

# 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 km<sup>2</sup> 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 km<sup>2</sup> 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. nesiotus* 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

Falcon activity, either sightings of birds or indications of their presence including faecal stains (whitewash), perching places and eyrie locations. Sites where no Peregrine Falcons were observed were revisited once or twice. LM also collated information from local birdwatchers.

### Map analysis

To estimate the total number of Peregrine Falcon pairs in Peninsular Malaysia, we supplemented our fieldwork with a map analysis (following Ratcliffe 1993). We examined topographic 1:50,000 scale maps (from the Malaysian Geographic Agency) and a geological 1:500,000 scale map (from the General Mineral and Geosciences Department of Malaysia) for suitable Peregrine Falcon nesting sites (limestone outcrops or hills with cliffs). Although a few cliffs may have been missed by observers and some pairs may live in large cities, it appears likely that the southern part of Peninsular Malaysia is not inhabited by breeding Peregrine Falcons (Jeyarajasingam and Pearson 1999, Wells 1999). We therefore focused our analysis on the central and northern sectors (north of 3°N). One hundred and thirty-one maps cover this area, with 75 currently available. Forty-eight of these were examined because they cover mountains, foothill country, and for a few maps from Perlis (two), Pahang (two) and Kedah (three), coastal areas with isolated limestone outcrops. To calibrate our map interpretation, we compared known sites that we had visited with their appearance on the maps. Field observations indicated that no cliff or network of cliffs within roughly 7 km was occupied by more than a single pair. We therefore assumed that only one pair of Peregrine Falcons would be found per cliff cluster on a map.

## RESULTS

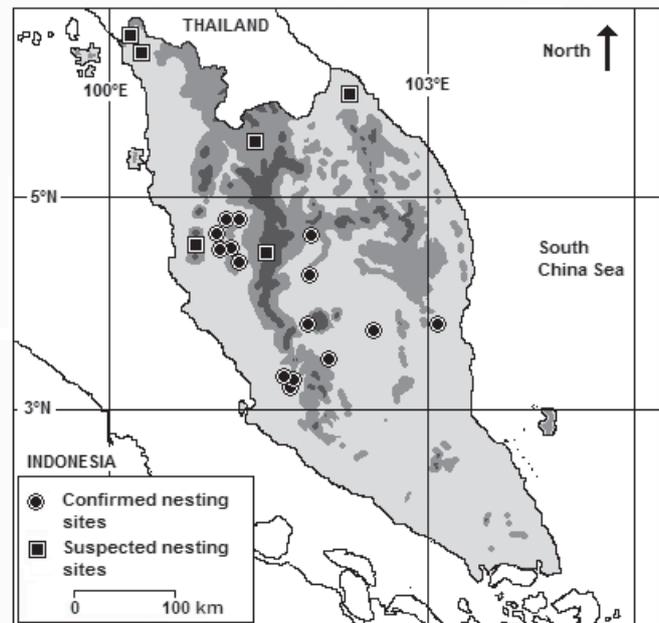
### Survey results

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 other sites are suspected to hold breeding pairs (Fig. 1).

#### **Kuala Lumpur and Selangor state (3°10'N 10°42'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,



**Figure 1.** Nesting sites of Peregrine Falcon *Falco peregrinus* in Peninsular Malaysia. Circles indicate confirmed sites (i.e., checked during our 2003–2005 survey). Squares represent suspected sites (i.e., reported previously or recently discovered, but not checked during our survey). Light grey represents lowlands (0–300 m), mid-grey represents hills (300–1,000 m) and dark grey represents montane zones (>1,000 m).

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

and the presence of abundant recent whitewash. At a site 1 km distant, a fledged juvenile was photographed in 2002 (Chang K. S. verbally 2006).

*Site 7.* No Peregrine Falcons were observed at this site on a rocky outcrop at the southern fringe of downtown Ipoh on 8 August 2004, but they were seen there before and after (Chiu S. C. and Chang K. S. verbally 2006).

*Site 8.* One juvenile was observed flying in typical food-begging, fluttering flight (Sherrod 1983) towards the adults on 29 May 2005 at this site, which is 20 km south of Ipoh in a large complex of tall cliffs on a 360-m-high limestone mountain.

*Site 9.* One fledged juvenile was observed on 29 May 2005, 15 km south of Ipoh in a disused quarry surrounded by cattle pastures. Two juveniles fledged in 2006 (Chiu S. C. verbally 2006).

### Pahang state

*Site 10.* In an isolated outcrop 10 km south-east of Bentong (3°29'N 101°56'E), a single Peregrine Falcon was observed attacking an *Accipiter* sp. on 16 January 2005. A pair was observed on 10 and 26 February 2005. Nesting was not documented despite observation of copulation. This isolated cliff is not very high (100 m) and groups of long-tailed macaques *Macaca fascicularis*, potential nest predators, were observed climbing on it.

*Site 11.* A single Peregrine Falcon was observed on 21 January 2005, on an isolated rocky outcrop 10 km north-west of Kuala Lipis (4°11'N 102°03'E). A pair of falcons was seen on 16 May 2005.

*Site 12.* One Peregrine Falcon was seen briefly on 5 February 2005, flying out of a rocky outcrop 10 km east of Raub (3°48'N 101°51'E), after giving an alarm call to a Black Eagle *Ictinaetus malayensis*. On 27 March 2005, a pair of Peregrine Falcons was observed in an aerial prey exchange, after which the female disappeared into a hole (presumably the eyrie) in the middle of an active quarry close to the first observation site. On 4 June 2005, a fledged juvenile was observed.

*Site 13.* A pair was observed on 28 March 2005 on the southernmost of three isolated rocky outcrops, 25 km inland from Kuantan (3°49'N 103°20'E). Two quarries had been worked in the two northern outcrops, and a company representative told LM that one outcrop at least would be completely destroyed. Like the Kuala Lumpur group of cliffs, this eastern group of sites is 50 km away from the nearest neighbouring sites in the central ridge of Peninsular Malaysia.

*Site 14.* On 28 March 2005, no adults were observed, but two nestlings were seen in an eyrie c.30 km north of Temerloh (3°27'N 102°21'E) at 250 m. On 10 April 2005, one juvenile had just left the eyrie, while the second was still present.

*Site 15.* No Peregrine Falcons were seen on 30 January 2005 at a site 10 km south of Merapoh (4°41'N 102°00'E), but two fledged birds were seen on 16 April 2005 flying to and from an adjacent smaller outcrop. No adults were observed. This site is part of a cluster of cliffs around Gua Musang in the adjacent state of Kelantan, where at least five other potential sites with copious whitewash were found.

### 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.

*Site 16.* Noack (2002) reported a pair in Perlis State Park close to the Thailand border from 26 January to 5 March 2002. Breeding may have taken place as one bird was seen on 26 January disappearing into a ledge after feeding. The nesting attempt may have been abandoned on 1 February, when a group of long-tailed macaques were seen being mobbed on the ledge by two adult Peregrine Falcons. A pair of Peregrine Falcons had previously been observed at this site on 28 and 31 December 2000 by Noack (2002).

*Site 17.* Chong (2002) published details of the first known successful breeding in Malaysia in Temengor Dam Reserve on 23 February 1996. Since he clearly saw the feeding female, but not the nestlings, they were likely less than one week old.

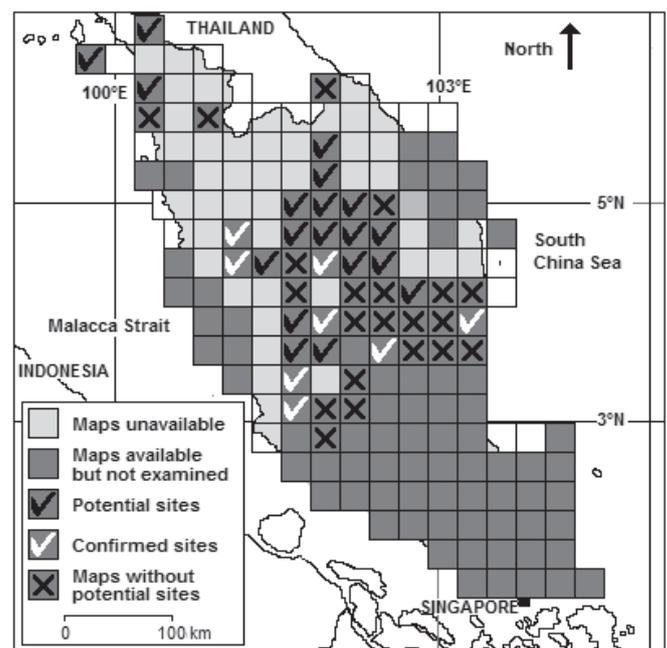
*Site 18.* In December 2003, photographs of three Peregrine Falcons, including one immature, were taken by the side of a road, east of Ipoh (L. Poh verbally 2004).

*Site 19.* In 2005, a Peregrine Falcon was seen perched on a high-tension tower at Ulu Sungai Guar recreation area (Bubu Forest), Kuala Kangsar district (Chiu S. C. *in litt.* 2006).

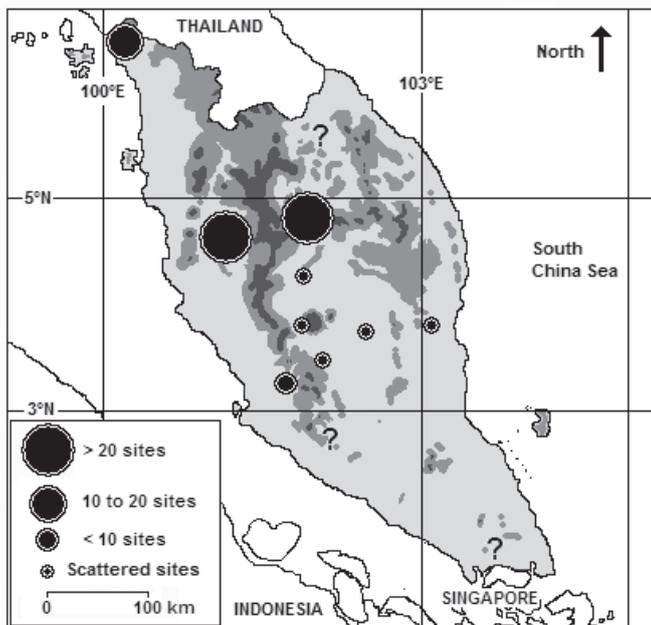
*Sites 20–21.* D. Wells (*in litt.* 2006) indicated two other sites which, owing to the species's nest-site fidelity, may still be occupied: Bukit Air Jernih, Perlis (occupied in the 1980s) and an outcrop in Kelantan plain (occupied in the 1990s). Peregrine Falcons have also been observed regularly at Genting Highland Resort, on the top of the main range at 1,770 m. Although it is not clear if the birds are nesting there, the large buildings offer possible nesting sites.

### Population estimate

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-



**Figure 2.** Map coverage of Malaysia from which Peregrine Falcon *Falco peregrinus* population estimates were calculated.



**Figure 3.** Estimated distribution of the Peninsular Malaysian subpopulations of Peregrine Falcon *Falco peregrinus* based on map analysis. Sizes of the circles indicates the estimated number of suitable sites. Question marks (?) indicate potential, but unconfirmed, nesting areas.

face), combined with the density of nesting pairs that we observed in the field (i.e., a distance of at least 15 km between pairs), allowed us to arrive at the following approximate population estimates: 20–30 pairs from Merapoh to Guah Musang area (a particularly dense area of cliffs), 20 pairs in Ipoh area (another area rich in cliffs), and ten pairs in coastal Perlis. An additional 20 pairs may occur in isolated sites away from these three concentrations, including those in Kuala Lumpur, Bentong, Temerloh, and Raub (Fig. 3). Further exploration of rocky outcrops in Terengganu, and location of pairs breeding in urban areas in the south of Peninsular Malaysia may add to this. These totals therefore provide a very preliminary estimate of 70–80 pairs breeding in Peninsular Malaysia. Note that a maximum of only 20 of these sites (i.e., <30%) have been directly observed either by previous observers or during this survey. The true number of pairs may well be lower than our estimates based on site suitability.

#### Timing of the annual cycle

From our observations, courtship takes place mostly in December–January. Egg-laying seems to occur from the end of January to the beginning of February. The female at the site in Kuala Lumpur appeared to start incubation on 9 February. Chong (2002) described the feeding of young nestlings at the end of February, and this was also seen at site 9 at the same time in 2006 (Chiu S. C. *in litt.* 2006). One newly fledged juvenile was seen in mid-April at site 5 in Pahang state, and in May, juveniles flying well were seen at sites 14 and 15 in Pahang state and at sites 8 and 9 in Perak around Ipoh.

## DISCUSSION

#### Distribution and population size

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.

Deleterious 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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## REFERENCES

- Brown, L. and Amadon, D. (1968) *Eagles, hawks and falcons of the world*, Vol. 2. New York: McGraw-Hill Book Company.
- Cade, T. J., Enderson, J. H., Thelander, C. G. and White, C. M., eds. (1988) *Peregrine Falcon populations: their management and recovery*. Boise, Idaho: Peregrine Fund.
- Chong, M. H. N. (2002) Peregrine Falcon *Falco peregrinus ernesti* nesting at Temengor Forest Reserve, Perak in February 1996: a first successful breeding record for Malaysia. *Asian Raptor Bull.* 3: 19–20.
- Clunie, F. (1972) A contribution to the natural history of the Fiji peregrine. *Notornis* 19: 302–322.
- Döttlinger, H. (2002) The Black Shaheen Falcon (*Falco peregrinus peregrinator* SUNDEVALL 1837), its morphology, geographic variation and the history and ecology of the Sri Lanka (Ceylon) populations. Ph.D. thesis, University of Kent, U.K.
- Döttlinger, H. and Nicholls, M. (2005) Distribution and population trends of the ‘black shaheen’ Peregrine Falcon *Falco peregrinus peregrinator* and the eastern Peregrine Falcon *F. p. calidus* in Sri Lanka. *Forktail* 21: 133–138.
- Ferguson-Lees, J. and Christie, D. A. (2001) *Raptors of the world*. London: Christopher Helm.
- Jeyarajasingam, A. and Pearson, S. (1999) *A field guide to the birds of west Malaysia and Singapore*. Oxford: Oxford University Press.
- Monneret, R.-J. (2000) *Le faucon pèlerin*. Second edition. Lausanne, Switzerland: Delachaux and Niestlé.
- Noack, F. (2002) Breeding Peregrine Falcons in Perlis State Park. *Suara Enggang* 2: 18–19.
- Ratcliffe, D. A. (1993) *The Peregrine Falcon*. Second edition. London: T. and A. D. Poyser.
- Sherrod, S. K. (1983) *Behavior of fledgling peregrines*. Boise, Idaho: Peregrine Fund.
- Wells, D. (1999) *The birds of the Thai-Malay Peninsula*. Volume 1. London: Academic Press.
- White, C. M., Brimm, D. J. and Clunie, F. (1988) A study of peregrines in the Fiji Islands, South Pacific Ocean. Pp. 275–287 in T. J. Cade, J. H. Enderson, C. G. Thelander and C. M. White, eds. *Peregrine Falcon populations: their management and recovery*. Boise, Idaho: Peregrine Fund.
- White, C. M., Brimm, D. J. and Wetton, J. H. (2000) The Peregrine Falcon *Falco peregrinus* in Fiji and Vanuatu. Pp. 707–720 in R. D. Chancellor and B.-U. Meyburg, eds. *Raptors at risk: Proceedings of Fifth World Conference on Birds of Prey and Owls*. Surrey, B.C., Canada: Hancock House.
- White, C. M., Olsen, P. D. and Kiff, L. F. (1994) Family Falconidae. Pp. 216–275 in J. del Hoyo, A. Elliott and J. Sargatal, eds. *Handbook of the birds of the world*, Vol. 2. Barcelona, Spain: Lynx Edicions.

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