Estimating the resident population size of Peregrine Falcon *Falco peregrinus* in Peninsular Malaysia

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The South-East Asian subspecies of Peregrine Falcon *Falco peregrinus ernesti* is among the least known of this cosmopolitan species, with no confirmed reports of its nesting in Peninsular Malaysia until 1996. Between October 2003 and May 2005, we conducted a field survey for breeding sites across c.20,000 km² of Peninsular Malaysia. Combining the survey results with sites found by others yielded a total of 15 known pairs, with six others strongly suspected. All reproductive behaviours, from courtship to the fledging of juveniles, were observed. Based on ecological requirements (cliff habitat and observed density), we conducted an intensive study of topographical and geological maps covering a quarter of Peninsular Malaysia. We suggest there may be at least 70–80 pairs in 135,000 km² of Peninsular Malaysia. Potential threats include excessive quarrying of limestone and the use of pesticides. The impact of these two factors, as well as the true distribution and abundance, need further study.

INTRODUCTION

The Peregrine Falcon *Falco peregrinus* is one of the most widely distributed terrestrial vertebrates (Cade et al. 1988, Ratcliffe 1993, Monneret 2000). Not surprisingly, therefore, there is extensive geographic variation in morphology, with between 16 (Ferguson-Lees and Christie 2001) and 24 (Monneret 2000) subspecies recognised worldwide. Perhaps as a consequence of its wide distribution, the Peregrine Falcon is one of the best-studied bird species, with over 2,000 references to it in the primary literature. However, most of these studies have been conducted in the Americas (particularly North America), Europe, southern Africa and Australia; relatively few data are available from Asia. Only two of the five subspecies found in the Asia-Pacific region have been studied: *F. p. nesiotis* in Fiji and Vanuatu (Clunie 1972, White et al. 1988, 2000) and *F. p. peregrinator* in Sri Lanka (Döttlinger 2002, Döttlinger and Nicholls 2005).

According to two of the major monographs on the species (Cade et al. 1988, Ratcliffe 1993), plus White et al. (1994) and Brown and Amadon (1968), Peninsular Malaysia is not included in the breeding range of the Peregrine Falcon. Although Wells (1999) and Ferguson-Lees and Christie (2001) have since corrected this error, only two putative breeding sites (Bukit Takun and Batu Caves) have been previously reported in the literature (Jeyarajasingam and Pearson 1999, Wells 1999). Furthermore, since the first documentation of a successful nest in Malaysia occurred only recently (Chong 2002), virtually nothing is known of the annual cycle of Peregrine Falcon in this region. Here, we report our findings on the breeding of the subspecies found in Peninsular Malaysia. We use data from an intensive two-year survey, a synthesis of the observations of others and a detailed map study to yield a breeding population estimate for Peregrine Falcon in Peninsular Malaysia.

METHODS

Identification

The resident subspecies *ernesti* is very dark, with a slate-grey back and a black head lacking white on the ear-coverts. The underparts are lavender with some grey suffusion and are heavily but narrowly barred black. In Malaysia, however, some adults are very deep rusty below, resembling the migratory subspecies *peregrinator* from the southern Indian subcontinent and Sri Lanka. However, *peregrinator* does not have the black head of *ernesti* and the barring on the underparts is not as fine, or is lacking altogether, while the back is a paler blue-grey. Fledglings in Malaysia also resemble *ernesti* rather than *peregrinator*, being darker brown, more heavily streaked below (and more broadly on the flanks), without conspicuous rufous fringes above or white ear-coverts.

While the current range of *peregrinator* is defined as extending eastward into northern Myanmar and central and south-eastern China, individuals from that region do not have the deep rusty colour below. The taxonomic status of these birds as well as those with rusty underparts in Malaysia requires additional study, but is beyond the scope of this paper. The literature suggests that *peregrinator* may occur as vagrants from Thailand or Burma in Malaysia (Wells 1999), perhaps based on the occurrence of individuals with rusty underparts. There is no white auricular area in *ernesti* and hence no distinct moustache, which clearly distinguishes *ernesti* from the migrant *japonensis* which visits during October–April from north-eastern Siberia, Japan and Korea (Cade et al. 1988, Wells 1999, Ferguson-Lees and Christie 2001). This subspecies is lighter-toned, with whiter underparts, lighter barring, a distinct moustache and often conspicuous white forehead. All information in this paper relates to the resident subspecies *ernesti*.

Fieldwork

For logistical reasons our study was restricted to Peninsular Malaysia, which extends roughly 400 km from north to south and 250 km from west to east. Fieldwork was conducted by LM between October 2003 and June 2005. After close examination of 1:50,000 topographical maps, a four-wheel-drive vehicle was used to explore suitable Peregrine Falcon habitat on roads or jungle trails. A half-day boat trip to the cliffs south of Tioman Island was also conducted. Since there are no confirmed records of tree-nesting Peregrine Falcons anywhere in South-East Asia, the search focused on rocky cliffs and tall buildings in urban areas. Typically, about one hour was spent scanning each potential nesting site, using 10×42 binoculars and a 20–60×80 mm telescope. At each site, LM took photographs and recorded any evidence of Peregrine
Falcons would be found per cliff cluster on a map. We therefore assumed that only one pair of Peregrine Falcons would be found per cliff cluster on a map.

RESULTS

Survey results

A total of 178 observations of Peregrine Falcon was made at 15 sites, of which eight were new confirmed sites and seven were previously known sites. Six sites are suspected to hold breeding pairs (Fig. 1).

Kuala Lumpur and Selangor state (3°10′N 101°44′E)

Site 1. LM observed a pair of Peregrine Falcons in a northern suburb of Kuala Lumpur for almost two years, from 6 October 2003. The pair shared their time between a telephone tower and a tall building, about 750 m apart. The full spectrum of breeding behaviour, from courtship (with aerial territorial display “Z” shaped flights [Monneret 2000] on 10 October 2004) to copulation (between 30 November and 24 April), food exchanges, egg-laying (around 10 February), incubation and hunting, was observed. This pair’s breeding attempts failed in both 2004 and 2005, as no juveniles were observed at this site in either year.

Site 2. An adult pair was found on 7 December 2003 at Bukit Takun, Selangor state, 15 km north from Kuala Lumpur. This site is a huge rocky outcrop (150 m tall), bordered on one side by primary forest and on the other by rapidly developing open landscapes containing housing and golf courses. The pair engaged in courtship and territorial activity. A passing female Peregrine Falcon of unknown subspecies and age was vigorously attacked by the pair on 16 November 2005. Incubation was confirmed on 24 January 2004 (the female was seen on a ledge, lowering her body and rolling it as if on eggs), but the eggs were lost or never hatched. On 23 January 2005, both birds were seen visiting the same ledge. This site is mentioned by Wells (1999), who also recorded an unsuccessful reproduction attempt in 1985.

Site 3. Continued occupation of another previously known site in Selangor state, at Batu Caves (Wells 1999), was confirmed on 11 June 2004. With a maximum elevation of 180 m, this site is slowly becoming enclosed by urban sprawl. However, this and its religious importance prevent it from being quarried. Social interactions such as pair-flight, prey exchange and copulation were observed.

Sites 1–3 form a triangle with side lengths of approximately 15 km. The exploration of other potential nesting cliffs revealed no other pairs in the area. The closest known occupied sites are 40 km to the north-east and 140 km to the north.

Perak state near Ipoh (4°36′N 101°04′E)

Site 4. On 4 July 2004, LM saw a pair at a previously known site 7 km from the centre of Ipoh in an ‘island’ of natural cliff vegetation within a developed urban area.

Site 5. A pair apparently nested in a small cliff, but spent most of their time in the structure of a suburban factory, 6 km from downtown Ipoh. From there, the birds attacked their favourite prey, House Swifts Apus affinis, thousands of which nest in the factory. This pair reproduced successfully in both 2004 and 2005: a juvenile was found nearly drowned in a factory tank in 2004 and at least three juveniles were seen in April–May 2005 (Chiu S. C. verbally 2004).

Site 6. This site is near one of the largest quarries in Malaysia, 20 km from downtown Ipoh. No Peregrine Falcons were observed when visiting on 8 August 2004, despite previous observations that year by local birders.
sites. The examination of maps (see Methods) indicated possible nesting sites at a number of locations in addition to the sites we surveyed. A total of 27 maps showed 77 isolated rocky outcrops or cliff clusters that are typical nesting sites (Fig. 2), including 15 of the 21 known or suspected sites. A closer examination of the topographic features (e.g., degree of isolation; steepness of the cliff-

Additional suspected sites
These were identified from a detailed review of Suara Enggang, the bulletin published by the Malaysian Nature Society, and through personal communications.

Figure 2. Map coverage of Malaysia from which Peregrine Falcon Falco peregrinus population estimates were calculated.
Peregrine Falcons in Peninsular Malaysia appear to be most abundant in the north-central area, in Perak and in Kelantan, on both sides of the main range, and close to the Thailand border in the west (Perlis state). Areas rich in rocky limestone outcrops are favoured and detailed analysis would be useful to determine if, as in other parts of the world, larger cliffs are preferred (Ratcliffe 1993). No nesting is known in smaller cliffs, at least in the Kuala Lumpur area. In central Peninsular Malaysia, Peregrine Falcons face a relative shortage of sites, and pairs are spaced by up to 60 km. South of Kuala Lumpur, nesting appears possible only in urban sites or old stone quarries. From our exploration of more than 20 nesting sites, their main characteristics seem to be the presence of a steep rock face or tall building and shelter from the sun (especially in the midday heat). During the survey, we observed many Peregrine Falcons perched in the shade in recesses (both in natural caves and on buildings). We have observed nesting sites surrounded by primary forest, populated suburbs, large urban cities and industrial palm or rubber tree plantations. All sites were close or immediately adjacent to open areas for hunting. Based on our observations, it seems that Peregrine Falcons have adapted to some degree to human-modified environments, as elsewhere in the world.

A total of 21 nesting sites is now known in Peninsular Malaysia in 2005, with pairs confirmed at 15 of them. Breeding was confirmed in 2003–2005 at five sites and was very likely at two others. Our map analysis suggested there might be as many as 70 pairs in Peninsular Malaysia. Wells (1999) suggested there may be 20–50 breeding pairs in the entire Thai-Malay peninsula, but our analysis indicates that this is likely to have been an underestimate, most probably resulting from a lack of observations. Our map-based estimate assumes that only one pair of Peregrine Falcons nest per cliff cluster. More observations are needed to confirm this, although a similar spacing of eyries has been found in optimal habitat in Fiji and Vanuatu (White et al. 1988, 2000).

Reproduction and threats
In 2005, nine juveniles were observed at five sites, confirming Chong’s (2002) observation that Peregrine Falcons successfully breed in Malaysia. There is, however, a troubling lack of breeding success in the Kuala Lumpur area, where no successful fledging was observed, despite close surveillance. Although disturbance may be a factor in downtown Kuala Lumpur, this cannot explain the lack of productivity at Bukit Takun, which is relatively undisturbed. A campaign of communication and public awareness, along with artificial nesting boxes in downtown Kuala Lumpur, may help, but not if infertility is the reason for failure.

Apart from direct disturbance, human alteration of breeding sites is the main threat to Peregrine Falcon habitat in Peninsular Malaysia. With the current strong economic development, housing construction is flourishing and this requires abundant cement derived from limestone cliffs. Quarrying is particularly intensive around Ipoh, although the sheer number of suitable cliffs in that area enables Peregrine Falcons to find alternatives if their nest sites are destroyed by quarrying. However, in areas where limestone outcrops are rarer, the preservation of the nesting cliff is essential. The destruction of cliffs could lead to the disappearance of nesting Peregrine Falcons in the lowlands, such as in south-east Pahang state.

Deliberious effects of pesticides may also occur in Malaysia because many organochloride products (such as dieldrin) are still used, despite being banned in Europe.
and North America since the 1970s. Chemical analysis of eggs or tissues from Peregrine Falcons might help to determine if these chemicals are adversely affecting the Malaysian population.

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