

### *Survival of satellite-tagged birds*

Our data suggest that satellite tags on Peregrines and Saker Falcons may have a significant impact on their mortality. The fact that two of the eight transmitters never left the place the tags were fitted and another two travelled less than 1,600 km suggests that these birds died prematurely although it is possible the latter two could also have been trapped. It is highly unlikely that the harnesses fell off on their own. Of the three birds that travelled more than 3,000 km, one was definitely trapped for falconry but the fate of the other two is unknown.

P. Paillat (*pers. comm.*) thinks that a bird tagged with a satellite transmitter might be more vulnerable to predation by other raptors. His reasoning is that the tagged bird may provoke an aggressive or predatory response either because the falcon looks unwell or because it looks as if it is carrying prey. The idea seems plausible, bearing in mind that raptors are abundant during autumn migration in western Asia.

The tag itself, however, is also likely to have directly affected the mortality of the birds. Although dummy transmitters were tested on captive falcons and gave the birds no problems in a confined space, we have no idea how birds cope under continuous flight or when hunting. Larger birds of prey including Ospreys, Lesser Spotted Eagles and Steller's Eagles do not seem to be affected by satellite transmitters (Meyburg, *pers. comm.*). Apart from the obviously greater bird-weight to transmitter-weight ratio these larger birds have, they also fly more slowly and have much slower wing-beats. Swainson's Hawks in the Americas tagged with satellite transmitters were also not adversely affected (Fuller, *pers. comm.*). The same team also tagged Peregrines in North America using a similar harness design to ours and also thought that the mortality of this species might have been affected by the transmitters, although this has not been quantified (Fuller, *pers. comm.*).

The weight of these transmitters is unlikely to have been a problem since it accounted for just 3% of total body-mass, well within the normally accepted range. We feel that the constrictive nature of the harness itself is likely to be the main problem through its influence on muscle performance and the ease with which prey are captured. Further tests on captive falcons using different harness designs will be conducted before further tagging takes place. Ongoing efforts to reduce transmitter size will undoubtedly help reduce these problems.

## CONCLUSION

So far the numbers of young falcons ringed or microchipped have been too small to estimate accurately the trapping pressure faced by Saker Falcon and Peregrine Falcon populations in the Far and Middle East. To improve the estimate, it will be essential to increase the number of birds marked and to improve our knowledge of detection rates and mortality of marked birds before being sold for falconry. Nevertheless even with a relatively small marking and 'recapture' effort, trapping pressure is detectable and could be very high in some years. For example, 23% of young Saker Falcons marked in 1993 were detected in falcon hospitals throughout the Middle and Far East. An absolute minimum of 5% of young Peregrines ringed in 1997 (11% of females) were similarly detected and at least one of six satellite tagged Peregrines was trapped on migration.

While we can conclude little from tagging a single bird, it appears that Sakers in the Altai mountains winter in central China, presumably in response to low prey availability on the breeding grounds in the non-breeding season. The data from satellite tagged Peregrine Falcons showed that the Ob Delta is an important staging area for Peregrines nesting in western Taymyr and that birds generally migrate directly south. The data also suggest that the area between the Caspian Sea and Pakistan is important for Taymyr Peregrines although it was not clear whether the tagged birds had reached their intended winter grounds.

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C.P. Eastham & N.C. Fox  
The National Avian Research Centre,  
The Falcon Facility, Penllyn Farm,  
College Road, Carmarthen,  
Carmarthenshire SA33 5EH  
Wales, U.K.

J.L. Quinn  
The Edward Grey Institute of Field Ornithology  
University of Oxford  
South Parks Road  
Oxford OX1 3PS  
UK

also  
The Wildfowl and Wetlands Trust  
Slimbridge  
Gloucestershire  
UK