Duckworth JW, Poole CM, Tizard RJ, Walston JL, Timmins RJ. 2005. The jungle cat Felis chaus in Indochina: a threatened population of a widespread and adaptable species. Biodiversity and Conservation 14:1263-80.

Keywords: 4TH/4VN/Cambodia/Catopuma temmincki/distribution/Felis chaus/habitat/jungle cat/map/Neofelis nebulosa/Panthera pardus/Panthera tigris/Prionailurus bengalensis/Prionailurus viverrinus/Profelis marmorata

Abstract: The Jungle Cat *Felis chaus* is widespread in India and neighbouring countries but is known by only one historical specimen from Cambodia, Laos or Vietnam (Indochina), widely published as from Vietnam, but in fact from Cambodia. All but two of the recent Indochinese records come from extensive natural lowland habitat dominated by deciduous dipterocarp forest in northeast Cambodia. The species probably occurred more widely in Indochina, largely through additional use of secondary habitats, where hunting pressure is now very heavy. Suggestions of decline in Indochina are corroborated by more conclusive evidence from Thailand. In Indochina, all other small and medium-sized cats are recorded much more frequently than Jungle Cat: closed evergreen forest supports source populations of them, but there is no evidence that Jungle Cat uses extensively such forest. The open forests of northern and eastern Cambodia are highly significant for conserving threatened biodiversity, notably large waterbirds, vultures and ungulates, groups where species formerly widespread across Indochina have contracted in range and declined steeply. These taxa were better collected than small cats and it seems plausible that Jungle Cat showed a similar change. Jungle Cat conservation in Indochina needs extensive habitat retention with intensive anti-poaching activities, because suitable habitat is easily accessible to hunters. The habitat adaptability shown elsewhere by Jungle Cat could allow a much healthier regional conservation status if hunting (including trapping) can be greatly reduced in scrub and agricultural habitats, but changing culturally ingrained hunting practices will take a long time.

Biodiversity and Conservation **14:** 1263–1280, 2005.
DOI 10.1007/s10531-004-1653-4

The Jungle Cat *Felis chaus* in Indochina: a threatened population of a widespread and adaptable species

J.W. DUCKWORTH[1,*], C.M. POOLE[2], R.J. TIZARD[3], J.L. WALSTON[2] and R.J. TIMMINS[4]

*[1]East Redham Farm, Pilning, Bristol BS35 4JG, UK; [2]Wildlife Conservation Society Cambodia Program, P.O. Box 1620, Phnom Penh, Cambodia; [3]1901 Nueces Drive, College Station, TX 77840, USA; [4]2313 Willard Avenue, Madison, WI 53704, USA; *Author for correspondence (e-mail: willduckworthdprk@yahoo.com)*

Received 16 April 2003; accepted in revised form 24 November 2003

Key words: Cambodia, Conservation status, Deciduous dipterocarp forest, *Felis chaus*, Geographical distribution, Hunting pressure, Laos, Limited historical data, Vietnam

Abstract. The Jungle Cat *Felis chaus* is widespread in India and neighbouring countries but is known by only one historical specimen from Cambodia, Laos or Vietnam (Indochina), widely published as from Vietnam, but in fact from Cambodia. All but two of the recent Indochinese records come from extensive natural lowland habitat dominated by deciduous dipterocarp forest in northeast Cambodia. The species probably occurred more widely in Indochina, largely through additional use of secondary habitats, where hunting pressure is now very heavy. Suggestions of decline in Indochina are corroborated by more conclusive evidence from Thailand. In Indochina, all other small and medium-sized cats are recorded much more frequently than Jungle Cat: closed evergreen forest supports source populations of them, but there is no evidence that Jungle Cat uses extensively such forest. The open forests of northern and eastern Cambodia are highly significant for conserving threatened biodiversity, notably large waterbirds, vultures and ungulates, groups where species formerly widespread across Indochina have contracted in range and declined steeply. These taxa were better collected than small cats and it seems plausible that Jungle Cat showed a similar change. Jungle Cat conservation in Indochina needs extensive habitat retention with intensive anti-poaching activities, because suitable habitat is easily accessible to hunters. The habitat adaptability shown elsewhere by Jungle Cat could allow a much healthier regional conservation status if hunting (including trapping) can be greatly reduced in scrub and agricultural habitats, but changing culturally ingrained hunting practices will take a long time.

Introduction

Many cat species are ranked as globally threatened by IUCN criteria. In the most recent list (IUCN 2002), no fewer than 25 species of the 36 recognised by Wozencraft (1993) are listed as threatened or near-threatened. Although no cat species has gone extinct since 1500 (MacPhee and Flemming 1999), this is a two-thirds representation in the global Red List. The reasons generally involve human activity: persecution (as pests of livestock and as dangers to human life); killing for trade (pelts as coats for the fashion trade, internal organs and other parts for perceived medicinal value); capture for food; and erosion of prey base (usually through over-hunting by people). Furthermore, cat populations often need large areas to be viable (see below), but

fragmentation and outright loss of habitat break up formerly contiguous populations. The remnants are small enough for more direct human pressures, combined with stochastic processes, to drive many local extinctions (Nowell and Jackson 1996 and references therein; Karanth and Stith 1999). The role of habitat degradation in causing cat population declines directly (as distinct from facilitating secondary factors such as hunters' access) seems to be less clear.

Indochina (*sensu* Delacour 1940: Cambodia, Laos and Vietnam) holds eight species of cat. Five (Fishing Cat *Prionailurus viverrinus*, Asian Golden Cat *Catopuma temminckii*, Marbled Cat *Pardofelis marmorata*, Clouded Leopard *P. nebulosa* and Tiger *Panthera tigris*) are listed by IUCN (2002) as globally threatened. Of the three not globally listed, Leopard *Panthera pardus* is highly threatened in Indochina (e.g., Duckworth et al. 1999), but has healthy populations across much of Africa (Nowell and Jackson 1996). The other two, Leopard Cat *Prionailurus bengalensis* and Jungle Cat *Felis chaus*, are both small, occur predominantly in Asia and are widespread and are reportedly common (Prater 1971; Lekagul and McNeely 1977; Payne et al. 1985; Nowell and Jackson 1996), although precise data sources are few. Recent surveys across Indochina indicate that Jungle Cat is not at all widespread there. This paper details the recent and historical records, and analyses the species's regional conservation status.

Jungle Cat occurs widely in tropical and subtropical Asia, including southern China and the Himalayan foothills, but not the Malay peninsula (Corbet and Hill 1992; Tohmé and Tohmé 2000). It occurs locally in the more mesic parts of Arabia (Harrison and Bates 1991) and marginally into Africa, although previous records from the Sahara were in error (Kingdon 1997). As with many small cats, ecology, habitat use and behaviour are not well known (Mukherjee 1998a). In India it is the most common wild cat, occurring in most habitats except deserts (hot and cold). It is scarcer in eastern India's woods and thick forests than in the west's relatively more open habitats. An apparent national decline may reflect a combination of reasons: active pelt trade; limited legal protection; conversion of scrub to agriculture; high livestock (especially cattle) densities reducing rodent numbers (the chief prey of adults); and perhaps effects of agricultural chemicals. Cats use agricultural lands, but whether these can support populations is unclear (Prater 1971; Acharjyo 1998; Gogate 1998; Sharma 1998; Mukherjee 1998a; Singh 1998; S. Mukherjee *in litt*. 2000). It is widespread in Sikkim (Jha 2000). In Pakistan it was "the most widely distributed and adaptable smaller cat", favouring riverine thickets or irrigated plantations and "well able to hold its own in areas of human settlement" (Roberts 1977). It is the most widely distributed cat in Bangladesh, using scrub jungle, 'scattered forests', bamboo brakes, mass graveyards in villages and 'all forests throughout the country', even entering city limits. Numbers in villages are dropping, apparently due to the loss of village tree groves (Khan 1986). Distribution in the former USSR is limited, but it is, or at least was, particularly abundant in Lenkoran, the lowlands of Azerbaijan, and the Alazani River valley, and quite abundant in parts of Turkmenia (Novikov 1962). In Afghanistan it was readily obtained, inhabiting dense vegetation near watercourses below 1000 m (Hassinger 1973). In Israel it was fairly common (Bodenheimer 1958). In Egypt, it

inhabited low cultivated or marshy ground, provided it has thick vegetation. Jungle Cats can live in association with people; ancient Egyptians mummified them, and recently they were said to do considerable damage at the Giza Zoological Gardens (Osborn and Helmy 1980). Although predation in zoos has also been noted elsewhere (e.g., Acharjyo 1998), M. Baha El Din (*in litt*. 2001) doubts that the species occurs at the zoo or anywhere else in central Cairo, and considers it to be now rare and/or elusive in Egypt. In China, where it has been recorded from the northwest (Sinkiang) and southwest (Tibet, Szechuan and Yunnan), it has been considered rare (Wang and Wang 1986).

Historically, very little scientific mammal collecting was carried out in Indochina (Osgood 1932; Delacour 1940; Deuve 1972). In the 1950s–1980s, wars and political isolationism in the region limited fieldwork by outside biologists. During the late 1980s, this situation began to relax and during the 1990s extensive survey work was carried out in Laos and Vietnam, and work was initiated in Cambodia. Survey work tended to focus on birds and large (i.e., field-identifiable) mammals (e.g., Duckworth et al. 1999; Walston et al. 2001; BIVN/FIPI 2001).

Methods

Most wildlife surveys in Indochina in the 1990s were reconnaissance assessments of overall conservation significance of potential or declared conservation areas. Fieldwork primarily documented overall habitat type, extent and condition; human usage; and bird and mammal species of particular management significance. Surveys typically covered areas of 500–3000 km^2 involved a team (usually 2–4 surveyors) and lasted only a few weeks, exceptionally for a few months. While no individual survey, therefore, could generate a comprehensive list of an area's field-identifiable mammals, regional-level analysis can reveal a species' regional status.

Of all mammals, cats are particularly challenging to survey. All possible methods had drawbacks. *Direct field observation* gave few sightings: cats probably live at low density, are probably prone to shyness (reflecting the history of persecution), have acute senses and are partially nocturnal. Most observation was by day (see, for Laos, by-site effort details in Timmins and Duckworth 1999), but, especially in Laos during 1992–1996, substantial amounts were performed by night (by-site effort details in Duckworth 1997). *Camera-trapping* reduces the problems of shyness and offers the best method of generating accurate locality records for wild cats in Indochina, but was only promoted in Indochina late in the fieldwork period discussed here. *Live trapping* would have been too labour intensive to carry out, given the surveys' general remit. *Sign searches* (footprints, faeces, feeding signs, etc.) are well able to detect cats, but identification to species is difficult where sympatric felids are of similar size. Even in areas with simpler carnivore communities, error rates in visual identification of signs by experienced naturalists may approach 50% (Halfpenny 1986). Moreover, carnivores as different as fox *Vulpes* and marten *Martes* may not be reliably distinguishable by 'experts', contrary to common opinion (Davison et al. 2002). In the absence of any objective evidence to the contrary, we consider that

reliable visual sign identification is impossible with Jungle Cat in Indochina. Laboratory techniques of collected samples, such as thin layer chromatography on extracted bile acids from faeces (Mukherjee 1998b; S. Mukherjee *in litt*. 2002) or genetic analysis of faeces, would be necessary (Foran et al. 1997). *Examination of remains*, in village houses and hunters' camps, detects quarry species, but current location may not reflect site of capture. *Wildlife markets* were widespread (e.g., Srikosamatara et al. 1992; Martin 1992a, b; Srikosamatara, and Suteethorn 1994; Li Wenjun et al. 1996; Martin and Phipps 1996; Nooren and Claridge 2001), but it is rarely possible to tell the origin of individual specimens (see, e.g., Duckworth 1997: pp. 4–5). Useful information on quarry species status at the regional level can, however, be gathered. *Captive animals* in zoos, menageries and restaurants often include carnivores: as with trade records, although provenance is not assessable, at least regional presence is documented. Finally, some surveyors made great use of *village knowledge*. This method has many problems in interpretation of data, and many outright limitations (e.g., Duckworth 1997; Fleck et al. 1999; Wilkie and Saridan 1999) and even experienced practitioners in the region find identification of cat species from local information in Indochina very difficult (Steinmetz 1998).

Thus, to assess the status of Jungle Cat in Indochina, it is necessary to collate what is essentially opportunistic evidence from various methods, each with its own biases and imperfections of coverage, to arrive at an overall judgement. The limited historical information on the species in Indochina is given here, followed by the recent records. Because opportunistic findings cannot be scaled against effort, the most instructive way to interpret recent Jungle Cat records is comparison with those of other small and medium cats in the region. All sites and areas with Jungle Cat records are shown in Figure 1, along with other significant sites in Indochina mentioned in the text.

Historical records

The only historical specimen of Jungle Cat from Indochina was collected by Delacour and Lowe, and forms the type of *F. c. fulvidina* Thomas, 1929. Contemporary sources are highly contradictory over locality. Thomas (1929) stated that "a new form of the Chaus Cat was obtained in Southern Cambodia", but Osgood (1932) gave "Tay Ninh, Cochin China" [=Vietnam]. Delacour (1940) himself stated that "Nous avons obtenu ce nouveau Chat, apparenté au Chaus, entre Kompong Thom et Tây-Ninh". Pocock (1939, 1951) gave "Kampong Tomb, Annam" [=Vietnam], a locality repeated by Corbet and Hill (1992). Both the specimen label and the BM(NH) register give the locality as "Kompong Thom, South Cambodia". The collector's number is 736; both the previous and subsequent numbered specimens are from Cambodia, from "Bokor" and "Kompong" respectively (D. M. Hills *in litt*. 2002). The memoirs of one of the collectors, Willoughby Lowe (1947: 53–54) leave no doubt that the cat was collected in Cambodia, close to Sambour, Kompong Thom Province: "Finally we camped at Sambor, which is a still more ancient capital than Angkor...at night we went in the car hunting for any small nocturnal mammals we might find...one night, seeing an animal's eyes shining...it proved to be a handsome new species of cat".

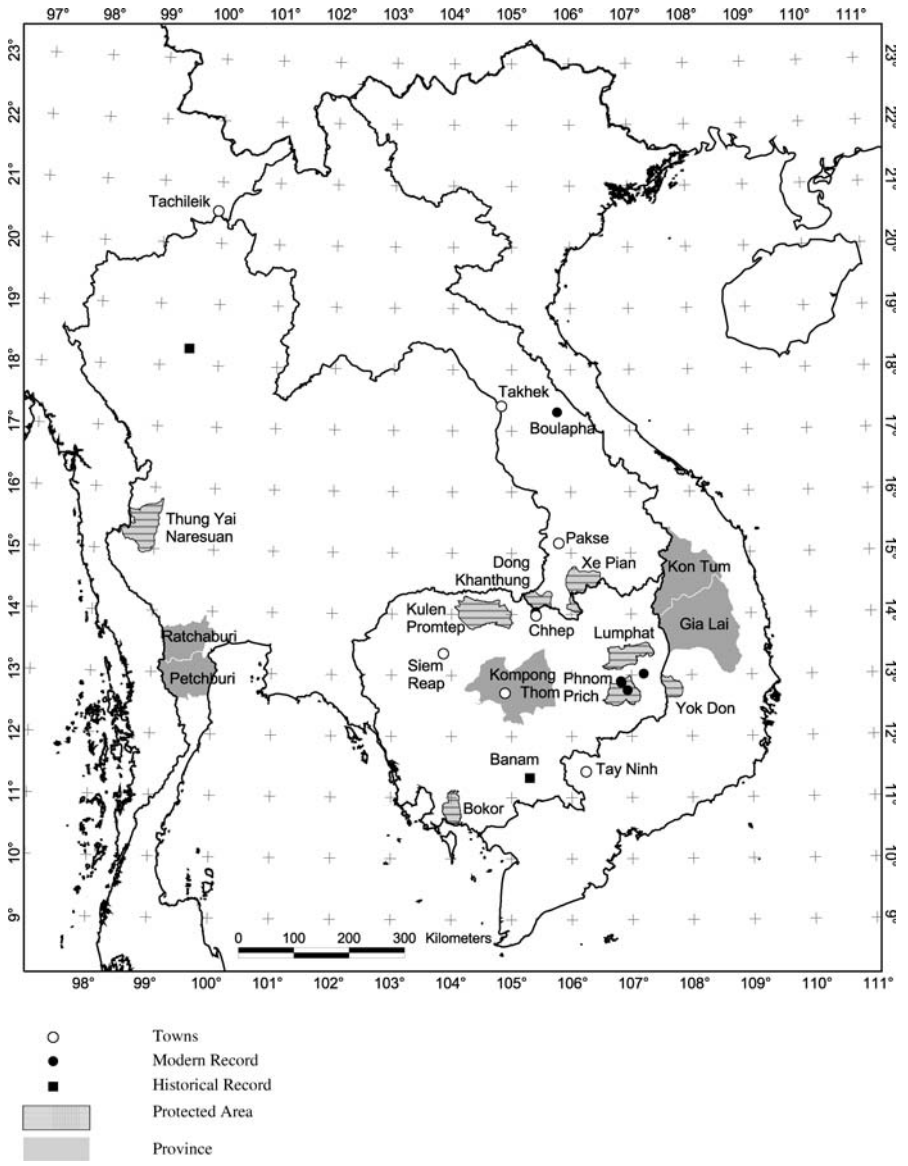

Figure 1. Sites of Jungle Cat records in Indochina and other localities mentioned in the text.

There are two historical collecting localities in Cambodia known as Sambor or Sambour (Thomas and Poole 2003); Lowe's statement that this was the former capital clearly places it as that in Komphong Thom, rather than that by the Mekong in Kratie Province. Ironically, Lowe's map (between pp. 26 and 27) marks only the latter, but this must be in error. The precise collection date is also questionable. It is given as 15 December 1927 by Thomas (1929), and also in the Natural History Museum register

and specimen label (D. M. Hills *in litt*. 2002). On this date, however, Lowe and Delacour travelled from Bokor to Siem Reap, while Jabouille remained at Bokor (Delacour 1928, 1929, 1933; A. Hennache *in litt*. 2000). (Note that the date of final collecting in Bokor, 21 December 1927 [Hennache and Dickinson 2000], is well after Delacour and Lowe's departure.) Lowe and Delacour's most direct road route would pass through Kompong Thom, both the province and provincial town (see Art East 1992). Nonetheless, collection of this cat on this journey is at variance with Lowe's (1947) explicit statement that it was collected on a nocturnal foray during their sojourn at Sambour. Delacour and Lowe left for Tay Ninh in early January (Lowe 1947: 54), meaning that the cat was collected some time between 15 December 1927 and early January 1928. Similar confusion surrounds other uniquely important Delacour specimens, e.g. the type specimens of the nominal taxon Imperial Pheasant *Lophura imperialis* (Eames and Ericson 1996). The only historical claims from Vietnam relate to the type of *F. c. fulvidina*, listed (it is now clear, erroneously) under Tay Ninh, in Van Peenen et al. (1969) and Dang Huy Huynh (1994).

The sole historical evidence for occurrence in Laos is Deuve (1972). He stated that Jungle Cat inhabited open forest and grassy savanna between Pakkading and Pakxe, being abundant along the road from Pakkading to Thakhek, using (usually not far from rivers) open deciduous forest and other habitats lacking a closed tall canopy, for example grassland. It is unclear whether this assessment was based upon personal experience. There is no specimen confirmation, and his demonstrable identification errors with much more distinctive species (e.g., Douc *Pygathrix nemaeus*; Timmins and Duckworth 1999) urge caution over his assessment. There is, however, a specimen from adjacent northeast Thailand (18°16′ N, 99°30′ E) in the Zoological Reference Collection of Singapore (C. P. Groves *in litt*. 1999).

Various hunters' memoirs contain reference to small cats, but it is often not clear what species is intended, even when scientific names are given (e.g., Monestrol 1952, pp. 137–138). A typical example of the confusion is given by Dumas's (1944, p. 254) description of the ''Chat Sauvage proprement'', an animal of savannas and open forests and thus potentially referrable to Jungle Cat; but said to resemble a very large domestic cat, banded black and white and overall rather dark (suggesting Fishing Cat); while the scientific name given (on p. 253), *Felis diardi*, is a synonym of *Pardofelis nebulosa*, the Clouded Leopard. No hunter's memoir that we have traced supports an identification of Jungle Cat with a photograph, and the presence of considerably less plausible carnivores (e.g., Ounce *Panthera uncia* and Sloth Bear *Ursus ursinus*; Monestrol 1952 and Cheminaud 1939, respectively) on hunters' lists would caution acceptance of any Jungle Cat records.

Historical collection of mammals in Indochina was too patchy to allow an inference that the paucity of historical specimens means that the species was never common in Indochina.

Recent records

This section presents all records up to 31 December 2002 that we have been able to trace. They come from all three countries.

Cambodia

Two observations were made near the O Krachau Stream, Mondulkiri Province (13°01′ N, 107°12′ E), at night on 28 April 2000, the first of an animal in deciduous dipterocarp forest that lasted 2–3 min, the second at a nearby water hole far from cover (Long et al. 2000; B. Long *in litt*. 2000). One near the O Kriengmeenyouee stream (12°53′ N, 106°50′ E) in Mondulkiri Province on 3 June 2000 was watched for 3 min under powerful torchlight at 4 m range just before dawn (04h32). It was crouched in a patch of short grass in deciduous dipterocarp forest with small glades (but few pools) in mosaic with mixed deciduous forest (Timmins and Ou Rattanak 2001; R. J. Timmins, own data). Singles were camera-trapped near Chhep, Preah Vihear Province (14°02′30″ N, 105°24′08″ E) on 12 February and 17 March 2001 in grassland within little-degraded deciduous dipterocarp forest (WCS Cambodia unpublished data). Photographs were also obtained in deciduous dipterocarp forest at three sites in northern Phnom Prich Widlife Sanctuary, Mondulkiri Province, on 29 November and 12 December 2001 (12°45′ N, 106°56′ E), 13 December 2002 (12°54′ N, 106°49′ E) and on 17 and 24 December 2002 (12°52′ N, 106°50′ E) (WWF Cambodia unpublished data). During January–September 2003, WWF Cambodia Programme (personal communication) undertook intensive camera-trapping within deciduous dipterocarp forest and habitat mosaics containing this forest type in Mondulkiri Province. Jungle Cat was camera trapped a further 14 times. There are now five sites with recent records within the province. These new records confirm that a significant Jungle Cat population persists in the remaining extensive tracts of deciduous dipterocarp forest in northeast Cambodia. All photographs came from areas remote from villages, and all sites lie below 150 m altitude.

Laos

A single was seen by car headlights in degraded flatland mixed deciduous forest in Boulapha District, Khammouan Province, at 21h00 on 4 May 1999 (R. J. Tizard in Duckworth et al. 1999). The roads mentioned by Deuve (1972; see above) were driven very many times during the 1990s, day and night, by the authors and colleagues, but no Jungle Cats were seen. Indeed, hunting pressure in accessible areas is so high that it is rare to see any wild mammals other than murids on or beside Lao roads. Jungle Cat appeared not infrequently in lists of animals reported by villagers (e.g., Duckworth et al. 1993; WCS 1996), but no survey produced any evidence that *Felis chaus* was truly involved. The tendency to list it probably reflects interviewers' perceptions that it ought to be common, based on Lekagul and McNeely (1977), and a semi-literal translation of 'forest cat', which may be used by villagers to signify wild, as distinct from domestic, cats. Village interview-derived claims of this species deserve extreme caution.

Vietnam

One mounted skin, undated and reported to come from Kon Tum Province, is in the University of Hanoi collection. One mounted skin in the collection of the

Department of Wildlife Management, Forestry College of Vietnam, was acquired from a market in Gia Lai Province in the mid 1990s (Pham Nhat verbally 1997). Although the species is frequently listed in Vietnamese survey reports, many such reports contain errors (Duckworth and Hedges 1998, pp. 66–68). Several experienced surveyors who have worked the length and breadth of the country have not observed the species at all (Le Trong Trai, Do Tuoc, Trinh Viet Cuong, Pham Nhat verbally 1997–1998). All agree that the species is either very rare or extremely localised. It was listed in both editions of the national Red Data Book of Vietnam as ''Endangered'' (MOSTE 1992, 2000).

Recent records of other small and medium-sized cats in Indochina

Hypothetically, the scarcity of Jungle Cat records in Indochina might simply indicate ineffectual detection of small and medium-sized cats. However, if other species were recorded significantly more frequently, this could suggest genuine scarcity or a localised distribution of Jungle Cat. In Laos, Leopard Cat is by far the most commonly found small or medium sized cat, with Asian Golden Cat being recorded not infrequently. There are several records each of Marbled Cat and Clouded Leopard (Table 1). In Cambodia, Leopard Cat is again much the most commonly found species (Table 2). Jungle Cat has recently been camera-trapped almost as frequently as the other small cats. This does not indicate the national situation, however, because camera trapping and direct observation have been strongly biased towards suitable Jungle Cat habitat (see below) in Cambodia. Other survey methods were not so biased, and provide a better national-level comparison: notably significant is the lack of any record of a captive Jungle Cat. In Vietnam, many agencies have undertaken surveys, and no comprehensive joint overview of survey results has been published. Therefore, the total number of records of other cat species during the 1990s is impossible to calculate. Pham Nhat (verbally 1997) reported that it is easy to find stuffed examples of Leopard Cat, Fishing Cat, Asian Golden Cat, Marbled Cat and Clouded Leopard in Vietnamese taxidermists, but he came across only one Jungle Cat (that now held in the Forestry College collection).

Except in Cambodia, recent field observation and camera-trapping had a strong bias to extensive and little-disturbed (semi-)evergreen forest, a habitat providing none of the recent records of Jungle Cat, but many records of other cat species. Nevertheless, even in Laos and Vietnam, the more open deciduous forests likely to hold the species have also hosted much work, because of their importance for globally threatened large water-birds, vultures, Green Peafowl *Pavo muticus* and wild cattle (see below). Such habitats have been best covered in Cambodia with approximately 30 and 50%, respectively, of Wildlife Conservation Society's and of WWF's national camera-trap effort being in deciduous dipterocarp forest. This difference between countries is because Cambodia supports by far the most extensive areas of such habitat and holds the least affected populations of large vertebrates associated with these habitats.

Table 1. Recent records of small and medium-sized cats in Laos[a].

Species	Total	Direct field observations	Camera-trapping	Village remains	Captives
Jungle Cat	1	1	0	0	0
Leopard Cat	25+	14	1[b]	6	Several
Fishing Cat	2	2	0	0	0
As Golden Cat	13+	2	1	6	Several
Marbled Cat	6	2	0	4	0
Clouded Leopard	9+	2	1	2	Several

[a]Figures are from Duckworth et al. (1999) and cover the period 1992–early 1999, except for Leopard Cat for which figures are taken from Duckworth (1997) and cover the period 1992–1996.
[b]Leopard Cat camera-trap figures relate to Wildlife Conservation Society activity extending into early 1999 and are provided by W.G. Robichaud (*in litt*. 2000).

Table 2. Recent records of small and medium-sized cats in Cambodia[a].

Species	Total	Direct field observations[b]	Camera-trapping[c]	Captives[d]
Jungle Cat	10	2	8	0
Leopard Cat	>85	12+	56	29
Fishing Cat	12	0	0	12
As Golden Cat	18	1	12	5
Marbled Cat	14	0	13	0
Clouded Leopard	11	0	4	6

[a]Observations of cats from villages have not been recorded systematically, invalidating comparison of encounter frequency by this method. However, no Jungle Cats or their remains are known to have been reported from either villages or markets between 1999 and 2002 inclusive.
[b]From 1999 to 2002 (JLW and RJTim, own data; B. Long, personal communication 2003; Men Soriyun, personal communication 2003).
[c]From 1999 to 2002 (WCS and WWF Cambodia Programs; J. Sanderson, personal communication 2003; B. Long, personal communication 2003; P. Pigott, personal communication 2003).
[d]From D. Ware and F. Goes (*in litt*. 2002), for the period 1999–April 2002 inclusive.

In all three countries, field surveys paid limited attention to disturbed, agricultural, and settled areas (habitats occupied by Jungle Cat in India), because of their predicted low importance for threatened wildlife. This hinders conservation status assessment for species of such habitats, especially in Laos (Duckworth et al. 2002). Among animals in trade and captivity, by contrast, species of open and secondary areas may be disproportionately represented. Trapping is intense around villages, and open semi-natural habitats are mostly easily accessible. Leopard Cats remain relatively common around villages (at least, those around remaining natural habitat – few visits have been made to villages distant from potential protected areas): the widespread reports of them are frequently confirmed by remains and/or sight

records. Villagers lose few opportunities to capture and kill small wild cats (perceived as poultry pests) in agricultural and village areas. Were Jungle Cats regularly and widely so taken, they would certainly be represented by remains in villages or captives in collections.

In summary, Leopard Cat is by far the most regularly recorded cat in the region, but Fishing Cat, Asian Golden Cat, Marbled Cat and Clouded Leopard are also well distributed and/or locally not rare. Jungle Cat stands out as startlingly patchy in occurrence (multiple reports only from north and east Cambodia), and probably very rare or absent over most or all of the rest of the region.

Current status of Jungle Cat in Indochina

The different methodologies cover, between them, all the region's habitats, and so the limited number of records of Jungle Cat away from north and east Cambodia shows that the species is very scarce, overall in Indochina. It must live at low density, and/or be highly habitat specific, and/or have a small geographical range.

The recent Cambodian records were all in extensive deciduous dipterocarp forest, and this habitat occurs widely within the provinces of Gia Lai and Kon Tum (Schmidt 1974), whence reportedly originated the two recent Vietnamese records. These together suggest that the species may occur mainly in such habitatl and the number of Cambodia records suggests that it may be locally quite common. The recent Lao record was not in deciduous dipterocarp forest, although significant areas of such forest remain in central Laos. Moreover, large areas of somewhat degraded semi-evergreen forest have become more open and more deciduous in central Indochina. If these can support the cat (as information from other range states, above, would suggest), then suitable habitat is abundant across Laos and Cambodia, and not rare even in Vietnam. Indeed, compared with a pre-human situation, the area of open forest and scrub has greatly increased, through the conversion of lowland (semi-)evergreen forest to secondary degraded mosaic with many clearings and edges, and, arguably, the area of deciduous forest has increased through repeated burning of formerly more evergreen forests (Wharton 1966, 1968; Legris and Blasco 1972; Stott 1984). Habitat restriction alone seems very unlikely explain to the species's current rarity.

The spread of records shows that the species was not highly restricted in Indochinese distribution. All recent records come from southern Indochina, but records from Yunnan, southern China (Zhang 1997), suggest that the species (at least formerly) may have occurred north through Indochina along the suitable habitats of the Mekong floodplain. Ancestral range alone seems unlikely to explain the species's current rarity.

The suggested habitat use can, however, clearly explain the paucity of current records when viewed in the context of hunting patterns. Although secondary habitats were not targetted for survey, in total a lot of time has been spent in and around villages. In such areas, Leopard Cats, but not Jungle Cats, are found not infrequently. This contrast in species status may provide an important clue about habitat

use. Across Laos and Vietnam, areas easily accessible to people, whether or not already settled, host very high levels of hunting, including snaring for medium-sized mammals. Ground-living wildlife close to villages and/or human activity areas is at risk from roaming village dogs. Almost the only areas where hunting (including dog) pressure is not extreme are rugged hills cloaked in evergreen forest and lacking road access, where labour and time costs of hunting are therefore high. Cambodia is the only one of the three countries with, until recently, extensive little-settled blocks of open deciduous forests, and this seems to explain the concentration of Jungle Cat records in this country.

In Indochina, several blocks of evergreen forest exceed 1000 km^2. These are combed for high-value natural products (e.g. *Aquilaria* spp., pangolins, turtles, wild cattle), but it is as yet rarely worthwhile to carry wildlife of low commercial value out of the heart of such areas. Many species of closed evergreen forest, and lacking high commercial value, therefore retain healthy populations. All Indochinese cats, except Jungle Cat, inhabit extensive closed evergreen forest (e.g. WCS 1996; Duckworth 1998), and this may well be their preferred habitat. Leopard Cat in Indochina is an extreme habitat generalist, inhabiting closed evergreen forest, open deciduous dipterocarp forest, and degraded areas (Duckworth 1997; Le Xuan Canh et al. 1997). It is plausible that animals dispersing from blocks of extensive evergreen forest offset the high hunting pressure in adjacent open habitats. The situation for Jungle Cat is very different: there is no evidence that dense evergreen forest can provide animals to replenish those killed in the open habitats, and the species overall is therefore very much reduced. Similarly, most birds approaching extinction in Laos are those that are confined to open habitats, particularly those associated with water (Thewlis et al. 1998).

Human population densities are much higher in Vietnam than in Laos, and in much of the country trapping levels are concomitantly higher. Although control over gun use by civilians (who use their guns for hunting wildlife) is further advanced than in Laos (Le Xuan Canh et al. 1997), this is barely relevant to cats, many more of which are trapped than are shot directly. In Laos and Vietnam there still remain a few areas of somewhat extensive deciduous dipterocarp forest not yet dissected by a network of access roads. These may offer the last refuges to Jungle Cat in these two countries, but as important may be their proximity to Cambodia.

In Cambodia, the overall human population density is much lower than Vietnam, and settlement patterns are less dispersed than in Laos and Vietnam. Until very recently, security concerns meant that large tracts of the north and east of the country were only very lightly settled. This included extensive areas of deciduous dipterocarp forest potentially suitable for Jungle Cat, most notably Mondulkiri and Preah Vihear Provinces, from where the recent records come. With the pacification of the country, however, these areas host increasing hunting, agriculture, commercial forestry and settlement (Timmins and Ou Rattanak 2001; Walston et al. 2001).

Hunting occurs for various reasons. Observations in villages across Laos indicate that most caught cats are used locally and the remains discarded; skins may be kept for local display, but there is no evidence of specific trade in them. There is an

enormous market from Indochina into China for wild meat (e.g., Nooren and Claridge 2001), but this is not known to involve many cats. There is wide global trade in the species. Between 1968 and 1972, the U.S. was recorded to import 54 live Jungle Cats. In 1979 and 1980 alone, 89,790 and 79,306 skins reportedly came in. Jungle Cat was one of the three cat species most in demand. Most imports were registered via Germany, having been declared as originating in India and Pakistan (McMahan 1986). Jungle Cat trade levels have remained high, involving thousands of cats per year, according to CITES parties' recent trade submissions (supplied by J. Caldwell *in litt*. 2001). Most trade concerned pelts or garments. The only trade reported as involving animals originating in Indochina or Thailand concerned four cats in 1987 that went from Laos via Singapore to Japan. This does not imply that they were caught in Laos (see Duckworth et al. 1999, pp. 255–256).

Conservation considerations

If Deuve's (1972) identification of the species was reliable, his comments contrast with Jungle Cat's current-day status in central Laos, suggesting strongly that it has deceased. Historical data are simply too patchy to assert this. The recent locations, coupled with information from other range states (see above), suggest that in Indochina, deciduous dipterocarp forest with at least scattered surface water is the natural habitat of the species. Open scrub and other secondary habitats were probably occupied in the past but, through hunting pressure, are currently largely unused. A somewhat similar pattern is shown by Golden Jackal *Canis aureus*, another medium-sized carnivore of open habitats. Most of the few recent Lao and Vietnamese records are from deciduous dipterocarp areas, rather than the extensive scrub the species occupies elsewhere in Asia (Duckworth et al. 1998). In Cambodia, as well as occurring in little-disturbed deciduous dipterocarp forests, they are still found not infrequently in scrub around agricultural areas and even villages amid natural habitat, although they are probably declining (J.L.W., own data).

Lekagul and McNeely (1977) described Jungle Cat as common in Thailand, but it has declined so much that Graham and Round (1994) wrote that "it is today difficult to find any biologist who has ever seen it in the wild in Thailand". The only recent direct observation we have traced is from Thung Yai Naresuan Wildlife Sanctuary in 1995, in the fairly sharp transition between semi-evergreen forest on level limestone and drier bamboo-dominated mixed deciduous forest at about 400 m (Steinmetz and Mather 1996; R. Steinmetz *in litt*. 2000). S. Jaisomkom (verbally 1997–1999), in regular monitoring of Thailand's illegal wildlife border markets, found many fewer Jungle Cat skins than of the other Indochinese cats. These were mostly in the Thai–Burma–Lao border area, with a few along the Thai–Cambodia border. An incomplete Jungle Cat skin was seen at Tachileik border market, Burma, on 8 May 1998 (T. Hansel *in litt*. 2000); this is a noted cat skin trading post (Davidson 1999). Animals have been held recently in Chaing Mai Zoo and Khao Khieaw Open Zoo, Thailand. It is not generally possible to establish origins of zoo animals, but these reportedly came not from Thailand itself but from

Myanmar and Cambodia (S. Jaisomkom *in litt*. 2000). The Thailand Institute of Scientific and Technological Research, Bangkok (TISTR) holds four specimens of Jungle Cat: two from Rajburi, one from Petchburi and one from a market; most recent, 1972. This is consistent with past national assessment of the species as not rare (Leopard Cat is the only species with more – seven – study skins in this collection). The species is currently listed as 'Critically Endangered' in Thailand, the highest threat category, by OEPP (1997). This apparently perilous situation in Thailand both corroborates the Indochinese picture, and increases the regional urgency for conservation action for this species. A more comprehensive review of Jungle Cat's recent and past status in Thailand is merited, as is one for Myanmar.

Deciduous dipterocarp forest well supplied with rivers and wetlands is an Indochinese habitat already firmly identified as of outstanding global conservation priority (Cox et al. 1992; Duckworth et al. 1994, 1999, in press; Desai and Lic Vuthy 1996; Evans and Timmins 1996; Thewlis and Timmins 1996; Thewlis et al. 1996, 1998; Le Xuan Canh et al. 1997; Brickle et al. 1998; Duckworth and Hedges 1998; Round 1998; Timmins and Men Soriyun 1998; Long et al. 2000; BirdLife International 2001; Davidson et al. 2001; Men Soriyun 2001; Timmins and Ou Rattanak 2001; Walston et al. 2001), for birds (Green Peafowl, storks [Ciconiidae], ibises *Pseudibis* spp., vultures *Gyps* spp. and *Sarcogyps calvus*, Sarus Crane *Grus antigone*), ungulates (Eld's Deer *Cervus eldii siamensis*, Hog Deer *Axis porcinus annamiticus*, wild cattle *Bos* spp. and Wild Water Buffalo *Bubalis arnee*) and plants (e.g., all six of the world's deciduous species of Dipterocarpaceae). Jungle Cat is, particularly at the regional level, also a conservation priority of these habitats. The taxonomic status of Indochinese Jungle Cats needs review; on current knowledge, the subspecies *F. c. fulvidina* occurs only east of Thailand. If valid, this taxonomic distinctiveness would enhance the need to conserve the species in Indochina.

There are already several large protected areas in such habitat in Indochina: Yok Don National Park in Vietnam, Xe Pian National Protected Area (NPA) and Dong Khanthung proposed NPA in Laos, and Kulen Promtep, Lumphat and Phnom Prich Wildlife Sanctuaries in Cambodia. In these, mammal hunting remains a serious problem. Given the social and cultural predisposition to hunt, and the ready markets available for wildlife products, serious reduction, let alone cessation, of hunting in these protected areas is a long-term issue. Because of the ease of access to these habitats, intensive anti-poaching patrols will remain a vital feature of these areas for the foreseeable future.

Heavy hunting prevents wildlife use of degraded habitats across much of Indochina, meaning that many of the region's most threatened species are actually non-forest species. This is a somewhat paradoxical situation, in that habitat loss is often a major driving force towards extinction (e.g., BirdLife International 2001). Laos and Cambodia are unusual in that closed forest remains widespread, and even though the tetrapod fauna is under heavy harvesting, human population densities in these two countries are simply too low to eradicate most species (except those of high commercial value and/or peculiarly easy to catch) from large blocks of closed forest. By contrast, those species which do not have self-supporting populations in (semi-)evergreen forest are, if larger than a bulbul *Pycnonotus*, mostly in severe population

decline. This includes almost all species of open habitats, and even adaptable species which reach pest proportions elsewhere have been greatly reduced, for example Large-billed Crow *Corvus macrorhynchos* is ecologically extinct across much of northern Laos (Duckworth et al. 2002). To stem the current wave of national and Indochina-level extinctions among birds and mammals, species of open habitats need greatly increased attention. Were hunting issues addressed, the low intensity of agriculture and the abundance of secondary shrub-land across Laos and Cambodia could form an exceptional resource for the recovery of wildlife populations. This option is not now open to most other tropical Asian countries, because of their much higher human population densities and concomitant pressures to use land for maximal economic production.

Further information on Jungle Cat is needed to generate conservation actions more specific than the above. Any records of the species from Indochina merit publication in regional or feline journals or newsletters. Camera-trappers and market surveyors should remain particularly vigilant for the species.

Acknowledgements

The surveys on which the Lao and Cambodian data are based took place over several years. We particularly thank the Centre for Protected Areas and Watershed Management (now Division of Forest Resources Conservation), Lao PDR, and the Department of Forestry and Wildlife, of the Ministry of Agriculture, Forestry and Fisheries, and the Department of Nature Conservation and Protection of the Ministry of Environment of the Royal Government of Cambodia, for permission. We are very grateful to many people for the provision of information and other assistance: Dave Ware, Rob Steinmetz, Gerry Schroering, Jim Sanderson, Craig Robson, Bill Robichaud, Prum Sovanna, Steve Platt, Peter Pigott, Pham Nhat, John Parr, Shomita Mukherjee, Men Soriyun, Andy Maxwell, Tony Lynam, Barney Long, Sakon Jaisomkom, Peter Jackson, Huy Keavuth, Daphne Hills, Alain Hennache, Troy Hansel, Colin Groves, Frederic Goes, Do Tuoc, Edward Dickinson, Pete Davidson, John Caldwell, Mike Baltzer, and Mindy Baha El Din. Lakkana Pakkarnseree arranged access to view specimens at TISTR. Fieldwork across Indochina to allow documentation of this pattern was funded by a wide variety of sources, as acknowledged in the reports cited, with much coming through WCS Lao Program, WCS Cambodia Program, IUCN Lao PDR office, BirdLife International Vietnam Programme, WWF Indochina Programme and FFI Indochina Programme.

References

Acharjyo L.N. 1998. The six small cats of Orissa. Envis (Wildlife and Protected Areas) 1: 18–20.Wildlife Institute of India, Dehra Dun, India.

Art East. 1992. A 1930s Guide to Saigon, Phnom Penh, and Angkor. Asia Books Bangkok, Thailand.

Bodenheimer F.S. 1958. The present taxonomic status of the terrestrial mammals of Palestine. Bulletin of the Research Council of Israel 7B: 165–190.

BirdLife International. 2001. Threatened Birds of Asia: The BirdLife International Red Data Book. BirdLife International, Cambridge, UK.

[BIVN/FIPI] BirdLife International Vietnam Programme/Forest Inventory and Planning Institute. 2001. Sourcebook of existing and proposed protected areas in Vietnam.BirdLife International Vietnam Programme and the Forest Inventory and Planning Institute Hanoi, Vietnam.

Brickle N., Nguyen C., Ha Q.Q., Nguyen T.T.C. and Hoang V.S. 1998. The status and distribution of Green Peafowl *Pavo muticus* in Dak Lak Province, Vietnam. BirdLife International Vietnam Programme/Institute of Ecology and Biological Resources (Conservation Report 1), Hanoi, Vietnam.

Cheminaud G. 1939. Mes chasses au Laos, Vol 1. Payot, Paris, France.

Corbet G.B. and Hill J.E. 1992. Mammals of the Indomalayan Region: A Systematic Review. Natural History Museum Publications and Oxford University Press, London and Oxford, UK.

Cox R., Laurie A. and Woodford M. 1992. The results of four field surveys for Kouprey *Bos sauveli* in Viet Nam and Lao PDR. Kouprey Conservation Trust.

Dang H.H. (ed.) 1994. Danh Luc Cac Loai Thu (Mammalia) Viet Nam [Checklist of the mammals of Vietnam]. Publishing House 'Science and Technics', Hanoi, Vietnam.

Davidson P. 1999. Spotcheck of wildlife on sale in Myanmar market. TRAFFIC Bulletin 17: 33–44.

Davidson P., Poole C. and Walston J. 2001. Cambodia's northern plains–heartland of the Giant Ibis. World Birdwatch 23: 16–18.

Davison A., Birks J.D.S., Brookes R.C., Braithwaite T.C. and Messenger J.E. 2002. On the origin of faeces: morphological versus molecular methods for surveying rare carnivores from their scats. Journal of Zoology, London 257: 141–143.

Delacour J. 1928. Quatrième expédition en Indo-chine. L'Oiseau 9: 257–269, 301–308.

Delacour J. 1929. On birds collected during the fourth expedition to French Indo-China. Ibis 12: 93–220, 403–429.

Delacour J. 1933. Dix ans d'explorations zoologiques en Indochine. Terre et Vie 3: 539–550.

Delacour J. 1940. Liste provisoire des mammifères de l'Indochine française. Mammalia 4: 20–29, 46–58.

Desai A.A. and Lic V. 1996. Status and distribution of large mammals in eastern Cambodia. IUCN/FFI/WWF, Phnom Penh, Cambodia.

Deuve J. 1972. Les mammifères du Laos. Ministère de l'Education National, Vientiane, Laos.

Duckworth J.W. 1997. Small carnivores in Laos: a status review with notes on ecology, behaviour and conservation. Small Carnivore Conservation 16: 1–21.

Duckworth J.W. 1998. A survey of large mammals in the central Annamite mountains of Laos. Zeitschrift für Säugetierkunde 63: 239–250.

Duckworth J.W. and Hedges S. 1998. A review of the status of Tiger, Asian Elephant, Gaur and Banteng in Vietnam, Lao, Cambodia and Yunnan (China), with recommendations for future conservation action. WWF Indochina Programme, Hanoim, Vietnam.

Duckworth J.W., Timmins R.J. and Cozza K. 1993. A wildlife and habitat survey of Phou Xang He Proposed Protected Area. Lao/Swedish Forestry Co-operation Programme, Vientiane, Laos.

Duckworth J.W., Timmins R.J., Thewlis R.C.M., Evans T.D. and Anderson G.Q.A. 1994. Field observations of mammals in Laos, 1992–1993. Natural History Bulletin of the Siam Society 42: 177–205.

Duckworth J.W., Anderson G.Q.A., Desai A.A. and Steinmetz R. 1998. A clarification of the status of the Asiatic Jackal *Canis aureus* in Indochina. Mammalia 62: 549–556.

Duckworth J.W., Salter R.E. and Khounboline K. (compilers) 1999. Wildlife in Lao PDR: 1999 Status Report. IUCN–The World Conservation Union/Wildlife Conservation Society/Centre for Protected Areas and Watershed Management, Vientiane, Laos.

Duckworth J.W., Davidson P., Evans T.D., Round P.D. and Timmins R.J. 2002. Bird records from North Laos, principally Xiangkhouang Province and the upper Lao Mekong, in 1998–2000. Forktail 18: 11–44.

Duckworth J.W., Poole C.M., Round P.D., Timmins R.J., Davidson P. and Wells D.R. in-press. Vulture *Gyps* and *Sarcogyps* populations in South-east Asia during the twentieth century.

Dumas C. 1944. La faune sauvage du Cambodge. Journal of Aspar, Saigon, Vietnam.

Eames J.C. and Ericson P.G.P. 1996. The Björkegren expedition to French Indochina: a collection of birds from Vietnam and Cambodia. Natural History Bulletin of the Siam Society 44: 75–111.

Evans T.D. and Timmins R.J. 1996. The status of the Green Peafowl *Pavo muticus* in Laos. Forktail 11: 11–32.

Fleck D.W., Voss R.S. and Patton J.L. 1999. Biological basis of saki (*Pithecia*) folk species recognized by the Matses Indians of Amazonian Perú. International Journal of Primatology 20: 1005–1028.

Foran D.R., Crooks K.R. and Minta S.C. 1997. Species identification from scat: an unambiguous genetic method. Wildlife Society Bulletin 25: 835–839.

Gogate M.G. 1998. Smaller cats of Maharashtra. Envis (Wildlife and Protected Areas) 1: 5–13. Wildlife Institute of India, Dehra Dun, India.

Graham M. and Round P. 1994. Thailand's Vanishing Flora and Fauna. Finance One, Bangkok, Thailand.

Halfpenny J. 1986. A Field Guide to Mammal Tracking in Western America. Johnson Books, Boulder, Colorado.

Harrison D.L. and Bates P.J.J. 1991. *The Mammals of Arabia* 3rd edn.. Harrison Zoological Museum, Sevenoaks, UK.

Hassinger J.D. 1973. A survey of the mammals of Afghanistan resulting from the 1965 Street expedition (excluding bats). Fieldiana, Zoology 60: 1–195.

Hennache A. and Dickinson E.C. 2000. Les types des oiseaux rapportés du Vietnam, du Laos et du Cambodge par Jean Delacour entre 1923 et 1939. Zoosystema 22: 601–629.

IUCN 2002. 2002 IUCN Red List of Threatened Species. Downloaded from www.redlist.org on 3 February 2003.

Jha A. 2000. A preliminary status survey of cats in Sikkim. Tigerpaper 27: 12–14.

Karanth K.U. and Stith B.M. 1999. Prey depletion as a critical determinant of Tiger population viability. In: Seidensticker J., Christie S. and Jackson P. (eds) Riding the Tiger: Tiger Conservation in Human Dominated Landscapes. Cambridge University Press, Cambridge, UK, pp. 100–113.

Khan M.A.R. 1986. The status and distribution of the cats in Bangladesh. In: Miller S.D. and Everett D.D. (eds) Cats of the World: Biology, Conservation, and Management. National Wildlife Federation, Washington, DC, pp. 43–49.

Kingdon J. 1997. The Kingdon Field Guide to African Mammals. Academic Press, San Diego, California.

Le X.C., Pham T.A., Duckworth J.W., Vu N.T. and Lic Vuthy 1997. A Survey of Large Mammals in Dak Lak Province, Vietnam. WWF/IUCN, Hanoi, Vietnam.

Légris P. and Blasco F. 1972. Notice de la carte de végétation du Cambodge au 1/1,000,000. Travaux de la Section Scientifique et Technique de l'Institut francais de Pondichéry 11: 1–238.

Lekagul B. and McNeely J.A. 1977. Mammals of Thailand. Association for the Conservation of Wildlife, Bangkok, Thailand.

Li W., Fuller T.K. and Wang S. 1996. A survey of wildlife trade in Guangxi and Guangdong, China. TRAFFIC Bulletin 16: 9–16.

Long B., Swan S.R. and Kry M. 2000. Biological Surveys in Northeast Mondolkiri, Cambodia. Fauna & Flora International–Indochina Programme and the Wildlife Protection Office, Hanoi and Phnom Penh.

Lowe W.P. 1947. The end of the trail. James Townsend & Sons Ltd, Exeter, UK.

McMahan L.R. 1986. The international cat trade. In: Miller S.D. and Everett D.D. (eds) Cats of the World: Biology, Conservation, and Management. National Wildlife Federation, Washington, DC, pp. 461–488.

MacPhee R.D.E. and Flemming C. 1999. Requiem æternam: the last five hundred years of mammalian extinctions. In: MacPhee R.D.E. (ed.) Extinctions in Near Time. Kluwer Academic and Plenum, New York, pp. 333–371.

Martin E.B. 1992a. The trade and uses of wildlife products in Laos. TRAFFIC Bulletin 13: 23–28.

Martin E.B. 1992b. Observations on wildlife trade in Vietnam. TRAFFIC Bulletin 13: 61–67.

Martin E.B. and Phipps M. 1996. A review of wild animal trade in Cambodia. TRAFFIC Bulletin 16: 45–60.

Men Soriyun 2001. Status and distribution of wild cattle in Cambodia. Tigerpaper 28: 9–14.

Monestrol H. 1952. Chasses et faune d'Indochine. Portail, Saigon, Vietnam.

[MOSTE] Ministry of Science, Technology and Environment 1992. *Red Data Book of Vietnam: Volume 1, Animals*. [In Vietnamese.] Science and Technics Publishing House, Hanoi, Vietnam.

[MOSTE] Ministry of Science, Technology and Environment 2000. *Red Data Book of Vietnam: Volume 1, Animals*. [In Vietnamese.] Science and Technics Publishing House, Hanoi, Vietnam

Mukherjee S. 1998a. Cats: some large, many small. Envis (Wildlife and Protected Areas) 1: 5–13.Wildlife Institute of India, Dehra Dun, India.

Mukherjee S. 1998b. Some methods to study the small cats. Envis (Wildlife and Protected Areas) 1: 35–38.Wildlife Institute of India, Dehra Dun, India.

Nooren H. and Claridge G. 2001. Wildlife Trade in Laos: The End of the Game. Netherlands Committee for IUCN, Amsterdam, The Netherlands.

Novikov G.A. 1962. Carnivorous mammals of the fauna of the USSR. Israel Program for Scientific Translations, Jerusalem, Israel.

Nowell K. and Jackson P. 1996. Wild Cats: Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland.

[OEPP] Office of Environmental Policy and Planning. 1997. Status of Biological Diversity of Thailand. Office of Environmental Policy and Planning Bangkok, Thailand.

Osborn D.J. and Helmy I. 1980. The contempory land mammals of Egypt (including Sinai). Fieldiana, Zoology (New Series) 5: 1–579.

Osgood W.H. 1932. Mammals of the Kelley-Roosevelts and Delacour Asiatic expeditions. Publications of the Field Museum of Natural History, Zoology Series 18: 193–339.

Payne J., Francis C.M. and Phillipps K. 1985. A Field Guide to the Mammals of Borneo. The Sabah Society with World Wildlife Fund Malaysia, Kota Kinabalu and Kuala Lumpur.

Pocock R.I. 1939. The Fauna of British India: Mammalia, Vol I, Primates and Carnivora (in part). Taylor and Francis, London.

Pocock R.I. 1951. Catalogue of the Genus *Felis*. British Museum (Natural History), London.

Prater S.H. 1971. The Book of Indian Animals. 3rd edn. Bombay Natural History Society and Oxford University Press, Mumbai, India (as updated 1998).

Roberts T.J. 1977. Mammals of Pakistan. Ernest Benn, London and Tonbridge, UK.

Round P.D. 1998. Wildlife, habitats and priorities for conservation in Dong Khanthung proposed National Biodiversity Conservation Area, Champasak Province, Lao PDR. Wildlife Conservation Society/Centre for Protected Areas and Watershed Management, Vientiane, Laos.

Schmid M. 1974. Végétation du Viet-Nam: le massif sud-annamitique et les régions limitrophes. Mémoires ORSTOM 74: 1–243.

Sharma V.D. 1998. Small cats in Rajasthan. Envis (Wildlife and Protected Areas) 1 (2): 14–17.Wildlife Institute of India, Dehra Dun, India.

Singh H.S. 1998. Records of small cats in Gujarat. Envis (Wildlife and Protected Areas) 1 (2): 22–23. Wildlife Institute of India, Dehra Dun, India.

Srikosamatara S. and Suteethorn V. 1994. Wildlife conservation along the Thai-Lao border. Natural History Bulletin of the Siam Society 42: 3–21.

Srikosamatara S., Siripholdej B. and Suteethorn V. 1992. Wildlife trade in Lao P.D.R. and between Lao P.D.R. and Thailand. Natural History Bulletin of the Siam Society 40: 1–47.

Steinmetz R. 1998. A participatory biodiversity assessment of Khammouan Limestone National Biodiversity Conservation Area, Khammouan Province, Lao, PDR. WWF Thailand Project Office, Bangkok, Thailand.

Steinmetz R. and Mather R. 1996. Impact of Karen villages on the fauna of Thung Yai Naresuan Wildlife Sanctuary: a participatory research project. Natural History Bulletin of the Siam Society 44: 23–40.

Stott P. 1984. The savanna forests of mainland southeast Asia: an ecological survey. Progress in Physical Geography 8: 315–335.

Thewlis R.M. and Timmins R.J. 1996. The rediscovery of Giant Ibis *Pseudibis gigantea* with a review of previous records. Bird Conservation International 6: 317–324.

Thewlis R.M. et al. 1996. Ornithological records from Laos, 1992–1993. Forktail 11: 47–100.

Thewlis R.M., Timmins R.J., Evans T.D. and Duckworth J.W. 1998. The conservation status of birds in Laos: a review of key species. Bird Conservation International 8 (Suppl.): 1–159.

Thomas O. 1929. The Delacour exploration of French Indo-China – Mammals III. Mammals collected during the winter of 1927–28. Proceedings of the Zoological Society of London '1928' (4): 831–841.

Thomas W.W. and Poole C.M. 2003. An annotated list of the birds of Cambodia from 1859 to 1970. Forktail 19: 103–127.

Timmins R.J. and Duckworth J.W. 1999. Status and conservation of Douc Langurs (*Pygathrix nemaeus*) in Laos. International Journal of Primatology 20: 469–489.

Timmins R.J. and Men S. 1998. A Wildlife Survey of the Tonle San and Tonle Srepok River Basins in Northeastern Cambodia. Fauna & Flora International and Wildlife Protection Office, Hanoi and Phnom Penh, Cambodia.

Timmins R.J. and Ou R. 2001. The Importance of Phnom Prich Wildlife Sanctuary and Adjacent Areas for the Conservation of Tigers and Other Key Species. WWF, Phnom Penh, Cambodia.

Tohmé G. and Tohmé H. 2000. Quelques nouvelles données sur le statut actuel des Felidae au Liban et plus particulièrement du Chat de Marais *Felis chaus* Güldenstaedt, 1776. Mammalia 64: 247–249.

Van Peenen P.F.D., Ryan P.H. and Light R.H. 1969. Preliminary Identification Manual for Mammals of South Vietnam. Smithsonian Institution, Washington, DC.

Walston J., Davidson P. and Men S. 2001. A Wildlife Survey of Southern Mondulkiri Province, Cambodia. Wildlife Conservation Society Cambodia Program, Phnom Penh, Cambodia.

Wang Z. and Wang S. 1986. Distribution and recent status of the Felidae in China. In: Miller S.D. and Everett D.D. (eds) Cats of the World: Biology, Conservation, and Management. National Wildlife Federation, Washington, DC, pp. 201–209.

Wharton C.H. 1966. Man, fire, and wild cattle in north Cambodia. Proceeding of the Tall Timbers Fire Ecology Conference 5: 23–65.

Wharton C.H. 1968. Man, fire, and wild cattle in Southeast Asia. Proceeding of the Tall Timbers Fire Ecology Conference 8: 107–167.

[WCS] Wildlife Conservation Society. 1996. Additional surveys and recommendations on the birds and mammals for the Nam Theun II hydropower project, with emphasis on the proposed corridor and reservoir islands areas. Wildlife Conservation Society, Vientiane, Laos.

Wilkie P. and Saridan A. 1999. The limitations of vernacular names in an inventory study, Central Kalimantan, Indonesia. Biodiversity and Conservation 8: 1457–1467.

Wozencraft W.C. 1993. Order Carnivora. In: Wilson D.E. and Reeder D.M. (eds) Mammal Species of the World. A Taxonomic and Geographic Reference. 2nd edn. Smithsonian Institution Press, Washington, DC, pp. 279–348.

Zhang Y. (chief author) 1997. Distribution of Mammalian Species in China. China Forestry Publishing House, Beijing, China.