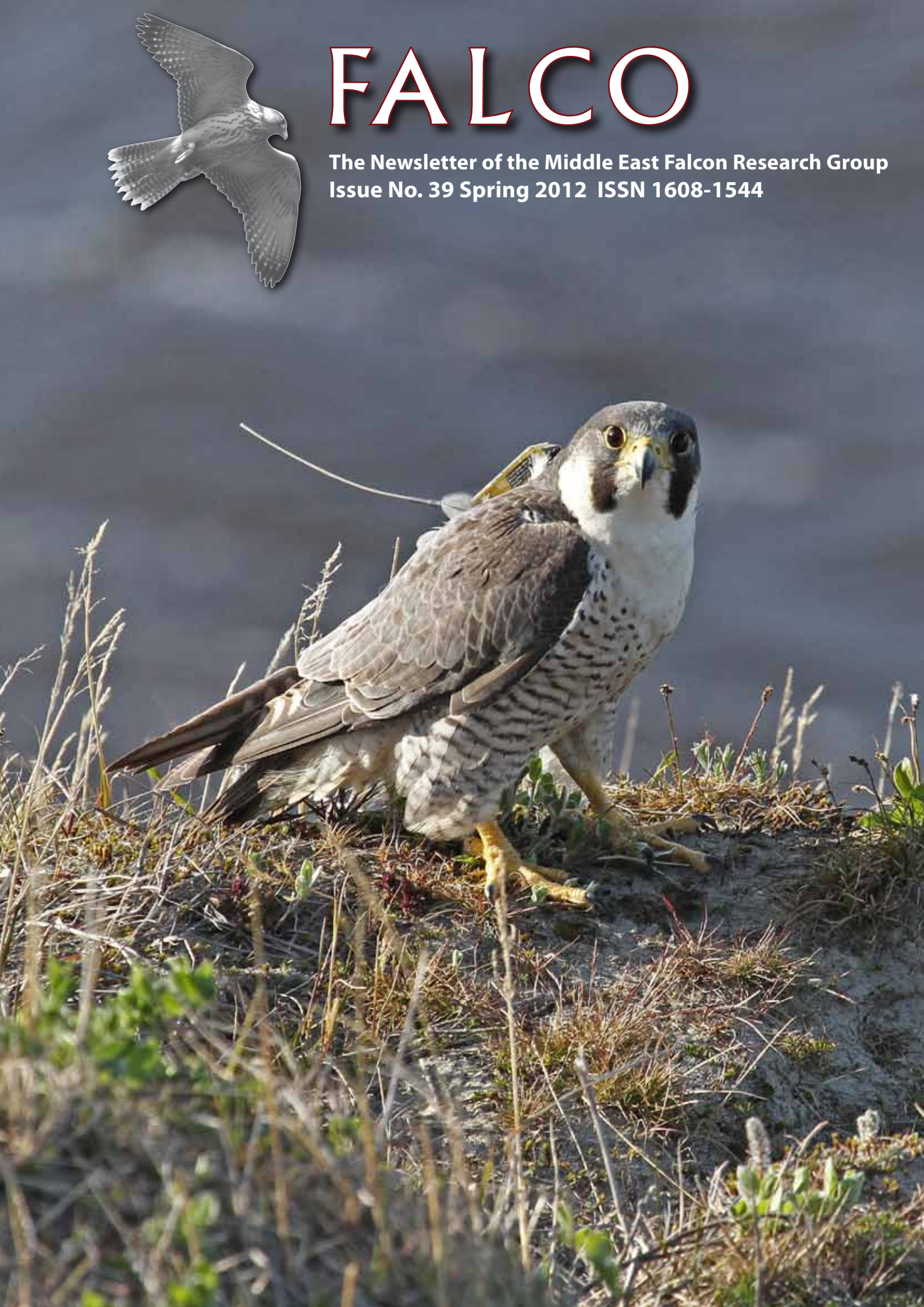

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The subspecies and migration of breeding Peregrines in northern Eurasia

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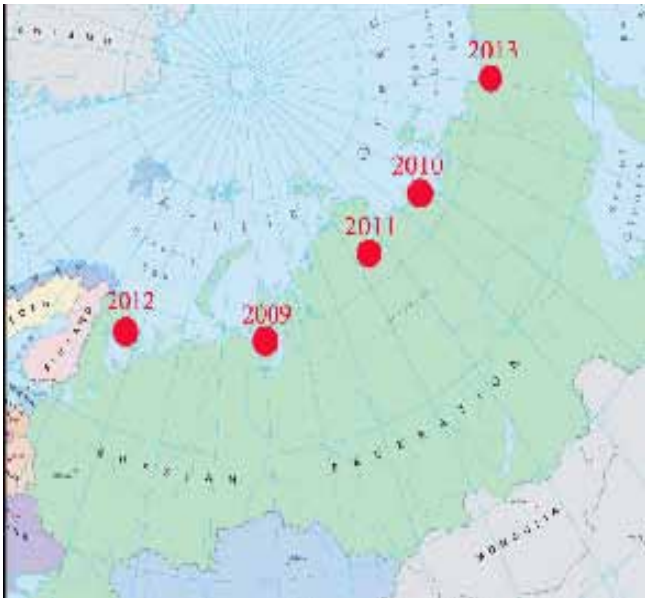
Introduction

In early 2008 our sponsors in Abu Dhabi wanted to initiate a study on the migratory Peregrines of northern Eurasia, as these falcons, together with Sakers, were traditionally caught on autumn passage for use in Arabic falconry. They were interested to know where the Peregrines came from, how their breeding populations were faring and if differences in size and plumage related to the natal origin of the birds. After the initial discussions, we developed a detailed project proposal to address these and other questions over a five-year field project (2009-13) based at five study areas across the Siberian tundra (Map 1).



Map 1 *showing the location of our five study areas across northern Eurasia, with one study site being visited each year (2009: Yamal Peninsula; 2010: Lena Delta; 2011: Eastern Taimyr; 2012: Kola Peninsula; 2013: Kolyma Delta). In each area the objective is to fit satellite tags to Peregrines and collect samples for genetic population analysis.*

Our sponsors were particularly interested in the size and plumage characteristics of the migratory Peregrines that reach the Arabian Peninsula, as the origin of these birds is a topic of much discussion among falconers in the region. Like falconers, taxonomists have long debated subtle differences in the characteristics of Peregrines and have attempted to allocate these variants to geographic regions as named sub-species. And, just like falconers, the taxonomists never agree, so there is no consensus on how many recognizable subspecies there are across the global breeding range of the Peregrine, or even on whether or not some of these distinct types should actually be recognized as separate species.

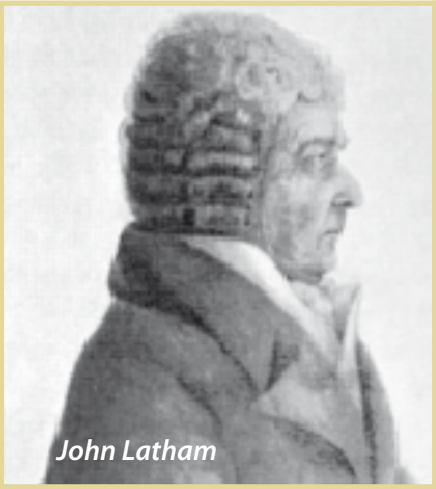
Current taxonomic opinion suggests that perhaps three Peregrine subspecies (*peregrinus*, *calidus* and *japonensis*) breed across the 7,500 km of Siberian tundra that stretches from Lapland to the Bering Sea; with *peregrinus* in the west, grading into *calidus* beyond the White Sea and grading from *calidus* to *japonensis* in the east beyond the Lena Delta. The southern limits of the breeding range are not certain but extend at least to the forested tundra.

A brief taxonomic history of northern Eurasian Peregrines

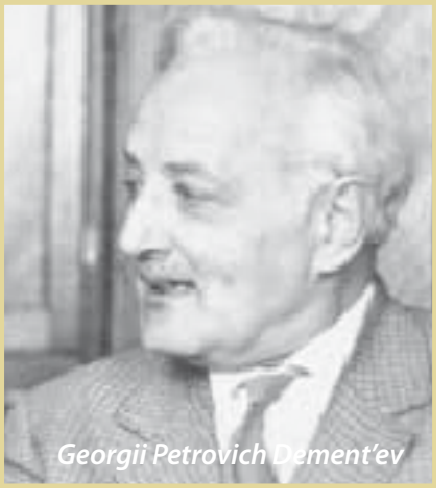
Theodore Pleske (1925) stated that "there may be a certain difference between the Peregrine Falcons that inhabit the western part of the Eurasian tundra as far as the Lena region, and those of the eastern part". He considered the western form to be *griseiventris* (meaning "grey-bellied"), which was first described by Brehm in 1833 from an adult male collected in Germany during October. Pleske regarded this form as "representative of the Peregrine Falcon characteristic of the tundra zone". Pleske considered the Peregrines of the eastern Eurasian tundra to be *peregrinus*, in contrast to Sergei Buturlin (1907), who regarded Peregrines from "the Lower Lena to Anadyr" to be distinct and he named this taxon *Falco peregrinus harterti*, based on specimens he collected during his expedition to the region in 1905-06.

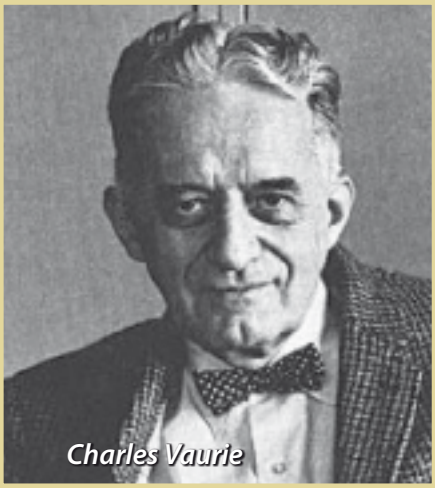
Another renowned Russian ornithologist to tackle the taxonomy of Eurasian Peregrines was Georgii Dement'ev. Dement'ev considered Buturlin's *harterti* to be synonymous with *leucogenys* (meaning "white cheeked"), first described by Brehm (1854) from a male shot in Germany during October. Dement'ev also considered *leucogenys* synonymous with *calidus*, a taxon first described by the English naturalist John Latham in 1790, based on a migrant bird collected in India. The name *leucogenys* was given precedence

Some notable figures in Eurasian Peregrine taxonomy


John Latham


Sergei Buturlin


Georgii Petrovich Dement'ev


Charles Vaurie

John Latham (1740-1837) published a description of *calidus* in his Index Ornithologicus (1790), based on a migratory specimen collected in India.

Sergei Buturlin (1872-1938), named the Peregrines found during his 1905-06 expedition to the Lena, Anadyr and Kolyma river deltas, as *harterti,* in recognition of Ernst Hartert, the renowned German taxonomist.

Georgii Petrovich Dement'ev (1898-1969), editor and a co-author of Birds of the Soviet Union (1951–54), was particularly fascinated by falcons and their taxonomy, and he 'lumped' all the tundra Peregrines under the name *leucogenys.*

Charles Vaurie (1906-1975) discussed the taxonomy of Eurasian Peregrines in detail in No. 44 of his 53-publication series "Systematic Notes on Palearctic Birds" in 1961.

over *calidus* by Russian taxonomists on the basis that the description of the latter was considered inadequate and was of an unpreserved migrant specimen.

The American taxonomist Charles Vaurie (1961) also considered *leucogenys* to be synonymous with *calidus*, though he gave priority to the earlier name coined by Latham. Subsequently, English-speaking ornithologists have tended to refer to *calidus* when discussing the tundra Peregrines of Eurasia, whilst Russian-speaking colleagues mainly refer to them as *leucogynys*. In contrast to Dement'ev, Vaurie also maintained the east-west split of tundra Peregrines favoured by Buturlin, though he preferred the name *japonensis* for the eastern form and regarded it as synonymous with Buturlin's *harterti*. The type specimen of *japonensis*, described by Gmelin 1788, was based on a migrant which "flew on board off Japan" during Capt. James Cook's last voyage in the North Pacific.

Leonid Portenko (1981) responded with his own analysis based on more material than was available to Vaurie. Portenko considered *leucogynys* to be the form nesting on tundra from Nova Zemlya eastwards to the Yana River, where it was encountered along with the eastern-tundra form *harterti*, which bred eastwards to the Bering Sea. Portenko's analysis essentially retained the same geographical divisions adopted by Vaurie for the northern forms of Eurasian Peregrines but he opted to use the names favoured by Russian colleagues. Most recently, Stepanyan (2004) has adopted the name *calidus* in preference to *leucogynys* but he has retained *harterti*, which he treats as distinct from the more southerly *japonensis*.

The western limit of *calidus* has received little attention but Galushin (2009) considered that the birds occupying the Kola Peninsula were of the nominate race *peregrinus*, whilst those further east on the Kanin Peninsula were more typical of *calidus*. The validity of this distinction is debatable as *calidus* differs only slightly from *peregrinus* by being generally paler and by averaging slightly larger. Vaurie (1961) considered *calidus* to be highly migratory, whereas he regarded *peregrinus* as sedentary, or only exhibiting limited migratory movements. This biological distinction prompted Vaurie to state, "I grant that *calidus* is not well differentiated morphologically, but, under the circumstances, it seems desirable to acknowledge the validity of *calidus* on slighter morphological grounds than would otherwise be acceptable." Nevertheless, despite the fact that many specimens cannot be identified with certainty, typical specimens of *calidus* can be distinguished from typical specimens of *peregrinus* by the colour of the upper parts, especially

the crown which is more greyish blue, less slaty and blackish; the under parts of typical *calidus* are also less heavily barred on a whiter background, and the black areas on the face are more restricted. As for *japonensis*, Vaurie described this race as darker than *calidus* and noted that the population inhabiting northern Eurasia was migratory. Portenko gave a little more detail in his description of the synonymous *harterti* stating that the crown, nape and back were more slate than grey, whilst the white area of the cheek was smaller than in *leucogenys/calidus* and the underparts were yellowish white with bigger, darker spots and broader barring.

Migration

Peregrines occupying the Eurasian tundra are highly migratory and they winter south to the Europe, the Mediterranean Basin, tropical and southern Africa, former soviet Central Asian states, Iran, Arabia, India east to Assam, Phillipines, Hainan, Indo-China and Malay Peninsula, Andaman Islands, the Sundas, and New Guinea. Vaurie (1961) suggested that the subspecific identity of winter visitors to southeastern Asia that have been identified as *calidus* in the past should be re-examined, as he believed many probably represented *japonensis*, adding that "I have examined migrants and winter visitors of *japonensis* from the Commander Islands, southeastern China, Philippines, Palawan, and Borneo and specimens which appear to be *calidus* from the Philippines, Hainan, India east to Assam, Andamans, Greater Sundas and New Guinea".

There has been limited research on migration of northern Eurasian Peregrines. Three females were satellite tracked from the Kola Peninsula in 1994 (Ganusevich *et al.*, 2004). One of these birds was tracked to its wintering area near Gibraltar, whilst the others stopped transmitting during autumn migration in Western Europe. Another Peregrine ringed on the Kola Peninsula was recovered dead as an adult on the

Female Peregrine fitted with a satellite transmitter in the Lena Delta

Dutch coast (*per*. P. van Geneijgen & S. Ganusevich). Two juveniles ringed at the Nenetsky Reserve were recovered on autumn migration in Urkraine and Sardinia (*per*. I. Pokrovsky).

An adult female fitted with a satellite tag on western Taimyr in 1996, was tracked to the Afghan border region of northwest Pakistan where it was trapped, whilst two others stopped transmitting during migration at the Aral Sea, Kazakhstan and at Tashauz close to the Uzbekistan-Turkmenistan border (Eastham et al, 2000). A one-year old *calidus* Peregrine released in 2001 as part of the Sheikh Zayed Falcon Release Programme in Gilgit, Pakistan, was tracked via satellite to the lower reaches of the Yenisey River, where it remained for the summer before embarking on an autumn migration to spend the winter in Uzbekistan and Turkmenistan. Furthermore, nestlings microchipped in Taimyr in 1997 and 1999 were trapped on passage in their first autumn in the Arabian Gulf (Eastham et al., 2000) and on the Gulf Coast of Saudi Arabia (Quinn, 2000). There were a further four recoveries of Peregrines that were microchipped in Taimyr, the others having been detected at veterinary hospitals in the UAE (Barton, 2002). Peregrines wearing Arabic jessies (sabooka) have been recorded twice in Taimyr, in 1996 and in 1999 (McDonald, 1997; Quinn, 2000) and twice on the Yamal Peninsula in 2008 (A. and V. Sokolov).

The timing of migration has been determined by observation in the breeding areas and by satellite telemetry. Eurasian Peregrines typically arrive at their Arctic breeding grounds in May and begin breeding at the end of the month or more usually in June. The young are hatched in July and fledge in August and remain in the nest area until September or October when they begin their migration south; they subsequently leave their wintering areas in April or early May. Individuals (including breeding pairs and their offspring) migrate separately and typically spend the winter in different areas; with breeding pairs only meeting again once they return to their nesting territories.

To date, our project, through the use of satellite telemetry, has obtained information on migration for birds (mainly adult females) from three different breeding areas in the Eurasian Arctic i.e., the Yamal Peninsula, the eastern Taimyr Peninsula and the Lena Delta (Map 2). Peregrines from the Yamal Peninsula travelled 3,050 to 8,000 km and distributed themselves across a huge area of southern Europe, Africa and the Middle East, whereas those from our easternmost population on the Lena Delta travelled 4,350 to 7,650 km to winter in southern China and Southeast Asia. The wintering areas of Peregrines from the eastern Taimyr Peninsula, situated between the former two study areas, spent the winter in southern Asia, travelling 5,540 to 7,430 km to reach wintering sites in Pakistan, India, Bangladesh and Myanmar.

Our preliminary results reveal some degree of migratory connectivity between breeding and wintering areas along a longitudinal axis; Peregrines from the eastern breeding population winter in areas to the east of those that breed further west. Consequently, we can say that that Peregrines wintering in south-east Asia are likely to originate from breeding populations east of the Taimyr Peninsula, whilst those wintering in the Indian subcontinent most likely originate from the breeding areas between the Gydan Peninsula and the Lena Delta, and those wintering in the Mediterranean originate from breeding areas west of the Gydan Peninsula. It seems likely that the Arctic Peregrines that winter or pass through the Arabian Peninsula primarily originate from breeding populations on the Taimyr, Gydan and Yamal Peninsulas.

Map 2 *showing autumn migration pathways of Peregrines from breeding populations on the Yamal Peninsula, Eastern Taimyr and the Lena Delta.*

Migratory connectivity and subspecies

The existence of the subspecies described earlier suggests (i) limited gene flow between the different races and (ii) the possibility of local adaptation to breeding and/or wintering areas. The level of 'gene flow' essentially relates to the likelihood that a chick from one breeding population will eventually settle to breed in another breeding population; a process known as natal dispersal. If natal dispersal is high then there will be greater gene flow between populations and they are less likely to exhibit distinctive 'subspecies' characteristics. The 'clinal' or gradual gradation from west to east of *peregrinus* through *calidus* to *japonensis*, suggests that gene flow is restricted to some extent across this north Eurasian breeding range. We still know little about patterns of natal dispersal but it is probably related to migratory connectivity, especially if there is a significant genetic component to migratory behaviour. If gene flow is reflected by the pattern of migratory connectivity we see in our study populations then it is easy to see how the clinal variation in Peregrine characters are maintained across northern Eurasia. A particularly interesting question is to understand how this variation arises; do the west-east differences between Peregrines arise through adaptation or are they simply neutral, chance differences maintained by the pattern of limited natal dispersal? This is a key element of our future work, where we hope to build on the information obtained from sequencing the genome of Peregrines to address this particular question.

Peregrine in Lena Delta

Acknowledgements

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Peregrine in Taimyr