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Michael Hoffmann¹ , Alexei Abramov² , Hoang Minh Duc³ , Le Trong Trai⁴ ,
Barney Long⁵ , An Nguyen⁶ , Nguyen Truong Son⁷ , Ben Rawson⁸ , Robert Timmins⁹,
Tran Van Bang¹⁰  & Daniel Willcox¹¹ 

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¹ Conservation and Policy, Zoological Society of London, Regent's Park, London, NW1 4RY, United Kingdom.

² Zoological Institute, Russian Academy of Sciences, Universitetskaya nab. 1, Saint Petersburg 199034, Russian Federation.

^{3,10} Southern Institute of Ecology, Vietnam Academy of Science and Technology. 01 Mac Dinh Chi St., District 1, Ho Chi Minh City, Vietnam.

⁴ Viet Nature Conservation Centre, Apt. 202, building 18T2, Le Van Luong Street, Hanoi, Vietnam.

^{5,6} Global Wildlife Conservation, PO Box 129, Austin, TX 78767, USA.

⁶ Leibniz Institute for Zoo and Wildlife Research, Alfred-Kowalke-Straße 17, 10315, Berlin, Germany.

⁷ Department of Vertebrate Zoology, Institute of Ecology and Biological Resources, Graduate University of Science and Technology, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam.

⁸ WWF-Vietnam, Nam Tu Liem District, Hanoi, Vietnam.

⁹ 51123 Monroe Street, Evanston, IL 60202, USA.

¹¹ Save Vietnam's Wildlife, Cuc Phuong National Park, Nho Quan, Ninh Binh, Vietnam.

¹ mike.hoffmann@zsl.org (corresponding author), ² a.abramov@mail.ru, ³ duchao71@yahoo.com, ⁴ trai.letrong@thienhienviet.org.vn, ⁵ blong@globalwildlife.org, ⁶ an.thetruongnguyen@gmail.com, ⁷ truongsoniebr@gmail.com,

⁸ nomascus@yahoo.com.au, ⁹ rjtimmins@gmail.com, ¹⁰ vn.vanbang@gmail.com, ¹¹ willcox.daniel@gmail.com

Abstract: Four species of wild canids are documented as occurring in Vietnam: Dhole *Cuon alpinus*, Eurasian Golden Jackal *Canis aureus*, Red Fox *Vulpes vulpes* and Raccoon Dog *Nyctereutes procyonoides*. Except for Dhole, all species are widely distributed globally and are listed as Least Concern on the IUCN Red List of Threatened Species. Concerned by the paucity of recent records of these species from Vietnam, especially in the context of rapidly declining mammal populations in the country in general, we undertook a review of the status of these species in Vietnam. All traceable and potentially verifiable canid records from 01 January 2002 until 31 December 2018 were collated and reviewed. The Dhole, formerly the most widely distributed of all canid species in Vietnam, and Raccoon Dog, apparently formerly widely distributed in the northern part of the country, appear to have both declined; Dhole is now either extirpated, or close to extirpation, while Raccoon Dog is of uncertain status. The Eurasian Golden Jackal does not seem to have been reliably observed in the wild since 2004, although it is possible the species may persist in some areas. Red Fox has only ever been known from a handful of records, and the current status of this species is unknown. In summary, Vietnam cannot be considered to sustain healthy populations of any of its four native wild canid species. These declines seem largely attributable to hunting of both the canids themselves and, for Dhole, their prey base, exacerbated by habitat loss.

Keywords: *Canis aureus*, *Cuon alpinus*, *Nyctereutes procyonoides*, *Vulpes vulpes*.

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INTRODUCTION

Vietnam has a diverse mammal fauna with the most recent checklist documenting 295 native species (Dang Ngoc Can et al. 2008), including four species of wild canids: Eurasian Golden Jackal *Canis aureus* (hereafter Golden Jackal), Dhole *Cuon alpinus*, Raccoon Dog *Nyctereutes procyonoides* and Red Fox *Vulpes vulpes*. The Golden Jackal, Raccoon Dog and Red Fox are all widely distributed globally and are listed as Least Concern on the IUCN Red List of Threatened Species (hereafter IUCN Red List). The Golden Jackal ranges from Western Europe (where it has been undergoing rapid range expansion) and the Middle East eastwards to mainland Southeast Asia; populations in Africa formerly assigned to *C. aureus* are now understood to represent a distinct species, the African Wolf *Canis lupaster* (Koepfli et al. 2015; Viranta et al. 2017). The Raccoon Dog is native to East Asia, occurring from northern Vietnam north to the Russian Far East, but was introduced to the European part of the former Soviet Union in the mid-20th Century and has now established itself in northern and eastern Europe (Kauhala & Kowalczyk 2011). The Red Fox has the widest distribution of all the world's wild canid species, with a native range in most of the northern hemisphere. In contrast to these three species, the Dhole historically occurred throughout southern and eastern Asia, to as far north as the Russian Far East, and as far west as eastern Kazakhstan to northern Pakistan. The species has undergone substantial declines across its range and is currently categorized as Endangered on the IUCN Red List.

A global status assessment of these four canid taxa was undertaken as part of a process of updating the IUCN Red List. During this assessment, evidence emerged to suggest that the population status of wild canids in Vietnam is of more significant concern than it is in much of the rest of these species' ranges. While Vietnam has more species of native canids than any other southeastern Asian country, pressures on ground-dwelling mammals in general in the country are very high, and have resulted in localised extirpations, or in some cases national-level extinctions of some mammals (such as Javan Rhinoceros *Rhinoceros sondaicus*; Brook et al. 2012). A general lack of available records of canids from Vietnam for the global assessment, and an understanding of the general trajectory of mammal populations in Vietnam, prompted us to undertake a more detailed review of the status of these species in the country.

METHODS

We surveyed recent literature, as well as current and recent conservation workers and researchers with significant experience working across the country, for published and unpublished records or observations of each of the four species. We adopted methods similar to Willcox et al. (2014) seeking any and all traceable records in the country from 01 January 2002 until 31 December 2018 (a period of ~16 years, equivalent to three generation lengths of the Dhole, which is the time-frame relevant for Red List assessment purposes). Records were compiled from potentially verifiable direct observations, camera trap images, and captives in villages near natural or semi-natural areas. Due to the general paucity of records, we remark also on observations not supported by photographic evidence, such as signs, and on reports from interviews, mentioned in the literature (although these records are not mapped). We briefly summarize these results below, put them in the context of what is known concerning each species' historical range, and discuss reasons for the current apparent scarcity of canid species in the country.

RESULTS

Eurasian Golden Jackal *Canis aureus*

There are very few historical records of Golden Jackal in Vietnam, although Millet (1930) and Delacour (1940) observed animals in zoos. The Muséum National d'Histoire Naturelle (MNHN), Paris, holds three historical Vietnamese specimens: one from Tay Ninh Province (with specimen number MNHN 1984-844); one that died in the Saigon Zoo in 1931 (MNHN 1932-3204); and a third specimen without locality data but with a date label of 9 March 1934 (MNHN 1941-82) (Duckworth et al. 1998). Pham Trong Anh (1990) was the first modern author to include the species among Vietnam's fauna; this was based on a specimen collected in 1987 in Ea Sup District of Dak Lak Province and held at the Institute of Ecology and Biological Resources in Hanoi. In their review of the status of the species in Indochina, Duckworth et al. (1998) observed this specimen, and a second taken in the same area, also in 1987, held at the Museum of the National University of Hanoi, and documented two sightings of single animals in Yok Don National Park, Dak Lak Province in June 1997. A specimen in the Tay Nguyen Institute of Scientific Research in Da Lat may have come from Lam Dong Province (Pham Trong Anh 1996). Dang Ngoc Can et al. (2008) listed the species



Image 1. Female Eurasian Golden Jackal at the Saigon Zoo.

as occurring in Dak Lak, Dak Nong (from Ta Dung Nature Reserve) and Kien Giang provinces. The latter record ostensibly comes from Phu Quoc National Park, although there are no further details provided and this record is best considered as equivocal; the species was not recorded in surveys by Abramov et al. (2007) or in camera-trapping studies conducted between December 2017 and September 2018 (4237 camera-trap nights, 69 camera-trap stations; Tran Van Bang et al. unpub. data).

The most recent confirmed records of the species in the wild appear to be those from Yok Don National Park. Two Golden Jackals were seen on 11 March 2003 (coordinates given as: 12.996°N & 107.625°E) and two animals were seen running across the T15 road on 16 June 2004 (12.853°N & 107.544°E) (Eames et al. 2004). Camera-trapping surveys undertaken in Yok Don National Park in 2017, however, only detected Eurasian Wild Pig *Sus scrofa*, Northern Red Muntjac *Muntiacus vaginalis* and Banteng *Bos javanicus*, although survey effort was low (499 camera-trap nights, 17 stations; WWF-Vietnam unpub. data). Recent surveys in Bu Gia Map National Park, Binh Phuoc Province, failed to detect the species in the wild, although local people reported that the species still occurs in some areas such as Dak Sa, Dak Manh and Dak Ka rivers (Nguyen Xuan Dang et al. 2011; Luu Hong Truong et al. 2012). In 2007, a hunted animal was apparently brought to the village of Bu Reng (Nguyen Xuan Dang et al. 2011). In Tay Ninh Province, camera-trapping surveys conducted in Lo Go - Xa Mat National Park between November 2017 and July 2018 (4844 camera-trap nights, 76 stations; Tran Van Bang et al. unpub. data) failed to record the species (among canids, only domestic dogs were photographed). The only other recent record traced is a captive individual

that has been kept at Saigon Zoo since 2007 (Image 1), and which is believed to have come from Dak Lak Province. Given the general adaptability of jackals, including their more opportunistic diets and potential use of degraded landscapes, the Golden Jackal may yet be shown to persist in some areas (especially in the border regions with neighbouring Cambodia) and it would be premature to consider the species extirpated from Vietnam. The species is listed as Data Deficient in the Vietnam Red Data Book (MoST) & (VAST) 2007.

Dhole *Cuon alpinus*

Historically, the Dhole occurred throughout most of, perhaps all, Vietnam (Dang Ngoc Can et al. 2008); it is unclear how far south it ranged, although Osgood (1932) documents a specimen from “Saigon” (housed in the Field Museum, FMNH 33500, collected in 1929).

There are very few recent confirmed records of the species from the country. The last confirmed records we could trace come from: 1999 in Pu Mat National Park, Nghe An Province (prior to January 2002, but included here for completeness); 2003 and 2004 in Yok Don National Park; and, incredibly, 2014 in Ninh Thuan Province. In Pu Mat, the report authors note that “One individual was observed crossing the Khe Bong on 18 July 1999. A single individual and a group of at least three individuals were photographed in the upper Khe Bu valley at c. 1,200m during October 1999. A fresh track was found on 16 June 1999 in the Khe Bong valley” (SFNC 2000). In Yok Don, a group of five Dholes was seen in the Dak Tol area on 19 March 2003, and another group of five was seen in the Yok Da area on 27 March 2003. A single Dhole was observed on 20 March 2003, and later a group of five pups were camera-trapped on the border of Cu Jut and Yok Don on 2 April 2003 (12.785°N & 107.719°E). In 2004, a group of five individuals were sighted in the Dak Ken area on 4 April, and a group of 4-5 individuals were sighted again in the Dak Tol area on 16 June 2004 (Eames et al. 2004). The most recent record from Ninh Thuan Province was recorded while conducting acoustic surveys for gibbons when To Van Quang, a staff member of the Southern Institute for Ecology, observed two individuals on 25 May 2014 (coordinates given as 11.568860°N, 108.651378°E, right on the border with Lam Dong Province) (SIE unpub. data). Finally, there is also an unconfirmed report of Dhole from 2002: Mahood & Tran Van Hung (2008) noted that residents of Cup and Cuoi villages in Bac Huong Hoa Nature Reserve, Quang Tri Province, reported the presence in the reserve of an animal taken to relate to this species by the authors, and

that two hunters reported that an animal taken to relate to a Dhole was trapped in the Cuoi area.

Recent camera-trap surveys in Yok Don National Park have failed to record the species (WWF-Vietnam unpub. data), although as noted above survey effort was low. The largest forest blocks remaining in Vietnam are within the Annamites mountain range bordering southeastern Lao PDR, western Vietnam and northeastern Cambodia. Although camera-trapping surveys have been patchy, these have been relatively intensive in the northern and central Annamites (including Bach Ma National Park, Quang Nam Saola Reserve, Thua Thien Hue Saola Reserve, Song Thanh Nature Reserve, Bac Hai Van proposed Nature Reserve, Phong Dien Nature Reserve and Pu Mat NP, totalling more than 44,000 camera-trap nights) (Leibniz-IZW & WWF-Vietnam unpub. data; Leibniz-IZW & SVW unpub. data), although less so in the south. All have failed to detect the species. Also noteworthy is the apparent absence of Dhole in Cat Tien National Park (at least based on extensive camera-trap surveys as well as absence of reports from various bird-watching and other tourists), even while a number of other co-occurring species susceptible to high hunting pressure (including Sambar *Rusa unicolor* and Green Peafowl *Pavo muticus*) have managed to survive.

Kamler et al. (2015) remarked that individuals may occasionally enter the country from neighbouring eastern Cambodia or from Lao PDR, where the species persists. At this point, it seems unlikely that animals would enter Vietnam from Lao PDR (given that the species has seriously declined there in the last 20 years), and very likely that the Dhole, as a resident species, is extirpated or near-extirpated from the country. The species is listed as Endangered (A1c,d; C1+2a) in the Vietnam Red Data Book (MoST) & (VAST) 2007.

Raccoon Dog *Nyctereutes procyonoides*

The Raccoon Dog is recorded in Vietnam only from the north-east. Dang Huy Huynh et al. (1994) and Kuznetsov (2006) listed it as occurring north-east of the Ma River, in the provinces of Thai Nguyen, Lao Cai, Yen Bai, Ha Giang, Cao Bang, Bac Kan, Lang Son, Hoa Binh, Vinh Phuc, Quang Ninh, Thai Binh, Ninh Binh and northern Thanh Hoa. Dang Ngoc Can et al. (2008) and Nguyen Truong Son et al. (2011) listed it for Ha Giang, Cao Bang, Tuyen Quang, Bac Kan, Lang Son, Phu Tho, Thai Nguyen, Vinh Phuc, Quang Ninh and Hoa Binh provinces. The Institute of Ecology and Biological Resources, Hanoi and the Zoological Museum, Hanoi University, have, between them, specimens from Lang Son, Thai Nguyen, Hoa Binh, Bac Kan, Thanh Hoa and Vinh Phuc provinces.



Image 2. Two young Raccoon Dogs observed in a household in Na Vang Village on 13 July 2004 in Tuyen Quang Province.

We found few recent published or observed records. Le Trong Trai et al. (2004) recorded two young in captivity observed in a household in the village of Na Vang (coordinates given as 22.509°N, 105.273°E; Le Trong Trai, pers. obs. 2004), Tuyen Quang Province, on 13 July 2004 (Image 2). The owner apparently took the two from a litter of three in a small cave in the Lung Nhoi area. A rapid assessment undertaken in Tam Dao National Park, Vinh Phuc Province, in late 2004 and early 2005 documented ample evidence of signs (tracks, dens and other) identified as Raccoon Dogs, although no Raccoon Dog was observed directly (Nguyen Xuan Dang et al. 2005); given possible confusion with, among others, domestic dogs, these identifications need to be treated with much caution and are not included in Fig. 1. Kim et al. (2013) reported on samples collected for DNA analysis in Lang Son Province. The samples were taken from eight animals captured by local hunters in 2010, including several individuals in Huu Lien Nature Reserve (Nguyen Truong Son pers. obs. 2010); three of these specimens are now housed in the Department of Vertebrate Zoology, IEBR. Finally, the most recent record is of an adult individual trapped by a hunter in secondary forest in Vu Son Commune, Bac Son District, Lang Son Province on July 26, 2018 (Phan Van Thuc pers. comm. 2018). Further, two young cubs, from an unidentified province in northern Vietnam and housed in Ho Chi Minh City, were found advertised for sale on the internet in late 2018 (Hoang Minh Duc pers. obs.). The species is not listed in the Vietnam Red Data Book (MoST) & (VAST) 2007.

Red Fox *Vulpes vulpes*

The first Vietnamese record of the Red Fox was a female individual from Lang Son province taken during 1926–1927 (Thomas 1928; Delacour 1940). Dao Van Tien (1977) documented a male and female collected 14 and 17 May 1966 at Trung Khanh, Cao Bang Province. Dang Ngoc Can et al. (2008) mapped its distribution also in Thanh Hoa Province, although the material basis for this latter record is unclear. The Zoological Museum of Hanoi University has the specimens from Trung Khanh, Cao Bang Province. There is also a record from Thang Hen in Cao Bang Province in 1999 (Tordoff et al. 2000). The record in question was a hunter's satchel, made out of the pelt of a Red Fox (A.W. Tordoff pers. comm. 2018), and may have come from an animal killed nearby or been traded from somewhere else or hunted on a trip to another location.

We were unable to trace any recent confirmed records of the species. Several localities are mapped for the species in neighbouring Guangxi, Guangdong and Yunnan provinces in China (Wang 2002), and it is entirely possible that this species may have been overlooked recently in far northeastern Vietnam, especially if it were mainly using open degraded habitats or areas of secondary growth within highly modified anthropogenic landscapes, while biologists and surveyors tend to concentrate efforts on a small number of remaining patches of remnant natural and semi-natural habitats in this region of Vietnam. Interestingly, there are several bird species that are widely distributed outside Vietnam and often found in degraded habitats that until recently were very poorly known in Vietnam, such as Collared Crow *Corvus pectoralis*, Carrion Crow *C. corone*, Eurasian

Magpie *Pica pica* and Common Pheasant *Phasianus colchicus*. All are known from a handful of historical records from the same areas of northeastern Vietnam (Cao Bang, Lang Son, Quang Ninh), but it is only in the last decade that reliable recent observations of these species have been recorded (A.W. Tordoff pers. comm. 2018). Red Fox is listed as Data Deficient in the Vietnam Red Data Book (MoST) & VAST) 2007.

DISCUSSION

The status of canids in Vietnam (Fig. 1; Table 1) is clearly cause for concern, certainly in contrast to their global situation. The reason for the apparent scarcity of canids in the country is probably attributable to a combination of factors, but most likely driven by hunting exacerbated by habitat loss (very few tracts of large, little-degraded forest remain in Vietnam). The impact of hunting on wildlife is well known in Vietnam and may have had significant non-target impacts on canids. All species of ground-dwelling mammals from the size of a rat and up are subject to non-selective snaring, an activity which is particularly widespread in the region (Gray et al. 2017, 2018) and will surely have contributed to keeping populations much lower than would otherwise be the case. Targeted hunting for canids is likely to have been much less marked, although Nguyen Dao Ngoc Van & Nguyen Tap (2008) mention both Golden Jackal and Red Fox as being used in traditional medicine in Vietnam. The basis for this, however, is unclear, given that there are only a handful of historical specimens of either species from Vietnam

Table 1. Records of wild canids in Vietnam between 01 January 2002 and 31 December 2018 indicating locality details (mapped in Fig. 1), type of observation, year of observation and reference. Only potentially verifiable claims are included; other claims are given in the main text.

Species	Locality	Province	Observation type	Year	Reference	Fig. 1 ref.
Eurasian Golden Jackal	Yok Don NP	Dak Lak	Direct observation	2003	Eames et al. 2004	1
	Yok Don NP	Dak Lak	Direct observation	2004	Eames et al. 2004	1
Dhole	Yok Don NP	Dak Lak	Direct observation	2003	Eames et al. 2004	1
	Yok Don NP	Dak Lak	Direct observation	2004	Eames et al. 2004	1
	11.568°N & 108.651°E	Ninh Thuan	Direct observation	2014	SIE unpub. data	2
Raccoon Dog	Na Vang Village	Tuyen Quang	Captive animals	2004	Le Trong Trai et al. 2004	3
	Huu Lien NR	Lang Son	Direct observation (caught by hunters)	2010	Kim et al. 2013; Nguyen Truong Son pers. obs. 2010	4
	Vu Son Commune	Lang Son	Direct observation (caught by hunters)	2018	Phan Van Thuc pers. comm. 2018	5
Red Fox	None					

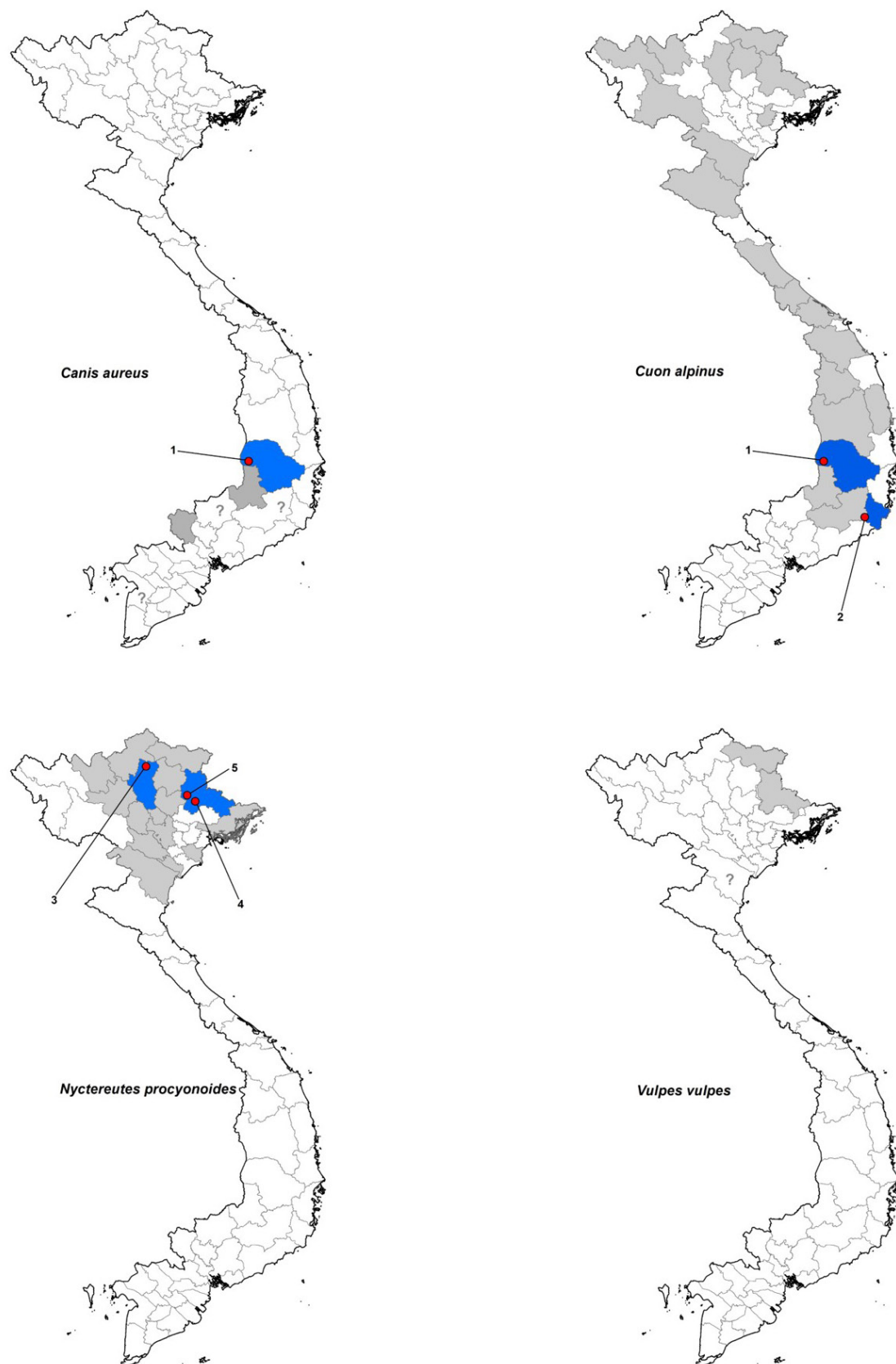


Figure 1. Current and former distribution, by province, of the four wild canid species in Vietnam. Grey areas show previously published range; question marks denote uncertain former presence (see text for references). Blue areas show provinces with confirmed site records (red dots) since 2002 (see Table 1 and main text for details).

compared with Dhole, which was until very recently far more widespread, far more abundant, and, hence, likely to have figured far more in folk resonance. High hunting pressure has also led to ungulate populations being at well below carrying capacity (Timmins et al. 2015, 2016), even in protected areas, and this depletion of the prey base is surely a key reason for the decline of the (formerly widely distributed) Dhole in Vietnam. Intensive snaring is surely also a leading cause of decline in Golden Jackal in Vietnam, although because jackals are generally more adaptable and opportunistic, very low numbers may persist in degraded landscapes where ungulates have already been extirpated and, consequently, snaring intensity is lower.

The paucity of records might conceivably be in part attributable to confusion with other species (jackals, for example, may readily be confused with domestic dogs). Domestic dogs, however, are also likely to be mistaken for Dholes or Golden Jackals, thus potentially inflating numbers of sightings (and this is even more so the case with signs). Thus, the fact that there are so few reports of Dhole and of Golden Jackal suggests that it is an accurate reflection of status. Paucity of records might also be considered a function of general detectability (given the nocturnal and evasive behaviour of some species). Given the extensive camera-trapping work that has been undertaken in protected areas (which cover the majority of remaining natural habitat) throughout the country over the last 10–15 years, it seems reasonable to expect that Dhole, at least, if present even at low densities, would have been picked up. This is less likely to be the case with other species, especially perhaps Red Fox, which may have been missed simply because of a focus of camera-trapping efforts on habitats not typically suited to Red Fox. Equally, Raccoon Dog may have gone undetected as camera-trapping effort in northern Vietnam has not been as high. Further, meat of Raccoon Dogs, sold at VND500,000 (~USD20), and live cubs, sold at VND2,500,000 (~USD110), are posted on wildlife trade groups on social media sites. Overall, it is possible that both Red Fox and Raccoon Dog are more numerous in modern Vietnam than records suggest, but given the poor national statuses of nearly all mammals of this size class or over, it is inconceivable that either has a widespread healthy population there.

In summary, available evidence suggests that wild canids in Vietnam are (except for Red Fox, which may never have been numerous) very likely to have undergone extensive declines. Dhole, formerly widely distributed, and Raccoon Dog, previously also widely distributed in the north-eastern part of the

country, have clearly both declined and are now either extirpated or close to extirpation in the case of the former, or of uncertain status in the case of the latter. For Golden Jackal, records probably do not accurately portray what is likely to have been a formerly fairly large range in the southern part of Vietnam, at least based on historical habitats; the paucity of recent records, together with the ongoing trends in hunting and habitat fragmentation, suggests that the species is now very scarce. For Red Fox, there is no evidence of anything more than marginal historical occurrence; the absence of records is difficult to interpret as it may reflect poor survey coverage of appropriate habitats or the species may genuinely be very rare. Its status is probably best considered equivocal at this juncture.

The trends for wild canids mirror, to some extent, those for wild cats in Vietnam: Willcox et al. (2014) noted a current rarity of recent records of small cats, except Leopard Cat *Prionailurus bengalensis*, and considered all the others to be in serious decline and plausibly extirpated from an increasing number of protected areas. Combatting the ongoing snaring crisis in Vietnam's forests is a critical first-step to averting the current devastating toll on the country's life. Gray et al. (2018) suggest several immediate steps that could be taken, including legislative reform, and accompanying enforcement, that criminalises the possession of snares, and the materials used for their construction, inside and immediately adjacent to protected areas. Such actions need to be accompanied by radical cultural change in the country and in neighbouring regions with respect to use of illegal wildlife, and other forest products (Nguyen Van Song 2008). What is certain is that a major concerted effort to focus on key issues and key sites is critical and that piecemeal conservation activities will do little to forestall the loss of Southeast Asian biodiversity.

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Vietnamese abstract: Bốn loài Chó hoang đã được ghi nhận phân bố ở Việt Nam bao gồm Sói đỏ *Canis lupus*, Chó rừng *Canis aureus*, Cáo lửa *Vulpes vulpes* và Lửng chó *Nyctereutes procyonoides*. Ngoài trừ loài Sói lửa, các loài còn lại có vùng phân bố rộng trên thế giới và mức độ bảo tồn theo danh lục các loài bị đe dọa của IUCN được đánh giá là ít quan tâm. Lo ngại về số ghi nhận ít ỏi của các loài này trong những năm gần đây ở Việt Nam, nhất là trong bối cảnh suy giảm nhanh chóng các quần thể thú nói chung, chúng tôi thực hiện việc rà soát tình trạng của các loài thuộc Chó hoang đã ở Việt Nam. Tất cả các ghi nhận có thể kiểm chứng và truy nguyên từ ngày 1 tháng Giêng năm 2012 đến 31 tháng 12 năm 2018 được tập hợp và đánh giá. Loài Sói đỏ từng có vùng phân bố rộng nhất trong họ Chó ở Việt Nam, và loài Lửng chó, từng phân bố rộng rãi ở Miền Bắc Việt Nam, dường như cả hai đều suy giảm; Loài Sói lửa đã tuyệt diệt hoặc gần tuyệt diệt, trong khi tình trạng loài Lửng chó là không chắc chắn. Đối với loài Chó rừng, không có ghi nhận khả tin nào ở ngoài tự nhiên từ năm 2004, mặc dù loài này vẫn còn khả năng phân bố ở một số vùng. Cáo lửa là loài duy nhất còn được ghi nhận nhưng tình trạng quần thể hiện không rõ ràng. Tóm lại, không có quần thể khỏe mạnh của bất cứ loài nào nêu trên tồn tại ở Việt Nam. Sự suy giảm này dường như do việc săn bắn các loài chó hoang đã cũng như thức ăn của chúng, như trường hợp Sói lửa, và trầm trọng thêm bởi tình trạng mất sinh cảnh.

Author details: Michael Hoffmann heads up global conservation programmes at the Zoological Society of London, with previous experience working in inter-governmental, NGO and academic environments. A mammalogist by training, he is co-editor of the acclaimed 6-volume *Mammals of Africa* series. Alexei Abramov does research in morphology, phylogeography and taxonomy of Carnivora. He also studies the biodiversity and systematics of Southeast Asian mammals during last two decades. Hoang Minh Duc is a Senior Researcher at Southern Institute of Ecology, Vietnam. He is a wildlife ecologist by training and also studies the biodiversity of terrestrial vertebrates in Vietnam. Le Trong Trai is a leading field ecologist (mammalogist and ornithologist) and protected area planner in Vietnam, with over 35 years' working experience. He is currently Director of Viet Nature Conservation Centre. Barney Long is Senior Director of Species Conservation at Global Wildlife Conservation and has worked in Vietnam since 1999. He previously ran the global species program for WWF-US and has conducted fieldwork and run conservation projects throughout Southeast Asia. Nguyen An has spent more than seven years on species conservation and fieldwork throughout Vietnam. Since 2014, he has been working with Leibniz Institute for Zoo and Wildlife Research to coordinate systematic biodiversity surveys across several protected areas in both Vietnam and Laos. Nguyen Truong Son is a researcher at the Institute of Ecology and Biological Resources, Vietnam Academy of sciences, specializing in the taxonomy, phylogeny and conservation of small mammals, especially bats. Ben Rawson has 16 years conservation experience in Cambodia and Vietnam, working on species conservation and monitoring projects and improving protected area coverage and management. He currently works as the Conservation and Program Development Director for WWF-Vietnam. Rob Timmins is a biologist with several decades of experience working in Southeast Asia, and has discovered several new species to science, including the Laotian Rock Rat and Annamite Striped Rabbit. Tran Van Bang obtained his MSc in 2013 and since then has been conducting research and species surveys across Vietnam to help document their distribution and conservation status. Daniel Willcox works as the Science Adviser for Save Vietnam's Wildlife, a local NGO in Vietnam.

Author contributions: MH conceived the study and wrote the first draft of the paper. AA, HMD, LTT, BL, AN, NTS, BR, RT, TVB and DW provided data and contributed to the writing of the paper.





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