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CHAPTER 19

Sympatric large carnivores in peril? Assessing the conservation status of the tiger, leopard and clouded leopard in Peninsular Malaysia

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Abstract: The Malayan tiger (*Panthera tigris*), Malaysia's national symbol, is now on the brink of extinction. With fewer than 150 individuals remaining, the Malayan tiger and Peninsular Malaysia's two other big cat species: the leopard (*Panthera pardus*) and clouded leopard (*Neofelis nebulosa*), continue to face persistent threats from poaching, prey depletion, habitat loss, fragmentation, and disease. The authors attempt to provide an overview of the status of these three large carnivores based on multiple sources of data including open-source information and where possible, over a 20-year period. The Malayan tiger population has dwindled from about 250 individuals in 2014 to less than 150 in 2022, whereas leopard numbers could be as low as 280. Although there are several site-level density estimates for clouded leopards, no national level population estimate has been published for this species. This paper discusses the major threats that affect these carnivores, describes pertinent ongoing conservation initiatives, and highlights key gaps while addressing the long-term conservation pursuits and recovery of Peninsular Malaysia's three large felid species.

INTRODUCTION

Southeast Asia has the highest rates of deforestation among the tropics (Sodhi *et al.* 2004) and around 21 – 48% of regional mammal species are predicted to be extinct by 2100 (Brook *et al*. 2003). Globally, large carnivores particularly have had substantial habitat range contractions and alarmingly show dwindling populations attributing to threats such as poaching, habitat loss/fragmentation, and prey decline (Wolf and Ripple 2017; Carter *et al.* 2019; Romero-Munez *et al.* 2020). The situation is dire, particularly for large cats in Southeast Asia (Gray *et al.* 2018, Petersen *et al.* 2020; Rostro-Garcia *et al.* 2024) and Peninsular Malaysia is no different (Kawanishi 2015; Rostro-Garcia *et al.* 2019; Gray *et al.* 2021).

Malaysia harbours a total of ten wild cat species, which are divided across Peninsular Malaysia (seven species) and the Bornean states of Sabah and Sarawak (five species), with some species overlap. In Peninsular Malaysia, the three largest wild cat species are the tiger (*Panthera tigris*), leopard (*Panthera pardus*), and clouded leopard (*Neofelis nebulosa*). Globally, tigers are listed as Endangered under IUCN's Red List and fall within Appendix 1 under the Convention on International Trade in Endangered Species (CITES). Both the leopard and clouded leopard are listed as Vulnerable and fall under CITES Appendix 1 as well. Globally, the current population trend for all three species has been noted to be decreasing.

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But what about locally? How are tigers, leopards, and clouded leopards faring in Malaysia? What are the current and emerging threats that these animals face? What are the key conservation initiatives relevant to these big cats in Malaysia and how have these panned out?

In this review, the latest information available on these big cats were synthesised by drawing upon open source and other available sources of information to address these questions, and conclude by highlighting the need to integrate science-based information, threat assessments and other key management perspectives so that a better understanding of the conservation status of Malaysia's three large felid species can be realised and meaningfully pursued for their long-term conservation and recovery.

PENINSULAR MALAYSIA'S THREE BIG CATS

Seven species of wild cats are found in Peninsular Malaysia – the tiger, leopard, clouded leopard, Asiatic golden cat (*Catopuma temminckii*), mainland leopard cat (*Prionailurus bengalensis*), marbled cat (*Pardofelis marmorata*) and flat-headed cat (*Prionailurus planiceps*). The tiger, leopard, and clouded leopard generally fall within the definition of large mammals, having a body weight of over 20 kg (Morrison *et al*. 2007; Jayadevan *et al.* 2020). Although clouded leopards fall within the lower range, their maximum size can exceed 20 kg (Francis 2019).

Malayan tiger (*Panthera tigris*)

Over the decades, national-level population 'guesstimates' of the Malayan tiger (Figure 1) have gradually grown more precise with the advances in scientific monitoring methods and analysis. In 1950s, Peninsular Malaysia was thought to have about 3,000 wild tigers (Locke 1954), which was revised to 600 – 650 individuals (Khan 1987), and later to around 500 tigers towards the early mid-2000s – a figure derived based on the possibility Malaysia had at least one tiger per 100 km^2; and its expected habitat range was about 50,000 km^2 (Kawanishi *et al*. 2003; DWNP 2008).



Figure 1. Malayan tiger (Source: WCS Malaysia).

Despite more than 20 years of camera-trap monitoring, there is still a startling paucity of published and statistically robust tiger density estimates for Malaysia. The first analogue camera-trap survey for tigers (1997 – 1999) across nine sites in Peninsular Malaysia (Lynam *et al.* 2007) yielded insufficient data for a capture-recapture analysis. The first publication using a robust Mark-Capture-Recapture (MCR) framework was from Taman Negara National Park (1.10 ± 0.52 to 1.98 ± 0.54 tigers per 100 km^2), spearheaded by a Japanese researcher, Kae Kawanishi (Kawanishi and Sunquist 2004). This was followed by the second published tiger population estimate in Gunung Basor Forest Reserve in Kelantan (2.59 ± SE 0.71 tigers per 100 km^2) by Rayan and Mohamad (2009).

In 2014, the lead author, through a collaborative effort via the Malaysian Conservation Alliance for Tigers (MYCAT), collated tiger density estimates from two sites in Perak (Rayan and Linkie 2015), and five different sites within Kelantan, Terengganu, Pahang and Johor from surveys conducted between 2010 – 2013 (unpublished). Three of the seven camera trap surveys were also reanalysed employing the newer established robust Spatially Explicit Capture-Recapture (SECR) framework to derive a more comparable and realistic density estimate across the sites. From this exercise, the compelling evidence indicated that there could only be 250 – 340 tigers remaining in Malaysia based on extrapolation of the available tiger habitats. This was the first nationwide extrapolated tiger estimate which incorporated actual robust densities estimates from several sites in Malaysia.

With the exception of Royal Belum State Park that had almost two tigers per 100 km^2, the average density estimate was close to 0.5 per 100 km^2, suggesting earlier assumptions of having at least one tiger per 100 km^2 and the corresponding guesstimate of 500 tigers nationwide were likely: (1) overestimated and erroneous from the start, (2) reflected genuine population decline over a decade or so, or (3) both. A joint press statement by the Department of Wildlife and National Parks (PERHILITAN) and MYCAT subsequently announced that Malaysia may have as few as 250 tigers remaining (WWF-Malaysia 2014), contributing to the revision of the Malayan tiger's IUCN status to Critically Endangered in 2015 (Kawanishi 2015).

Though the SECR framework is now used as the standard for estimating tiger population densities, only two known studies using such a framework have been published in Malaysia: one from Belum-Temengor (0.61 – 1.95 tigers per 100 km^2) in Perak (Rayan and Linkie 2015) and another from Kenyir (0.15 – 0.53 tigers per 100 km^2) in Terengganu (Lam *et al.* 2023). The report from the 1st National Tiger Population Survey (2016 – 2020) has yet to be published, but publicly announced official figures state that fewer than 150 tigers remain in Malaysia. Coupled with the fact that tiger densities are well below a threshold of one tiger per 100 km^2 (except for Royal Belum State Park), these findings paint a bleak scenario, but one that warrants greater scrutiny at the site-level.

There is limited published information on prey preference of tigers in Peninsular Malaysia. Early evidence from tiger scat samples in Taman Negara—albeit with a limited sample size of three – identified sun bear, cattle and pangolin as prey species (Kawanishi and Sunquist 2004), although these are unlikely the tigers' preferred or main prey species. A more recent publication by PERHILITAN used DNA metacoding to analyse tiger scats from five localities in the states of Perak, Kelantan and Terengganu (Gani *et al.* 2024). Surprisingly, no evidence of barking deer, wild boar or sambar deer was detected. From the six scat samples obtained from human-tiger conflict areas, the primary prey selection of tigers primarily consisted of livestock (86%) from the genus *Bos* (cattle), *Bubalus* (buffalo), *Capra* (goat) and *Gallus* (chicken). The remaining four scat samples were taken from a protected area and had predominantly medium-sized prey (90%) comprising the genus *Canis* (dogs) and *Capricornis* (serow). Tigers typically prey on large ungulate species such as wild boar and sambar deer (Hayward *et al.* 2012), and may also prey on other large ungulate species such as serow (>100kg) and even gaur (up to a tonne), although these species are less common and patchily distributed. Barking deer is one of the most common ungulate species detected based on camera-trapping rates, but their smaller size and agility may make them less energetically favourable prey. Tapirs would perhaps be an ideal size as they can weigh upwards of 300kg, but evidence of tiger predation on this species remains scarce at best.

Leopard (*Panthera pardus*)

Leopards are highly adaptable but now only occur in about 36% of their historical range in Malaysia (Rostro-García *et al.* 2016). Despite this, Peninsular Malaysia was recognised as one of only two remaining leopard strongholds in Southeast Asia, although the authors of this publication were cautious to state that this could change due to recent evidence of leopard poaching (Rostro-García *et al.* 2016).

Leopards in Peninsular Malaysia are predominantly melanistic (Kawanishi *et al.* 2010), while the spotted variant has only been recorded in a handful of localities including Endau Rompin, Ulu Muda and Lenggong (Mohamad *et al.* 2023). Within these localities, the spotted variant (Figure 2) is thought to be more common in the Endau Rompin Landscape based on camera-trapping data by WCS Malaysia.



Figure 2. Spotted leopard (Source: WCS Malaysia).

Peninsular Malaysia is estimated to have 282 – 847 leopards (Rostro-García *et al.* 2016), based on a total area of confirmed and potential distribution of 47,051 km^2 multiplied by an inferred density of 1 to 3 leopards per 100 km^2, whilst assuming 60% occupancy. A similar density range assumption pattern that was used for tigers has also been applied to leopards in this study, and so the figures might well be flawed with similar undertakings used for tigers previously. Therefore, this warrants cautionary interpretation on national-level figures.

Since the majority of leopards in Peninsular Malaysia are melanistic, distinguishing each individual using coat patterns is extremely challenging. However, it was discovered that the almost-indiscernible rosette patterns on melanistic leopards (Figure 3) become visible via infrared camera-trap images taken under low-light conditions. A novel camera -trapping study by Hedges *et al.* (2015) developed a modified camera-trap method that forces the usage of infrared flash during both day and night, allowing rosettes to be detected consistently. This study resulted in providing the first density estimate of melanistic leopards in Malaysia.

Using this method, several density estimates have been obtained using the SECR method, which ranges from 0.98 per 100 km^2 (Pasir Raja, Terengganu, to 2.64 per 100 km^2 in Taman Negara National Park (Rostro-Garcia *et al.* 2024), to 3.00 per 100 km^2 in the Kenyir Wildlife Corridor in Terengganu (Hedges *et al.* 2015). Leopard density estimates from another study (Lam *et al.* 2023), which did not use the forced infrared flash to enhance the leopard rosettes in Kenyir, Terengganu ranged from 2.53 – 2.74 per 100 km^2, was derived using a Space-to-Time Event (STE) framework rather than SECR. The STE approach assumes random camera-trap placement, a requirement lacking in their study design, which therefore warrants cautious interpretation of these estimates and limited direct comparison with SECR-based estimates.



Figure 3. Melanistic leopard (Source: WCS Malaysia).

Although leopards are agile climbers and often feed on primates, they appear to prefer medium-sized ungulate prey within the range of 10 – 40 kg, where available (Stein *et al.* 2025). Two ungulate species in Malaysia fall within this range: barking deer and wild pig. Some studies in India and Nepal have found wild pig to be a preferred leopard prey species, alongside barking deer, sambar deer, and hog badger in Thailand (as referenced in Rayan and Linkie 2016). However, there is extremely limited information on actual leopard prey preference in Malaysia and no published DNA analyses of leopard scat samples in Malaysia are currently available.

Clouded leopard (*Neofelis nebulosa*)

The clouded leopard (Figure 4) is believed to have a relatively wide distribution across Peninsular Malaysia. A recent habitat suitability assessment identified Malaysia as having the highest mean suitability for the species across its range, followed by Laos, India, and Cambodia (Abedin *et al.* 2024). Based on these findings, it was suggested for these countries to be prioritised for conservation of the species, amidst projected substantial habitat loss/ degradation from deforestation, land-use change, and climate change. Using detection/ non-detection camera trap data from Peninsular Malaysia, Tan *et al*. (2017) found that the habitat use of clouded leopard increased (i) further away from water bodies, (ii) in higher number of smaller fragmented forest patches, (iii) at higher elevations, and (iv) in sites with higher average forest change values. These findings suggest that the species might use recently disturbed forests or adapt well to changing landscapes.

Although there is no national-level population estimate for clouded leopards, several site-level density estimates using the SECR framework have been recorded and published. The first ever density estimates for the mainland clouded leopard, conducted in Belum -Temengor, Perak, reported densities of 3.46 ± SE 1.00 per 100 km^2 in Temengor Forest Reserve and 1.83 ± SE 0.61 per 100 km^2 in Royal Belum State Park (Mohamad *et al.* 2015). The estimated density of clouded leopard in Gunung Basor, Kelantan was 1.15 ± SE 0.35 per 100 km^2 (Razak *et al.* 2019) and in Kenyir, Terengganu ranged from 0.99 to 1.25 per 100 km^2 (Lam *et al.* 2023) across three different years.

Clouded leopards have been known to prey upon a variety of arboreal and terrestrial prey including hog deer, slow loris, brush-tailed porcupine, pangolin, squirrels, primates, muntjac and argus pheasant (Gray *et al.* 2021). In Belum-Temengor, clouded leopard habitat use was found to be highly influenced by the availability of small and medium prey species such as pig-tailed macaques, porcupine, mouse deer, and small carnivores (Mohamad *et al.* 2015).



Figure 4t. Clouded leopard (Source: WCS Malaysia).

Interspecific interactions among the three big cats

The Malayan tiger, leopard and clouded leopard overlap in distribution and habitat across Peninsular Malaysia (DWNP 2017). However, population dynamics among these sympatric carnivores remain complex, particularly regarding their spatial and temporal relationships. A prominent pattern of spatial avoidance by leopards in areas with high tiger abundance has been documented in India, where leopards are forced to occupy poor quality habitats outside protected areas, resulting in increased conflict with humans (Harihar *et al.* 2011). In areas where leopards are absent, clouded leopards exhibit stronger temporal avoidance of tigers (Sunarto *et al.* 2015). The smaller size difference and physical capabilities of leopard and clouded leopard are hypothesised to result in stronger avoidance between these two species (Sunarto *et al.* 2015).

Leopards and clouded leopards may occur at higher densities where densities of larger cat species such as tigers are lower (Harihar *et al.* 2011; Gray *et al.* 2021). This pattern was observed in Belum-Temengor, where it was found that the density of clouded leopards was almost two times higher and leopard relative abundances were almost five times higher in Temengor Forest Reserve than Royal Belum State Park (Mohamad *et al.* 2015; Rayan and Linkie 2016), where tiger density in Royal Belum State Park was three-fold higher than in Temengor Forest Reserve (Rayan and Linkie 2015). The higher ungulate prey base in Royal Belum likely supported greater tiger densities, which in turn may have suppressed leopard abundance and influenced fine-scale behavioural avoidance from leopards (Rayan and Linkie 2016). Similar tiger-mediated interactions have been documented in Nepal and India, where a bottom-up effect on tigers by large prey availability consequently exerted a top-down regulative effect on leopards and dholes (Seidensticker *et al.* 1990; Odden *et al.* 2010; Harihar *et al.* 2011; Mondal *et al.* 2012). However, such regulatory effects may diminish when tiger densities fall below one adult tiger per 100 km^2 (Rayan and Linkie 2016), which reflects the current scenario in Malaysia.

CURRENT AND EMERGING THREATS

Habitat loss/ degradation/fragmentation

Forest conversion

A report by RimbaWatch (2023) indicates that close to 2% of forest cover in Malaysia was lost between 2017 and 2021, declining from 18,332,583 ha to 17,983,338 ha. Timber plantations were identified as the main driver of deforestation during this period, accounting for 41.6% of total forest loss, followed by oil palm plantations (15.5%). In Peninsular Malaysia, forest loss was highly concentrated in Pahang and Kelantan, which collectively lost 158,627 ha, while Perak, Johor, Terengganu and Kedah each recorded losses between 7,000 and 9,000 ha between 2017 and 2021 (RimbaWatch 2023). Even more concerning, the report further

projected that Malaysia could lose over 2.3 million hectares of forest in the future due to timber plantations and oil palm plantations, potentially reducing the national forest cover to below the 50% committed threshold. Kelantan and Pahang are also projected to experience the highest future losses, overlapping with existing key strongholds of tigers, and likely leopards and clouded leopards, raising significant conservation concern.

Another key aspect that is often ignored in relation to habitat loss for big cats in Malaysia is that certain habitats are likely to harbour higher nutritional resources for big cat prey. Lowlands are especially important for most of these prey species. In Belum-Temengor, occupancy of key ungulates such as sambar deer, barking deer, and gaur was higher at lower elevations (Rayan and Linkie 2020). There also seems to be a larger concentration of saltlicks at lower elevations – from Belum-Temengor, out of the >70 saltlicks recorded, approximately 80% were situated below 500 m above sea level (WWF-Malaysia, unpublished data). In fact, about 45% of the saltlicks were at lowlands <300 m in elevation, despite limited remaining lowland habitat due to inundation from the construction of Temengor Dam back in the 1970s (Mohamad *et al.* 2023).

Forest degradation

Logging practices may not cause complete large scale forest loss but can significantly reduce and degrade habitat quality. About 60% of Peninsular Malaysia's Permanent Reserved Forests are production forests subject to logging, while the remaining 40% are classified as protection forests (Forestry Department of Peninsular Malaysia 2023). Secondary forests subjected to selective logging may still harbour many wildlife species and may theoretically result in an increase in ungulate density due to a presumed higher availability of browse material (Rayan and Mohamad 2009). However, selecting logging can severely degrade soil and river systems, at the same time lead to canopy disruptions, road expansion, and increased access for poaching, all of which likely outweigh the potential benefits from a presumed increase in browse materials for ungulates (Free Malaysia Today 2022). Consequently, prey densities and predator carrying capacity are often reduced in these impacted areas.

Forest degradation also threatens a more specific tiger prey resource – saltlicks. Under the Wildlife Conservation Act 2010 (WCA 2010), it is an offence to disturb salt licks, where hunting, trapping, building platforms and possession of weapons is prohibited within a 400 m radius from saltlicks. Saltlicks are not explicitly recognised under the *National Forestry Act 1984*, and although the Malaysia Criteria and Indicators for Sustainable Forest Management (Criterion 6.2) calls for the protection of rare, threatened and endangered species and their habitats, including saltlicks, management interventions remain insufficient. For example, the Special Area Plan for Royal Belum State Park designates only a 40 m buffer around saltlicks in production forests. Out of the 40 identified saltlicks, only one saltlick was formally classified as a High Conservation Value Forest (HCVF), with an area size of 0.002 ha. Such minimal buffering is likely insufficient for key species such as sambar deer (Rayan *et al.* 2013). Furthermore, saltlicks and their buffer areas are highly interdependent owing to their ecological functionality, and need to be managed as one. Without official recognition and incorporation into forest management plans, saltlicks remain vulnerable to disturbance from commercial logging and increased accessibility for poachers.

Forest fragmentation

Forest fragmentation isolates big cat individuals into smaller pockets of habitat, reducing genetic diversity, as well as increasing the risks of inbreeding and local extirpation. Large-scale linear infrastructure such as roads, highways and railways increasingly bisect the previously contiguous forest blocks, and restricts wildlife movement, dispersal, and gene flow between subpopulations (Laurance *et al.* 2009). Roads also provide easy access for humans intruding into remote forested areas, indirectly intensifying threats such as poaching, illegal encroachment, and resource extraction.

Roadkill incidents involving wildlife have emerged as a significant and increasing anthropogenic threat in Malaysia, particularly in regions where forest fragmentation and linear infrastructure intersect into key wildlife habitats. Between 2012 and 2024, PERHILITAN reported at least 5,554 wildlife roadkill incidents in Peninsular Malaysia, with more than 3,300 cases involving mammals. At least six adult Malayan tiger deaths were reported from vehicle collisions between 2023 – 2024 alone, compared to only one recorded case between 2008 – 2020 (Ten *et al.* 2021). Nine leopards were reported killed by vehicles between 2020 – 2024. Data on clouded leopard road kills were not published, but at least four records related to clouded leopard road collisions were found online, all from 2021 – 2024 (Astro Awani 2021a; Harian Metro 2023; Sinar Harian 2023; Bernama 2024).

Although the number of roadkill records for large cats are lower than those recorded for Malayan tapir (200 cases), wildlife mortality on roads has been increasingly prevalent. The death of breeding individuals is especially consequential for species that are now left with critically small numbers in the wild. For example, a female tiger that was struck by a lorry on the Gerik-Jeli Highway in November 2024, had raised four cubs to maturity over a year prior to the tragedy. The death of such an individual directly reduces reproductive output and may skew the local sex ratios, thereby disrupting the population and its social dynamics within a site.

Poaching and illegal trade

Poaching for illegal trade remains the most immediate threat to large felids in Peninsular Malaysia, particularly the critically endangered Malayan tiger. Despite intensified enforcement efforts in recent years, poaching for international trade and local markets (including traditional medicine, talismans, bushmeat and other products) continues to exert severe pressure on the already depleted populations of large felids and their prey species.

Analysis of seizure records involving tigers, leopards and clouded leopards in Peninsular Malaysia from 2006 – 2025 revealed there were 74 known cases over the 20-year period (Figure 5). These records were gathered from open-source media, government and partner records, and exclude cases involving zoos, captive facilities and those linked to human-wildlife conflict. It is therefore assumed that animals from these 74 cases were poached from wild populations in Peninsular Malaysia to supply illegal trade.

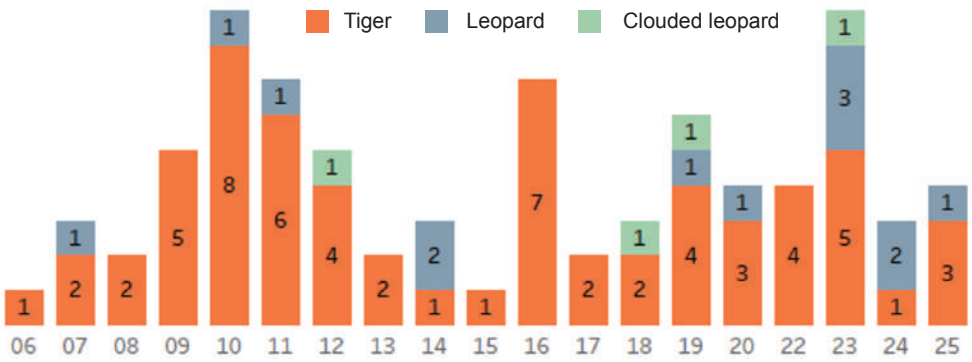

Figure 5. Seizures involving tigers, leopards and clouded leopards in Peninsular Malaysia from 2006 – 2025.

The majority of the incidents involved tigers (86%), followed by leopards (18%) and clouded leopards (4%), with several seizures involving multiple species and therefore, these percentages are not additive. Seizure data does not necessarily reflect the true scale of poaching, as they reflect only intercepted cases and are heavily influenced by enforcement effort and detection probability. The actual magnitude of such illegal activity is thus likely

underestimated. Records do not always indicate subspecies level, particularly for tigers. Nonetheless, even relatively small numbers are deeply concerning for Malaysia, where the national wild population is estimated to be fewer than 150 individuals.

These 74 incidents involved minimum estimates, with 116 equivalent big cats that entered the illegal trade chain; 77% involved tigers (n = 90), 19% leopards (n = 22) and 4% clouded leopards (n = 4). The estimation approach follows Wong and Krishnasamy (2025), with adaptations to also account for leopards and clouded leopards. Trafficking volumes experienced significant fluctuations over the two decades analysed, with an average of six big cats confiscated per year, with peaks exceeding 10 – 25 individuals in certain years (notably in 2015), while 11 years recorded only 0 – 3 individuals, likely reflecting under-detection (Figure 6). Recent trends suggest increased trafficking of leopards alongside reduced tiger seizures, potentially indicating substitution of tigers with leopard and other felids, although further data are needed to confirm this pattern in Malaysia.

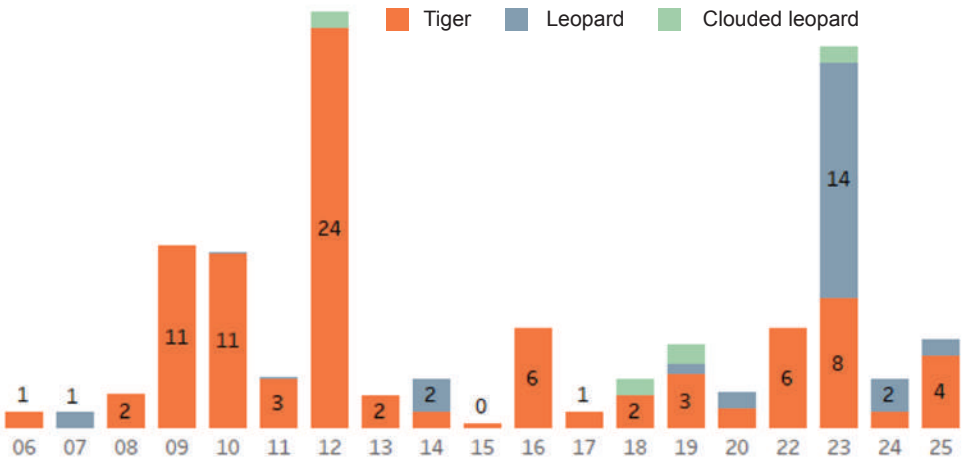

Figure 6. Estimated volume of confiscated big cats from 2006 – 2025.

In terms of tigers, leopards, and clouded leopards that have been seized by the authorities, about 978 individual commodity items (whole animal and its bodily parts) were confiscated over a 20-year period. The most commonly seized parts were claws and teeth, accounting for 402 and 161 items confiscated, respectively (Table 1). Leopard claws and teeth accounted for an increasingly larger share of confiscated body parts in recent years, suggesting a possible partial substitution of leopards for tigers within the trade networks.

Table 1. Big cat parts confiscated from 2006–2025.

	Tiger	Leopard	Clouded leopard	TOTAL
Claw	133	230	39	402
Teeth	114	44	3	161
Body parts (Other)	105	60		165
Bone	97			97
Skin (whole)	34		1	35
Skin (piece)	33			33
Meat	17	14		31
Head and skull	22	1		23
Individual - Dead	18	4		22
Individual - Live	5	2	1	8
Skeleton	1			1

` At the State level, Kedah recorded the largest number of big cats confiscated (36 equivalent animals), despite ranking 5th in seizure incidents (7 cases), largely due to the major 2012 wildlife bust in Kedah involving at least 22 tigers. In this case, a 29-year old Malaysian man was found with eight tiger skins, 22 tiger bone pieces including whole skulls, six African elephant tusks, and an antelope horn. Pahang state recorded the highest number of seizure incidents involving big cats (16 cases), involving at least 32 animals (Figure 7 and 8). While tiger seizures were actively pursued across the peninsula, leopard and clouded leopard seizures were concentrated in fewer states (Figure 9).

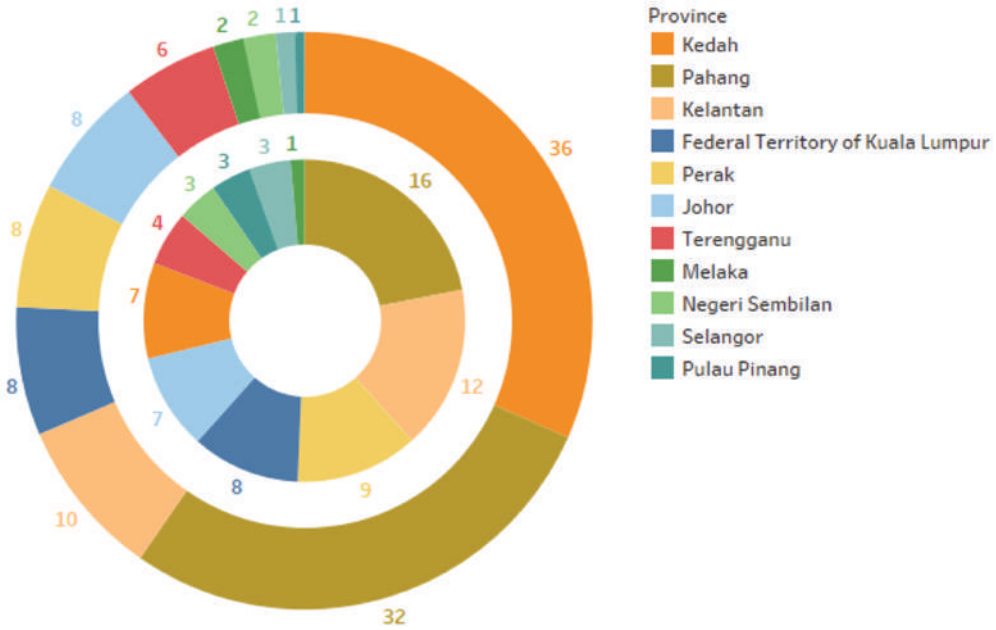

Figure 7. Distribution of seizures and volumes confiscated by state from 2006 – 2025. (Inner ring: seizure incidents; Outer ring: individuals confiscated).

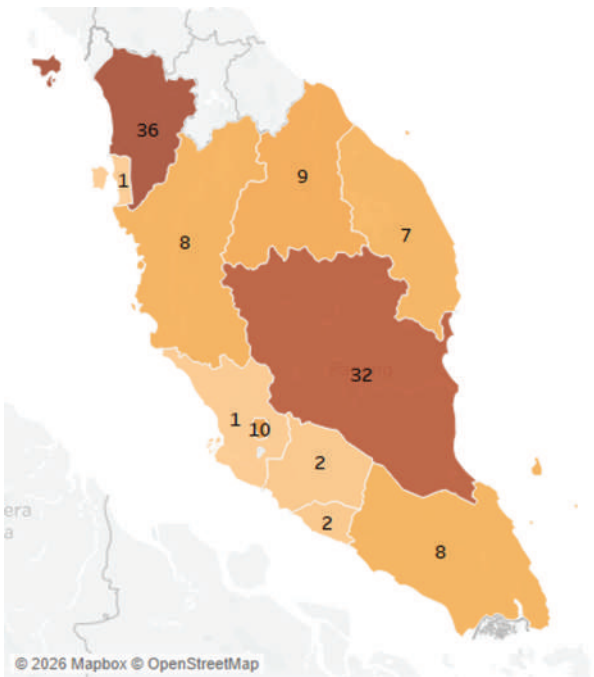

Figure 8. Confiscated big cat individuals by state from 2006 – 2025.

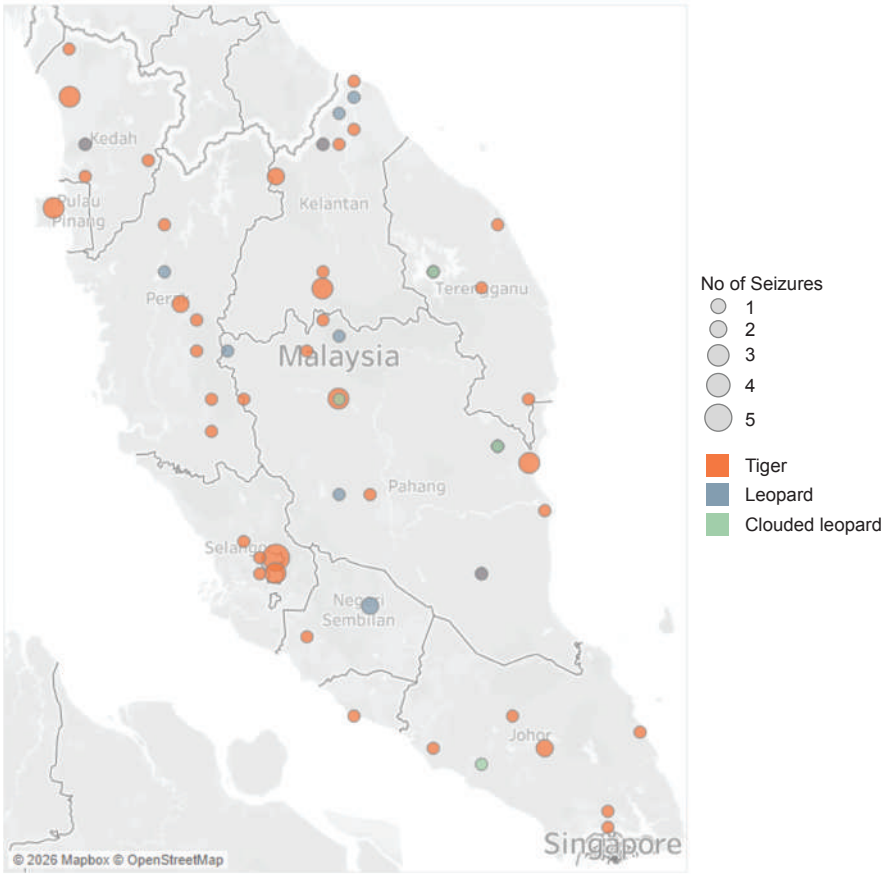

Figure 9. Big cat seizure hotspots in Peninsular Malaysia from 2006 – 2025.

Of the 74 cases analysed, at least 60 cases resulted in the arrest of 130 individuals. Available prosecution records indicate that 68 individuals were charged with violating relevant wildlife protection laws, which resulted in monetary fines for 40 individuals and jail sentences for at least 35 individuals.

Since WCA 2010 came into force, jail sentences for wildlife crimes have ranged from one month to ten years, with an average of 40 months and a median of 27 months. Monetary fines ranged from RM350 to RM1.56 million, averaging at RM230,000 with a median of RM15,000. Penalties varied considerably depending on the specific factors such as number of suspects charged, variety of species and parts involved, nature of the charges, with few extreme outliers that heavily impact the average.

For several suspects, judicial proceedings may still be ongoing though in many of these cases, the outcome is unknown to the authors. Apart from Malaysians (about 52%), cases also show the involvement of Vietnamese, Indonesian, Thai, Cambodian, Burmese and Chinese nationalities, reinforcing the fact that big cat poaching and trafficking is impacted by international trafficking syndicates, and likely facilitated by Malaysians.

In Malaysia and across many other Southeast Asian countries, many poachers deploy wire cable snares to target large mammals and commercially target valuable species such as tigers, leopards, and sun bears (Belecky and Gray 2020). However, snares are inherently indiscriminate and frequently entrap non-target species, resulting in severe depletion of the key prey species such as sambar deer, serow, barking deer and other ungulates that sustain carnivore populations. In addition, some snares are not checked by

the poachers, resulting in the snared wildlife, including tigers being left to die. In Belum-Temengor, snaring is believed to have contributed to >50% decline in tiger population (Says 2019). Prior to this, WWF-Malaysia recorded a dramatic increase in snares, particularly linked to Indochinese poachers. However, this declined after intensified patrolling and reduced movement during the COVID-19 pandemic.

PERHILITAN's annual reports showcased that over 4,300 snares were removed from forests across Peninsular Malaysia between 2019 and 2024 (Table 2). Although it is unclear if these were all active snares or if they include remnants, the actual number of snares deployed is likely far higher than the figures reported, as many more would have gone undetected. While many cases involved foreign poachers and are often associated with organised wildlife trafficking syndicates (Lam *et al.* 2023), local involvement was also found to be significant, and they too were implicated in more than 50% of the seizure incidents analysed. This is a serious cause for concern as the narrative on poaching over the past two decades has been largely confined towards Indochinese poachers. This needs an in-depth assessment to investigate local poachers and their network of underlying syndicates. The blatant disregard by local poachers in exploiting wildlife is best shown from the recent case of a tiger that was snared and found in the trunk of a car in Johor (The Straits Times 2025).

Table 2. Number of snares removed across Peninsular Malaysia by the *Operasi Bersepadu Khazanah* and Community Ranger programs between 2019 and 2024.

Year	Snares removed by *Operasi Bersepadu Khazanah*	Snares removed by Community Rangers
2019	218	-
2020	672	128
2021	303	456
2022	440	594
2023	270	559
2024	400	260
Total	**2,303**	**1,997**

Source: Annual reports of PERHILITAN

Prey loss

Key prey species for the three large felids in Peninsular Malaysia include sambar deer, bearded pig, wild boar and barking deer, with some overlaps based on prey preferences and predator-prey mass ratio. However, habitat loss, poaching, and disease outbreaks have severely threatened the prey population.

Prey depletion is driven by both local hunting for consumption and trade (New Straits Times 2026a), as well as illegal poaching by organised Indochinese syndicates (MYCAT 2012). Due to the decline in sambar deer population, the Malaysian government has imposed a hunting moratorium in 2009 as a measure for population recovery (Kawanishi *et al.* 2014) and has proposed upgrading the species to Totally Protected under the WCA 2010. Even then, the bigger problem still lies with in having enough enforcement capacity to intensively detect and effectively deter poaching activities.

Disease outbreaks, particularly the African Swine Fever (ASF), have recently caused substantial decline in the wild pig population in the country (WCS Malaysia, unpublished data; WWF-Malaysia, unpublished data; PSPC, unpublished data). In the southern region, the effect is more apparent on bearded pigs (WCS Malaysia, unpublished data). ASF was first detected in Malaysia in Sabah in February 2021, before spreading into Sarawak in July 2021 (World Animal Health Information System 2023). At the end of 2021, the first ASF

case was detected in Peninsular Malaysia – from wild boar carcasses found in Batang Padang District, Perak. Subsequently, cases were detected exponentially in the wild, in which 85 cases of wild boar and five cases of bearded pigs, were reported dead (World Animal Health Information System 2023).

Camera-trap surveys in Belum-Temengor and Endau Rompin showed a sharp decline in detecting the presence of wild boar and bearded pig after 2021 (WCS Malaysia, unpublished data; WWF-Malaysia, unpublished data). To highlight the severity of the disease, data from Endau Rompin showed a decline of 99% for bearded pigs and 81% for wild boar between 2021 and 2023, which also correlates with increased tiger attacks on cattle (Malay Mail 2025). Despite these downward trends, signs of breeding in both pigs and tigers in Endau Rompin were observed during camera trapping surveys in 2024, with fewer reported cases of human-tiger conflict in 2024 – 2025.

During the ASF outbreak in Royal Belum State Park in 2022, the wild boar population crashed within a short period of two months, where carcasses were largely spotted during November and December. Samples collected from two carcasses in December 2022 tested positive for ASF. There were also earlier reports of wild boar carcasses from adjacent Temengor Forest Reserve discovered in September 2022, followed by reports from Bang Lang National Park in southern Thailand later during the end of the same year. These anecdotal observations demonstrated how the highly contagious and deadly ASF virus infected the wild boar population across a vast contiguous forest landscape. Wildlife monitoring through camera trapping in Royal Belum State Park and adjacent forests revealed that the population of wild boar in the area suffered a 99% decline between 2021 and 2025 (WWF-Malaysia, unpublished; Perak State Parks Corporation, unpublished). Two and a half years after the outbreak first started, the wild boar population has still not shown any positive signs of recovery.

PERHILITAN annual reports (2019 – 2024) indicated a 9% decline (225 cases) of wild boar conflict cases in 2022 and a 44% decline (1,000 cases) in 2023 (Figure 10). Across six states with the highest recorded cases of wild boar and tiger conflicts; the decline in wild boar conflicts appeared to coincide with the increase in tiger and leopard conflict cases (Figure 11). There was no available published data for 2022. Although there is the potential for over- or under-estimation of wildlife conflict reports and the trend is not proof of a direct causal effect, the data does indicate a correlation between the decline of wild boar and increase of big cat-human conflict which warrants further scrutiny.

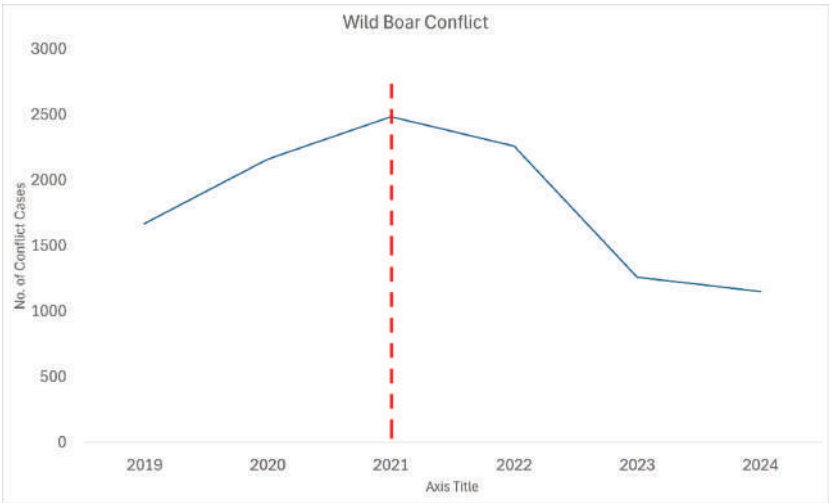

Figure 10. Reports of wild boar conflict in Peninsular Malaysia before and after African Swine Fever was first detected in 2021 (indicated by the red line).

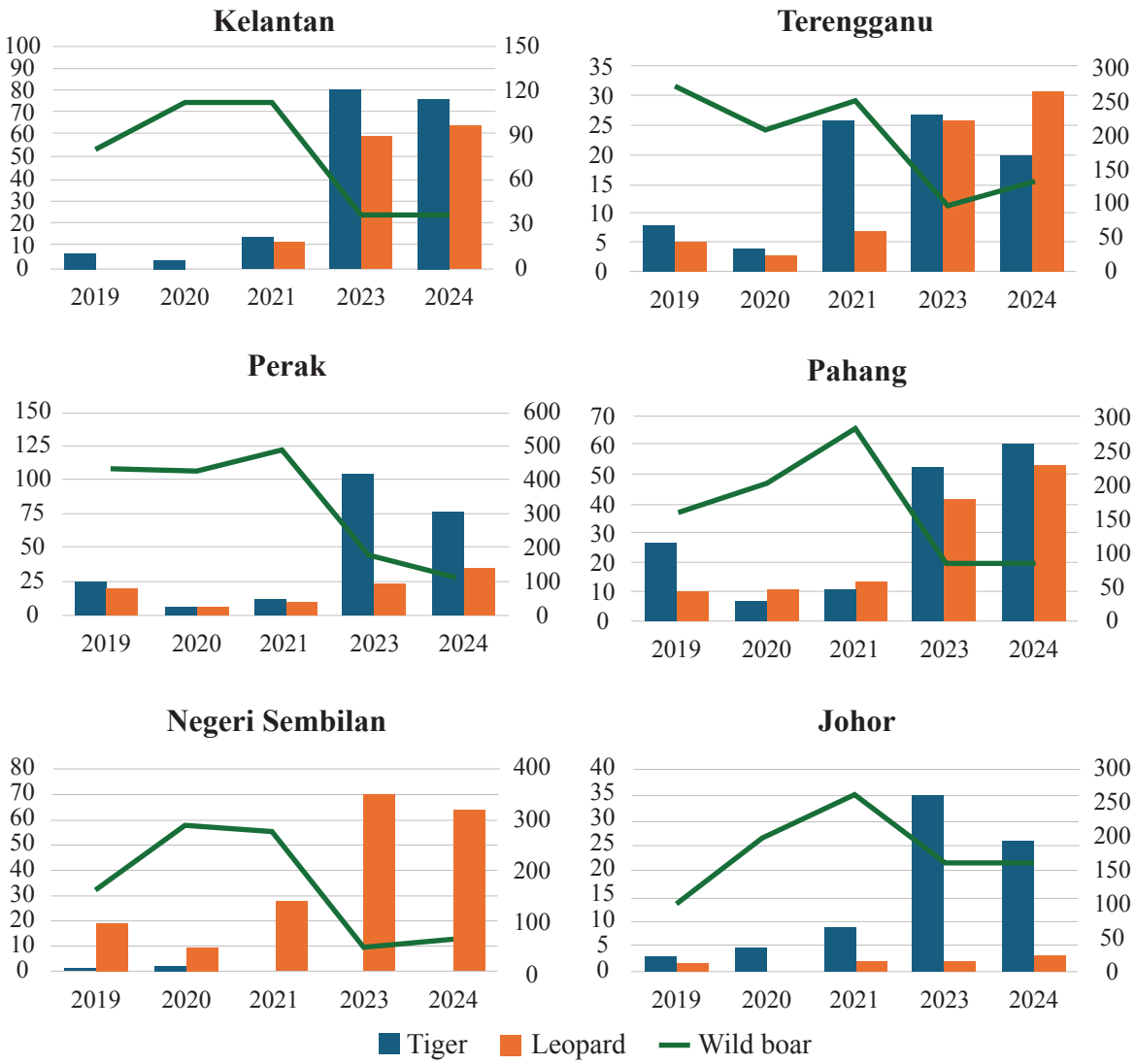

Figure 11. Cases showing the trend of conflicts involving tigers, leopards, and wild boar in Kelantan, Terengganu, Pahang, Perak, Negeri Sembilan and Johor two years before and after African Swine Fever was first detected in 2021.

ASF is probably the best known and devastating disease affecting swines. Apart from this, wild boar is also susceptible to other diseases such as the classical swine fever, Aujeszky's disease, and porcine circoviruses and parvoviruses (Nisavic *et al.* 2021). Other tiger prey species such as gaur and sambar deer are susceptible to diseases as well. From captive gaur research in Malaysia, some of the recorded infectious diseases include brucellosis, foot and mouth disease, lumpy skin disease and cowpox (Rosli *et al.* 2023). However, there is an absence of substantial published data of infectious diseases amongst local wildlife, and how such diseases impact wild populations.

Diseases directly impacting the three big cat species

Over the past two decades, several diseases have been recorded directly affecting tigers, leopards and clouded leopards. Avian influenza H5N1 has caused the death of captive tigers, leopards and clouded leopard in Thailand (Keawcharoen *et al.* 2004; Dudley 2012); whilst sporadic reports of SARS-CoV-2 (Covid-19) have been detected in tigers and

leopards (Forbes 2021; Independent 2022). In this millenia, Malaysia has experienced four waves of H5N1 outbreaks in 2004, 2006, 2007 and 2017 (Wan Norulhuda and Tariq 2018), but no published reports on the detection of H5N1 or even the recent SARS-CoV-2 was reported for tigers, leopards or clouded leopards in Malaysia.

Canine Distemper Virus (CDV) is a highly contagious disease with a high mortality rate that affects domestic dogs and all families of terrestrial carnivores. CDV affects the central nervous system, resulting in disorientation in the affected animals (Deem *et al.* 2000; Gilbert *et al.* 2020, 2023). The first confirmed case in Malaysia involved a tiger in Terengganu in July 2019, where a tiger was sighted roaming around Kampung Besul unfazed by the presence of humans. Following that, CDV cases in tigers began to emerge in Mersing, Johor (New Straits Times 2020), Gua Musang, Kelantan (New Straits Times 2022), and the most recent case at Chemor, Perak (Perak Department of Veterinary Services 2026). CDV has also been detected in a clouded leopard in Perak (Astro Awani 2021), while no confirmed cases have been reported for leopards in Malaysia. Aside from CDV, other domestic animal diseases such as feline parvovirus and feline immunodeficiency virus have been reported for wild tigers, but these viruses have not been documented in Malaysia (Lazarus *et al.* 2025).

Human-wildlife conflict

Human-wildlife conflict (HWC) refers to negative interactions between humans and wildlife, often perceived as threats to human activities including livelihoods, livestock, and safety. Such interactions often lead to mitigation responses and in severe cases, retaliatory killing or removal of wildlife (Ten *et al*. 2021; South China Morning Post 2024; New Straits Times 2025a; New Straits Times 2026b). Rapid land-use changes such as deforestation, agricultural expansion, and infrastructure development driven by human population growth are widely recognised as key factors influencing the occurrence and trends of HWC (Shevade *et al.* 2017; Morales-González *et al*. 2020). This is further exacerbated by prey declines linked to ASF outbreaks (Luskin *et al*. 2020), which may push large carnivores toward livestock and edge habitats, increasing conflict incidence (Braczkowski *et al*. 2018; Lubis *et al.* 2020).

Compiled data from PERHILITAN's annual reports and published materials from 2005 to 2024 illustrate incident trends of HWC with Malayan tigers, leopards, and clouded leopards (Figure 12). Incidents classified as conflicts are not limited to livestock depredation and wildlife attacks towards humans, but also include pugmark reports and direct sightings (Ten *et al.* 2021; DWNP 2005–2024). It is also not known whether each HWC genuinely involved the three big cat species, or whether some sightings were misidentified. Data obtained for years 2014, 2018, and 2022 were incomplete due to inaccessibility to or the lack of HWC details in those annual reports.

Human-wildlife conflict data (DWNP 2005–2024) indicates that tigers consistently represent the highest number of carnivore conflict cases in Peninsular Malaysia, with more than 1,700 reported cases between 2005 and 2024. A notable peak occurred in 2005 (133 cases), followed by a recent surge in 2023 (316 cases) and 2024 (264 cases) (Table 3, Figure 11). Despite a decline in the tiger population (Ten et al. 2021), the number of human-tiger conflict incidents remains relatively high. At the State level, Pahang recorded the highest human-tiger conflict with 553 cases, accounting for nearly one-third of the total reports. In 2023 and 2024, there was an upsurge in annual case numbers recorded in Kelantan (80 and 76 cases) and Perak (105 and 76 cases), compared to Pahang (53 and 61 cases).

Leopards account for the second highest number of human-carnivore conflict in Peninsular Malaysia, with 1,095 reports since 2005 – 2024 (Table 4). Human-leopard conflict has become increasingly frequent, particularly due to the adaptability of the species to human-modified landscapes. Table 4 and Figure 11 shows that leopard conflict incidents occur consistently across Peninsular Malaysia and have increased substantially in recent years, with recorded 238 cases in 2023 and 266 in 2024. Negeri Sembilan consistently recorded the most cases of leopard conflict, apart from 2019, where it had the same number of incidents as Perak (19 cases). Negeri Sembilan's leopard conflicts total to almost 30% of the cases nationwide since 2005.

Clouded leopard conflict with humans has historically been reported to be less frequent compared to tigers and leopards in Peninsular Malaysia. Records between 2005 and 2024 show relatively low numbers of incidents, totaling 249 cases within this period (Table 5). Kedah recorded the highest number of conflicts, contributing to almost 40% of the reported cases. Mainland Penang too, recorded a case in 2008, while no cases of clouded leopard conflict were recorded in Federal Territory of Kuala Lumpur since 2009, except for one recent report that emerged in 2023. Recent data indicates an increasing trend in the Peninsular, with 43 cases recorded in 2023 and 47 in 2024. Although it is still comparatively lower than tigers and leopards, this increase may suggest escalating interactions between clouded leopards and human activities along the forest-edge environments.

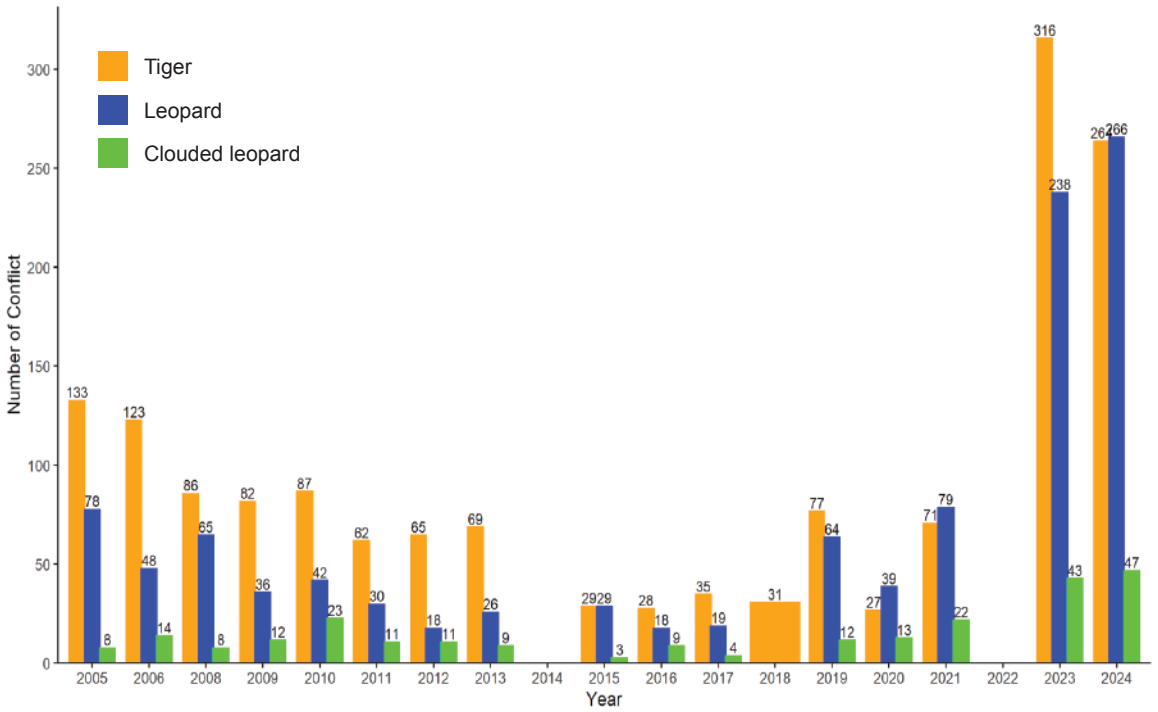

Figure 12. Conflict cases between humans and tigers, leopards and clouded leopards in Peninsular Malaysia from 2005 to 2024.

Table 3. Human-tiger conflict incidences in Peninsular Malaysia from 2005 – 2024, by state.

Year	JHR	KDH	KTN	PNG	NSN	PHG	MLK	PRK	PLS	SGR	TRG	WLY	Total	%
2005	13	5	15	1	6	52	2	16	0	3	19	1	133	-
2006	9	8	10	0	4	41	2	27	1	4	15	2	123	–7.5
2007	NA	16	NA	NA	NA	127	NA	19	NA	NA	NA	NA	162	+31.7
2008	11	11	11	0	2	30	1	8	0	4	8	0	86	–46.9
2009	21	3	5	0	3	23	1	9	1	4	12	0	82	–4.7
2010	4	7	10	0	0	30	1	22	0	0	13	0	87	+6.1
2011	3	5	6	0	0	24	0	18	1	0	5	0	62	–28.7
2012	3	6	8	0	0	19	1	9	1	2	16	0	65	+4.8
2013	8	3	11	0	0	25	0	13	0	3	6	0	69	+6.2
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	38	–44.9
2015	4	2	3	0	0	8	0	5	0	3	4	0	29	–23.7
2016	4	7	2	0	0	9	0	5	0	1	0	0	28	–3.4
2017	2	0	11	0	0	6	0	5	0	1	10	0	35	+25.0
2018	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	31	–11.4
2019	3	3	6	0	2	27	0	25	1	2	8	0	77	+148.4
2020	5	0	3	0	2	7	0	4	0	2	4	0	27	–64.9
2021	9	NA	13	NA	1	11	NA	11	NA	NA	26	NA	71	+163.0
2022	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
2023	35	9	80	0	1	53	0	105	0	6	27	0	316	-
2024	26	3	76	0	0	61	0	76	0	2	20	0	264	–16.5

Abbreviations: JHR – Johor, KDH – Kedah, KTN – Kelantan, PNG – Penang, NSN – Negeri Sembilan, PHG – Pahang, MLK – Malacca, PRK – Perak, PLS – Perlis, SGR – Selangor, TRG – Terengganu, WLY – Federal Territory of Kuala Lumpur, NA – No Data, % - percentage of change (increase/decrease) from previous year. Note: 2014, 2018 and 2022 data are not available from PERHILITAN annual reports. The total number of HTC cases for 2014 and 2018 were taken from Ten *et al.* (2021).

Table 4. Human-leopard conflict incidences in Peninsular Malaysia from 2005 – 2024, by state.

Year	JHR	KDH	KTN	PNG	NSN	PHG	MLK	PRK	PLS	SGR	TRG	WLY	Total	%
2005	4	14	5	0	15	15	0	9	0	7	2	7	78	-
2006	5	1	1	0	13	9	2	8	1	2	5	1	48	–38.5
2007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
2008	9	9	1	1	20	16	1	3	0	2	3	0	65	-
2009	0	2	4	0	7	13	0	4	0	4	1	1	36	–44.6
2010	4	4	3	0	16	9	0	3	0	1	2	0	42	+16.7
2011	4	1	3	0	9	5	0	5	0	1	2	0	30	–28.6
2012	1	2	3	0	4	1	0	4	1	1	1	0	18	–40.0
2013	1	3	2	0	9	6	0	3	0	1	1	0	26	+44.4
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
2015	1	4	3	0	7	5	1	2	0	3	3	0	29	-
2016	0	2	4	0	9	1	0	1	0	0	0	1	18	–37.9
2017	0	3	1	0	6	3	0	4	1	0	1	0	19	+5.6
2018	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
2019	2	4	1	0	19	10	0	19	0	4	5	0	64	-
2020	0	2	1	0	10	11	1	4	2	5	3	0	39	–39.1
2021	2	2	11	-	29	13	1	9	1	4	7	-	79	+102.6
2022	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2023	2	1	59	-	72	42	-	24	-	12	26	-	238	-
2024	3	3	64	-	66	54	3	35	1	6	31	-	266	+11.8

Abbreviations: JHR – Johor, KDH – Kedah, KTN – Kelantan, PNG – Penang, NSN – Negeri Sembilan, PHG – Pahang, MLK – Malacca, PRK – Perak, PLS – Perlis, SGR – Selangor, TRG – Terengganu, WLY – Federal Territory of Kuala Lumpur, NA – No Data, % - percentage of change (increase/decrease) from previous year. Note: 2007, 2014, 2018 and 2022 data are not available from PERHILITAN annual reports.

Table 5. Human-clouded leopard conflict incidences in Peninsular Malaysia from 2005 – 2024, by state.

Year	JHR	KDH	KTN	PNG	NSN	PHG	MLK	PRK	PLS	SGR	TRG	WLY	Total	%
2005	0	5	0	0	2	0	1	0	0	0	0	0	8	-
2006	0	1	0	1	8	0	0	1	3	0	0	0	14	+75.0
2007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
2008	0	1	0	1	4	0	0	1	0	1	0	0	8	-
2009	0	5	0	0	0	0	1	1	3	1	0	1	12	+50.0
2010	1	14	1	0	0	0	0	4	1	1	1	0	23	+91.7
2011	0	6	0	0	0	0	0	1	1	2	1	0	11	–52.2
2012	0	8	0	0	0	1	0	2	0	0	0	0	11	0.0
2013	3	4	1	0	0	1	0	3	0	0	0	0	9	–18.2
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
2015	0	1	2	0	0	0	0	0	0	0	0	0	3	-
2016	0	1	1	0	1	2	0	4	0	0	0	0	9	+200.0
2017	0	1	1	0	1	0	0	0	0	1	0	0	4	–55.6
2018	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
2019	0	1	1	0	5	1	0	2	0	2	0	0	12	-
2020	3	6	1	0	0	0	0	3	0	0	0	0	13	+8.3
2021	0	9	2	0	0	4	0	6	0	0	1	0	22	+69.2
2022	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-
2023	1	13	15	0	1	1	0	10	1	0	0	1	43	-
2024	1	20	10	0	1	2	1	7	0	5	0	0	47	+9.3

Abbreviations: JHR – Johor, KDH – Kedah, KTN – Kelantan, PNG – Penang, NSN – Negeri Sembilan, PHG – Pahang, MLK – Malacca, PRK – Perak, PLS – Perlis, SGR – Selangor, TRG – Terengganu, WLY – Federal Territory of Kuala Lumpur, NA – No Data, % - percentage of change (increase/decrease) from previous year. Note: 2007, 2014, 2018 and 2022 data are not available from PERHILITAN annual reports.

CONSERVATION INITIATIVES, POLICIES AND FRAMEWORKS

There is an absence of dedicated action plans or initiatives specifically for leopards and clouded leopards in Peninsular Malaysia. As such, we describe below the best currently available strategies aimed at conserving tigers, which to a large extent indirectly mitigates the underlying threats, issues and challenges besetting large carnivores in Malaysia.

Action plans and high-level government coordination

Malaysia has adopted and implemented the National Tiger Conservation Action Plan 2008 – 2020 (DWNP 2008) for almost 15 years. After years of advocacy by NGOs, the inaugural National Tiger Survey of which the scientific framework was developed and designed by the author and several co-authors of this paper, was spearheaded and undertaken by PERHILITAN and NGO partners between 2016 to 2020. However, the outcome of the systematic countrywide survey using thousands of camera traps at a cost of RM18 million in government funding was bewildering: the Malayan tiger population had plunged to less than 150 individuals in the wild.

The Malaysian government and NGO partners recognised that the Malayan tiger was in a state of peril. Proactive measures to ensure its long-term survival must address the major issues of management/protection of the species habitat, resource mobilisation and funding gaps (DWNP 2024). In response, the Ministry of Natural Resources and Environmental Sustainability (NRES) adopted nine Strategic Actions to Save the Malayan Tiger in 2021 and subsequently, formulated the Malayan Tiger Crisis Action Plan 2022-2030.

The implementation of these actions is being monitored by a high-level National Tiger Conservation Task Force (MyTTF), chaired by the Prime Minister of Malaysia (NRES 2024), and supported by the National Tiger Implementation Working Group (MyTWG) – chaired by the Minister of NRES, and the Technical Committee (JTMyTTF) – chaired by the Director General of PERHILITAN (DWNP 2023, 2024). As a result, Malaysia has undertaken several significant and sustained law enforcement and management efforts on the ground to protect the Malayan tiger, which also contributes to the conservation of other wildlife and their habitats.

The formation of this high-level task force has been a major victory for many stakeholders, especially the NGOs involved in tiger and wildlife conservation. Despite this progress, certain challenges remain. Since 2018, six Ministers have overseen wildlife-related portfolios and four since the formation of MyTTF. The frequent changes in the government have also seen several changes in the name and focus of the Natural Resources Ministry. Therefore, establishing a permanent Secretariat consisting of representatives from the government and NGO representatives would be much needed to ensure comprehensive policy papers are brought to the attention of MyTTF for decision making. Additional gaps include the infrequent meetings per year, lack of NGO representation within these committees, particularly those working on tiger protection efforts on the ground, and insufficient attention given to state level issues such as forest conversion, all of which may reduce the effectiveness of this task force.

Motivating State governments with financial incentives

Under the Malaysian Constitution, land and forest management falls under State jurisdiction. As a result, most of the Malayan tiger habitats are managed by the respective State Forestry Departments. In contrast, Taman Negara National Park, established in 1939, is managed by the Federal Government through PERHILITAN. However, State governments have generally been reluctant to upgrade more forested areas for tiger habitats to national protected areas due to concerns over potential loss of revenue and lack of capacity (DWNP 1996; Elagupillay 2004).

To motivate the State Governments to protect tiger habitats, the Federal Government introduced the Ecological Fiscal Transfer (EFT) funding mechanism, which provides financial incentives for conservation. The scheme has supported the States in designating 15,000 ha of new protected areas (NRES 2024). To ensure the State governments use the EFT financial grants to prioritise tiger habitats in a sustainable manner, EFT funding should be incorporated into the 5-year Malaysia Plans, with stronger monitoring frameworks that incorporate big cats and its prey as key performance indicators in the use of the funds.

Initiatives to counter the illegal wildlife trade and poaching

In 2022, the Royal Malaysian Police established the Wildlife Crime Bureau, strengthening investigative capacity and intelligence coordination nationwide. By institutionalising wildlife crime enforcement within the national policing framework, Malaysia has elevated offences involving wildlife to the level of serious organised crime. To complement and assist the Wildlife Crime Bureau in gathering evidence in the field, PERHILITAN expanded its Special Protected Area Response Team (SPARTA) in 2023 and enhanced the capacity of the National Wildlife Forensic Laboratory (DWNP 2024). Based on the recent successes in the arrests and prosecution of several prominent wildlife crime cases, many involving big cats, the formation of the Wildlife Crime Bureau has helped in Malaysia's efforts to combat organised wildlife crime. Joint investigations between multiple agencies have increased in recent years and should be encouraged further, although there is a need for more in-depth post-arrest investigations to identify the entire network of people involved in each case.

To address limited enforcement capacity on the ground, the government allocated RM80 million in 2025 to deploy over 2,500 Community Rangers across protected areas and forest reserves in Malaysia, including critical big cat habitats within the Central Forest Spine

landscape. The Community Ranger programme is led by PERHILITAN and supported by various other government agencies and NGOs. The programme was initiated in 2020 with just 150 rangers and has since annually increased both in allocation and personnel. Members of local and Orang Asli communities are recruited to assist enforcement personnel to conduct patrols, dismantle snares, detect encroachments, and gather vital ground intelligence in remote forest areas (NRES 2025).

Under the current arrangement, funding for the Community Ranger programme is allocated annually by the Ministry of Finance to NRES and PERHILITAN. As a result, ranger contracts typically end in December and are only renewed in January or February once new funds are approved and administrative processes are completed. This creates temporary staffing gaps during which key tiger habitats may become more vulnerable to poaching and encroachment. To ensure sustainability and continuity, the programme would benefit from being incorporated into the 5-Year Malaysia Plan. So while this initiative is great, mechanisms should be developed to convert Orang Asli ranger positions from short-term contracts into permanent and formally institutionalised roles.

Malaysia also launched *Operasi Bersepadu Khazanah* (OBK) in 2019 as the country's first joint taskforce to combat wildlife crime. Jointly helmed by the Royal Malaysian Police, PERHILITAN and Royal Malaysian Customs, it involves the participation of various law enforcement agencies including Forestry Departments, Malaysian Border Control and Protection Agency, Immigration Department, Perak State Parks Corporation, Johor National Parks Corporation, with NGOs included as observers in meetings. Through this initiative, integrated patrols combining wildlife authorities, police and enforcement agencies have intensified action against poaching and trafficking networks. Between 2021 and 2024, these operations resulted in 427 arrests of poachers and encroachers, with 73 foreign nationals apprehended, and RM150 million worth of wildlife-related assets seized (NRES 2024).

To address several weaknesses in legislation, significant amendments were made to the WCA 2010, which were passed by Parliament in February 2022. The amendments introduced stricter protections and heavier penalties involving totally protected species, including the Malayan tiger, leopard and clouded leopard. This includes minimum fines for offences involving juvenile and female tigers, leopards and clouded leopards, as well as penalties per wildlife part or derivative, resulting in higher cumulative fines for multiple items. Maximum penalties now reach up to RM1 million in fines and imprisonment of up to 15 years (DWNP 2024). The new law is not fully enforced in entirety, as only 44 sections of the 2022 Amendment were enforceable in January 2023, while other regulations and schedule amendments (including changes to species protection status) are pending approval.

On 19th February 2026, three foreign nationals were fined RM128.9 million and sentenced to a combined 65 years of imprisonment for possession of nearly 1,000 parts of protected wildlife species, including 54 tiger parts, 273 leopard parts and 20 clouded leopard parts, as well as four snares (Bernama 2026). This conviction reinforces a strong legal deterrent against wildlife crime, which requires continued momentum towards enforcement.

International practices, standards and collaboration

Realising the need to enhance the management of tiger habitats, Malaysia has adopted the Conservation Assured | Tiger Standards (CA|TS), a global certification system that sets benchmarks for protection, habitat management, community involvement, and wildlife monitoring for tiger conservation areas. Royal Belum State Park, a major tiger habitat, became the first CA|TS approved site in Southeast Asia in 2023. Taman Negara National Park and Endau Rompin National Park subsequently registered for this scheme in 2025, where both parks are undergoing rigorous assessment and management enhancement (International Big Cats Alliance 2026).

Malaysia has also been an active participant of the Global Tiger Forum and recently became an official member of the International Big Cats Alliance (Ministry of Foreign Affairs Malaysia 2026). With the increasing commitment of Malaysia to global standards and in line with '*Think Globally, Act Locally*', more resources will be allocated by the government and local and international funding sources for the conservation of the Malayan tiger. Together with strengthened enforcement outcomes, these developments indicate increased national commitment to conserving Malaysia's big cat species and implementing both global and national frameworks including the Global Tiger Recovery Programme 2.0 and Malaysia's Malayan Tiger Crisis Action Plan 2022 – 2030.

Prey release program

PERHILITAN has implemented several captive-bred prey release programmes over the years, with sambar deer being the most frequently-released prey species. Since 2010, at least 24 gaur, 13 banteng and seven barking deer have been released according to PERHILITAN's annual reports. At least 132 sambar deers (63 males and 69 females) were released across various sites from 2014 – 2026 (Table 6). However, it remains to be seen how well the animals fared after release as post-release monitoring has generally been limited.

Table 6. Documented sambar deer releases in Peninsular Malaysia.

Year	Month	Wildlife Conservation Centre	Release site	No. of Individuals (Male: female)	Method of Release
2014	June	Gua Musang	Taman Negara Pahang, Sg Relau	14 (8:6)	Soft release
2015	April	Gua Musang	Taman Negara Pahang, Sg Relau	9 (5:4)	Soft release
	June	Sungkai	Taman Negara Pahang, Kuala Tahan	5 (1:4)	Hard release
	July	Sungkai	Taman Negara Pahang, Kuala Tahan	4 (2:2)	Hard release
	November	Sungkai	Amanjaya Forest Reserve, Perak	2 (0:2)	Soft release
2016	March[a]	Sungkai	Tembat Forest Reserve, Terengganu	4 (3:1)	Hard release
	May[a]	Sungkai	Tembat Forest Reserve, Terengganu	6 (3:3)	Hard release
	October[b]	Sungkai	Taman Negara Pahang, Sg Relau	5 (1:4)	Soft release
2017	July	Gua Musang	Taman Negara Pahang, Sg Relau	9 (5:4)	Soft release
	October	Sungkai	Taman Negara Pahang, Sg Relau	6 (1:5)	Hard release
2018	October	Sungkai	Taman Negara Pahang, Sg Relau	6 (3:3)	Hard release
2019	May[c]	Sungkai	Taman Negara Pahang, Sg Relau	6 (3:3)	Hard release
	May[d]	Gua Musang	Taman Negara Pahang, Sg Relau	1 (0:1)	Hard release
2020	August	Sungkai	Taman Negara Terengganu, Sg Terenggan	5 (5:0)	Hard release
	October	Sungkai	Gunung Basor Forest Reserve, Kelantan	4 (4:0)	Hard release
2021	March	Not stated	Gunung Basor Forest Reserve, Kelantan	8 (4:4)	Hard release
	October[b]	Sungkai	Royal Belum State Park, Perak	10 (5:5)	Hard release
	November	Not stated	Taman Negara Pahang, Sg Relau	2 (1:1)	Hard release
2022	August[b]	Sungkai	Royal Belum State Park, Perak	8 (3:5)	Hard release
2023	May[e]	Sungkai	Royal Belum State Park, Perak	6 (3:3)	Hard release
	October	Not stated	Taman Negara Terengganu	4 (1:3)	Not stated
	October	Not stated	Taman Negara Pahang	2 (0:2)	Not stated
2024	October	Sungkai	Taman Negara Terengganu	2 (0:2)	Hard release
	October	A'Famosa Safari Wonderland	Taman Negara Terengganu	2 (0:2)	Hard release
2026	February	Taiping Zoo	Royal Belum State Park, Perak	2 (2:0)	Hard release
			TOTAL	**132 (63:69)**	

Notes:
[a] All sambar deer were fixed with VHF-radiotelemetry collars.
[b] Four sambar deer were fixed with VHF-radiotelemetry collars.
[c] Five sambar deer were fixed with VHF-radiotelemetry collars, and one male sambar deer fixed with a GPS-satellite collar.
[d] One female sambar deer was fixed with a GPS-satellite collar.
[e] Three sambar deer were fixed with VHF-radiotelemetry collars.
Sources: 2014 – 2020: Badmanathan *et al.* (2022); 2021 – 2024: PERHILITAN annual reports; 2026: Perak State Parks Corporation, unpublished data.

Between 2021 and 2023, PERHILITAN released 24 sambar deer into Royal Belum State Park (Perak State Parks Corporation, unpublished). Of the 24 individuals, 11 were fixed with VHF-radiotelemetry collars (Table 6). Two months after the 2023 release, a survey over six nights was carried out at the release sites which detected eight collared sambar deer, of which three were from the 2021 release, three from the 2022 release, and two from the 2023 release. At least four fawns were also observed with the released females. Some individuals remained near the release sites and nearby Orang Asli villages to feed on crops such as cassava leaves (Perak State Parks Corporation, unpublished). There were limitations with the radio collar to detect how far the released sambar deer had travelled. However, the longest recorded distance travelled was obtained via an opportunistic observation where a released male sambar deer was detected about 11.5 km apart between two observations (Perak State Parks Corporation, unpublished). One male sambar deer was killed by a tiger 658 days after its release, whilst another female was photographed surviving a tiger attack with visible claw marks on its back. Two more sambar deer were released into Royal Belum State Park in 2026, where the stock was provided by Taiping Zoo (Table 6).

In general, the number of released animals is still relatively small to produce significant outcomes, particularly when compared to more targeted programmes implemented in Thailand (WWF Foundation 2023). PERHILITAN is currently exploring the involvement of private breeders to increase sambar deer stock production for future releases, although details are not publicly available. Moving forward, there is a critical need for greater investment in optimising breeding conditions for captive animals so that a larger cohort of animals can be released, ideally via soft-release approaches. Post-release monitoring using satellite collars is also essential to assess the survivorship, movement and habitat use of released animals to enhance our understanding on best practices to improve future augmentation efforts.

Malayan Tiger Conservation Centre

The Malayan Tiger Conservation Centre is an 80-hectare site in Lanchang, Pahang, that costs about RM40 million and was established to support the captive breeding of Malayan tigers, with the long-term aim of rehabilitation and eventual rewilding (Bernama 2025). While the initiative may have been an immediate response to try to stem the rapid decline of wild tigers, the practicality of breeding, rewilding and eventually releasing tigers into the wild requires careful evaluation and may not be a viable and successful option to increase tiger numbers in the wild. In fact, even if a tiger was able to be rewilded, released and survives, it may be disruptive to the existing social organisation and population dynamics of tigers within a site or landscape and should only be explored in areas where tigers are no longer there and where the underlying threats that caused local extinction of tigers (such as poaching, habitat loss/degradation and lack of prey) have been addressed. It is critical that these factors be given due consideration before any decision is made towards releasing tigers into the wild.

Other state level initiatives

In 2023, Malaysia established its first tiger reserve—the Al-Sultan Abdullah Royal Tiger Reserve—in Pahang, spanning 1,340 km2. Adjacent to Peninsular Malaysia's largest protected area, Taman Negara National Park, this extension effectively increased the national park's area by 30% (CNN 2026). Strong royal support from the Crown Prince of Pahang serves as a clear example of how political will can aid biodiversity conservation within the country.

Within Perak State, stakeholders are coming together to develop a Perak Tiger Conservation Plan aimed at tiger recovery efforts, which includes supporting patrolling and monitoring of tigers, as well exploring financial mechanisms to sustain these efforts over the long term (The Edge 2025). In Johor, State authorities are discussing plans to establish a state-level conservation committee to coordinate responses towards threats faced by biodiversity that would include tigers, leopards and clouded leopards, and translating these discussions into potentially targeted conservation actions for their recovery.

KEY RECOMMENDATIONS

Further science-based assessments to understand the conservation status of the three sympatric carnivores

For tigers, sufficient data already exist to establish baselines at national, state, landscape, and site levels. The priority now should be to move beyond national population estimates and focus on site- and landscape-level analyses that examine population dynamics in relation to prey availability, poaching pressure, habitat loss and fragmentation, human-tiger conflict, disease, and road mortality. Particular attention should be given to how social organisation and demographic structure within the tiger sub-population respond to these pressures. The low tiger densities (<1 tiger per 100 km^2), coupled with nationwide prey declines, suggest a trajectory similar to that reported in Thailand, where reduced tiger reproduction rate and low cub survival impedes the potential for population recovery even in connected landscapes (Steinmetz *et al.* 2025). A shift towards assessing site-specific demographic components of growth, survival, reproduction, dispersal, recruitment and threats is therefore essential, but is currently severely lacking. Administratively, the management and decision-making is possibly more straightforward at the State-level, but conservation assessment should focus on site-specific subpopulations or broader landscape units, which often extend across several states.

Existing data from the National Tiger Survey and other recent surveys need to be analysed to gain a better understanding of the population and distribution of leopards, clouded leopards, prey and possibly other species. For clouded leopards, population-level analysis and density estimation is possible due to the presence of natural markings to identify individuals as opposed to melanistic leopards. This would enable a nationwide assessment of the species with no additional fieldwork required, although it would take a significant amount of effort to extract the species records, identify individuals, verify the information, and analyse the data. Some caveats also have to be made as the camera trap spacing and locations were optimised for tiger detections, and clouded leopards are known to be at least partly arboreal. Therefore, any densities derived would likely have to be recognised as conservative estimates due to the lower detection probabilities. It would be even more challenging to produce density estimates for leopards due to the predominantly melanistic form found within Malaysia without standardised use of infrared-enhanced imaging. However, it would be extremely feasible to produce an updated distribution map or occupancy estimates as an alternative indicator of the conservation status for leopards, clouded leopards, other large mammal species and even prey in Peninsular Malaysia from the National Tiger Survey data and other recent surveys. While the National Tiger Survey (completed in 2020) provides an important baseline, more recent updated data would be required to assess their current conservation status.

There is also a dearth of information on the preferred prey of these three large cat species in Malaysia. Existing information is largely opportunistic or inferred from studies in other regions. Even though Malaysia may share some habitat and species similarities with neighboring countries, especially Indonesia, the biodiversity and conditions are not quite the same. Targeted dietary studies using DNA metabarcoding of scat samples are needed to generate reliable prey profiles, so that informed management decisions can be made in terms of prey recovery. To support this, a standardised scat collection protocol should be established across agencies and NGOs, with samples processed through the forensics laboratory of PERHILITAN. This would enable a consistent national dataset on prey preference profile of the three large cat species, and improve understanding of prey availability and recovery needs across different landscapes. In addition, interspecific interactions between the carnivore guilds and how these regulate prey would need to be assessed to better understand ecological functionality and recovery over the longer term.

Threat reduction actions

Habitat loss, degradation and fragmentation

Over the years, habitat loss and degradation have significantly altered big cat landscapes in Peninsular Malaysia, contributing to declines in habitat size, quality and connectivity. Future land-use decisions—such as road expansion, forest conversion and mining, including for rare earth elements—will be critical in determining the long-term viability of tigers and other wildlife. And so, there is a need to harmonise land use plans at the Federal and State level, including the upcoming 5th National Physical Plan, with district and local plans to designate critical wildlife habitats as 'no-go zones' and minimise conversion, fragmentation and land use change within these areas. Knowledge at the Federal level must be effectively integrated into local plans, and State-level decision-makers should be briefed on the critical values of these forest complexes to ensure their continued protection.

In Peninsular Malaysia, the Malayan tiger, leopard, and clouded leopard occupy overlapping forest habitats. The global effort in mapping the Tiger Conservation Landscapes (TCLs) since the 1990s up to 2023 (Dinerstein *et al*. 1997; Sanderson *et al.* 2006; Sanderson *et al.* 2023) provides useful information on the tiger distribution alongside satellite-derived habitat data, incorporating landscape, connectivity, human pressure and other ecological characteristics. TCLs represent a good starting point for big cat landscape-wide assessments and analysis for Malaysia, especially when data is scarce for leopards and clouded leopards. However, Malaysia lost 29% of area within its TCLs between 2001 and 2020 (Sanderson *et al*. 2023). Current estimates indicate around 55,000 km^2 of suitable tiger habitat remaining in Peninsular Malaysia (Tiger Conservation Landscapes - Global Forest Watch 2019).

An overlay of TCLs with protected areas and lowland dipterocarp forests in Peninsular Malaysia (Figure 13) shows that only 25% of these areas are protected, which includes both protected areas and portions of Permanent Reserved Forests under a specific class of protection. Hence, approximately 75% of tiger habitats remain unprotected and at risk of conversion or degradation. Lowland dipterocarp forests—comprising around 35% of TCLs—should be prioritised for protection due to their importance for both big cats and their prey, as well as their high susceptibility to agriculture or monoculture forest plantations.

This issue is especially important as 60% of Permanent Reserved Forests are classified as production forests and constitute close to 75% of tiger habitats. Despite their designation, these natural forests can still be converted into timber plantations while remaining classified as forest cover. Intensively-logged production forests have been known to be reclassified or labelled as 'poor forests' (*hutan miskin*) and converted into monoculture plantations such as latex-timber clones. These conversions reduce their natural capacity to support prey and consequently big cats. In terms of degradation caused by selective logging, although the annual allowable cut of timber in Permanent Reserved Forests was reduced from 1,165,300 ha to 890,000 ha under the 13th Malaysian Plan (The Star 2026), stricter enforcement of Reduced Impact Logging guidelines is needed to reduce collateral damage from logging. In addition, control over encroachment via logging roads, and reducing poaching within concessions need to be enforced.

Greater attention is needed to safeguard natural saltlicks before embarking on the creation of artificial saltlicks, which is increasingly being applied as habitat enrichment intervention. Natural saltlicks are critical resources for ungulates, yet their protection remains weak and severely neglected. Degradation and hunting in and around saltlicks can negatively impact the occupancy of ungulates and ultimately lower the carrying capacity for large carnivores over time. Saltlicks should be formally recognised as High Conservation Value within Forest Management Plans with a protection buffer of at least 400 m following WCA 2010, though a minimum of 2 km would be ideal to increase the likelihood for a species such the sambar deer to occupy a site within the vicinity of a saltlick (Darmaraj 2012).

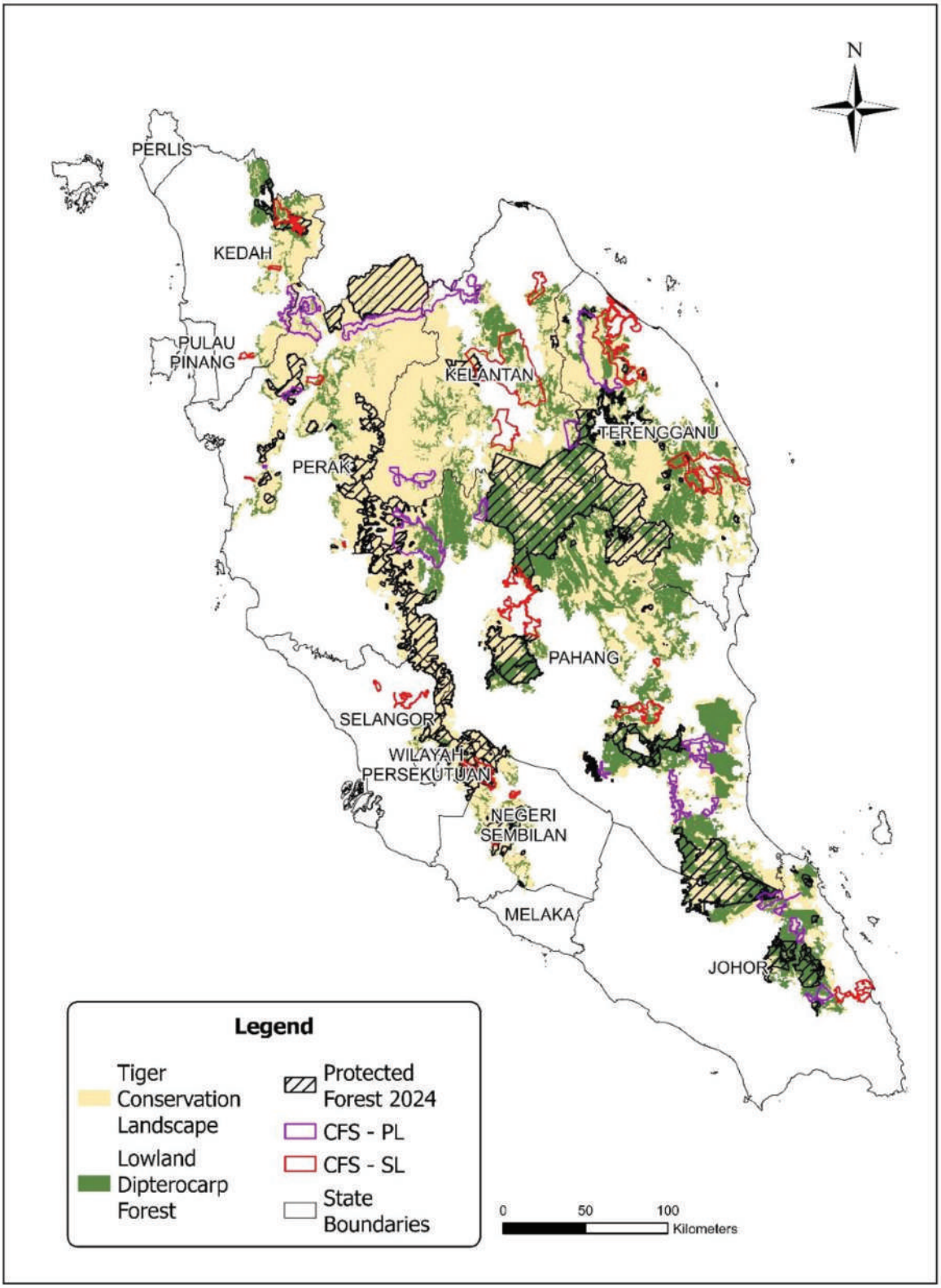

Figure 13. A map that shows linkages as per the Central Forest Spine Master Plan and lowland areas that needs to be legally protected, restored and monitored for tigers, leopards, and clouded leopards as an initial basis for conservation planning. Source data: WWF-Malaysia.

In addition, degraded areas such as log yards could be rehabilitated into grass pastures, while areas infested with false staghorn ferns (*Dicranopteris linearis*) should be weeded out and planted with fig trees and other prey browse plants as means of increasing food availability for ungulates. Such practices would need to be embedded within the silviculture practices of sustainable forest management for Peninsular Malaysia.

In addressing habitat fragmentation and lack of connectivity threatened by linear infrastructure and other land used development, Malaysia has the Central Forest Spine (CFS) Master Plan for Ecological Linkages, a Federal planning spatial blueprint that identifies Ecologically Sensitive Areas and ecological linkages. Although the plan has recently been revised, its implementation in development plans at the State level remains inconsistent as land matters fall under the State jurisdiction. As a result, despite existing plans and policies for conservation planning; monitoring, implementation, and enforcement remain severely lacking. Whilst much effort is needed to secure primary and secondary ecological linkages, there is an imminent risk of the larger forest blocks being converted into other land uses, undermining the very purpose of the Master Plan. For example, about 185,413 ha of forest reserves in Peninsular Malaysia were cleared for forest plantations between 2012 and 2020, of which 68% had not been replanted, with the largest affected area in Pahang and Kelantan (Macaranga 2022).

New linear infrastructure such as roads crossing the CFS could further fragment the habitat, making them vulnerable for conversion into agriculture or other development. Sustained financing support mechanisms are therefore needed to help States retain critical tracts of forest to maintain the forest contiguity. The establishment of the national Ecological Fiscal Transfer (EFT) mechanism is an important step to incentivise States to preserve their forest, but funding levels and governance mechanisms need to be strengthened to ensure that existing natural forests are not converted to other land uses or degraded. Although this mechanism is promising and allocations have increased annually, there remains a substantial funding gap to support the scale of action required for effective biodiversity conservation nationwide.

The State governments' commitment to retain forest cover is critical. Efforts should be expedited to operationalise mechanisms to aid or enable States to leverage approaches such as REDD+, Climate Change Funds, and Nature-Based Solutions, not only to preserve natural forest and its ecosystem services, but also to safeguard the habitat for big cats and broader biodiversity. The implementation of the CFS Master Plan will need stronger financial support of mechanisms such as EFT, the Malaysia Forest Fund's Forest Conservation Certificates and Forest Carbon Offsets, and other emerging Nature-Based Solutions. Together these efforts can be maximised to protect, restore, and connect big cat habitats that will benefit Malaysia's biodiversity as a whole.

Although current roadkill numbers for big cats are not critically high, this threat is expected to grow as the road networks and traffic volume increase, especially near wildlife habitats. Whilst wildlife crossings such as underpasses and overpasses can be useful to enable safe passages, the location, length-spread and intensity of applying such structures need to be more strategically and extensively implemented to minimise road-induced big cat mortality. Other measures include mandatory speed limiters for commercial heavy vehicles and AI-assisted speed cameras to enable "point-to-point" detection with hefty fines for non-compliance as a deterrent. Ultimately, road use intensity, as well as placement and alignment of roads near critical big cat habitats will strongly influence wildlife roadkills. A clear Federal and State directive requiring all future linear infrastructure to avoid bisecting contiguous forest patches would significantly reduce habitat fragmentation and infrastructure -related mortality of big cats.

In terms of forest contiguity and size, the greater Taman Negara-Banjaran Titiwangsa landscape is the largest in Peninsular Malaysia and likely harbours a significant portion of the nation's big cats. However, it would be counter intuitive to neglect efforts for big cat conservation efforts in other key landscapes, such as the Bintang Range in the north and Endau-Rompin in the south despite their fragmentation. Endau-Rompin (~4,000 km^2) is the only tiger landscape in Malaysia that harbours bearded pigs which reinforces its ability to sustain a high tiger density at carrying capacities and therefore warrants increased investment and sustained efforts. Tigers have been recorded to venture from Endau-Rompin to as far as Tasik Chini, suggesting movement through plantations, secondary forests, and human -dominated areas. Enabling safe passage through ecologically functioning corridors or even smaller forest patches that serve as 'stepping stones' is much needed and would greatly enhance the connectivity and genetic exchange of tigers and other big cats. Given the likely low genetic diversity in Malayan tigers among the surviving tiger subspecies, even partially isolated populations like those in Endau-Rompin play a critical role in contributing to the future persistence of tigers in Peninsular Malaysia (Allberry *et al*. 2024). This accentuates the need to shift the narrative that fragmented landscapes are less important; instead, they warrant equal government attention and investment to ensure the long-term survival of the big cats.

Illegal wildlife trade and poaching

Despite sustained government and conservation efforts, continued seizures of tigers, leopards, and clouded leopards in Peninsular Malaysia still persist, which indicates that current responses remain insufficient. The recorded cases in this paper likely represent only a small proportion of actual poaching and trafficking activity, given the covert and organised nature of the crime. The true scale is likely to be substantially higher, underscoring the urgency to intensify and recalibrate enforcement strategies.

Central to addressing big cat poaching is a decisive investment toward intelligence -led investigations that operate across the full criminal chain, from poaching in forested landscapes to domestic and transnational trafficking networks. Too often, enforcement efforts conclude at the point of seizure or arrest of low to mid-level actors. This approach delivers only short-term disruption, as organised criminal networks can quickly replace intermediaries. More lasting impact will require systematically identifying and dismantling the broader networks, including recruiters, financiers, transporters, coordinators, and end buyers. Without this, Malaysia's big cats will remain persistent targets.

Whilst it is critical to dismantle poaching syndicates, it is equally important to understand the motivations behind local poaching and how it forms part of an intertwined web of criminal networks. At the source site, the authorities need a better understanding on why individuals become involved in poaching so that measures can be taken to prevent or reduce this pathway. This can include multiple initiatives ranging from addressing the communities' basic needs, to making it difficult for poaching to occur, and increasing the likelihood of being caught as a means of deterrence. A strong deterrent requires better law enforcement such as deploying more patrol rangers, as well as improving patrol skills, frequency and coverage using the latest technology to detect incursions early.

Efforts on the ground must also be strengthened in high-risk poaching areas. The suggested benchmark of ten rangers per 100 km^2 implies that, across roughly 50,000 km^2 of forest available in Peninsular Malaysia, at least 5,000 rangers would be needed to monitor, detect and potentially deter poachers effectively. Beyond ranger numbers, it is equally important to assess ranger capacity, coverage and intensity of patrolling as well as site-specific threat intensity and variation levels. In addition, intelligence gathered from anti-poaching operations should be integrated into broader investigation efforts, linking field-based evidence with trafficking networks operating beyond protected areas and moving big cats and their parts into demand centres.

Given that big cat trafficking is driven by high profits and relatively low perceived risk, integrating financial investigation into enforcement efforts is critical. Authorities should consistently apply a "follow-the-money" approach to uncover dubious financial flows underpinning poaching and trade. Malaysia already has a strong legal foundation through WCA 2010 and the International Trade in Endangered Species Act 2008, with wildlife crime being recognised as a predicate offence under Malaysia's Anti-Money Laundering, Anti-Terrorism Financing and Proceeds of Unlawful Activities Act 2001 (AMLA). This allows authorities to seize assets and impose fines of up to RM5 million. However, this tool remains underutilised. Actively pursuing financial investigations alongside wildlife offences would enable asset seizures, disruption of profit streams, and expose higher-level actors who enable trafficking without directly participating in it.

Judicial outcomes are also central to deterrence. Strong custodial sentences and substantial financial penalties should be consistently pursued and imposed in offences involving tigers, leopards, and clouded leopards, to reflect the severity of the crime and reinforce deterrence. Strong sentencing sends a clear signal that wildlife crime carries serious consequences. These efforts should be supported by improved data collection and analysis to better understand poaching trends, enforcement gaps, and network structures specific to tigers and leopards. On the whole, addressing this threat requires a multi-pronged and coordinated approach from the government, transnational agencies, NGOs, local communities, and the general public.

Prey loss

There is enough evidence to indicate declines in prey due to poaching, habitat loss and diseases are negatively impacting big cat abundance and distribution in Malaysia. To support recovery, a comprehensive strategy is needed to increase wild prey populations by improving habitat quality, food availability, and mineral resources, alongside strengthening captive breeding and release programmes for key prey species.

At the site level, a proper evaluation on the current status of prey needs to be carried out so that a systematic assessment to determine whether interventions such as prey habitat enrichment and/or large prey (e.g., sambar deer and bearded pigs) supplementation are required, and the intensity of such interventions. Selected areas could be designated as prey recovery zones, where habitat restoration and enrichment are carried out by increasing the availability of high-quality forage for prey species, establishing mineral licks and grasslands (Bhumpakphan 1997; Steinmetz *et al*. 2010), and intensifying protection against poaching. However, it is critical to consistently monitor and document the efforts applied and its resulting outcomes to assess its impact on recovery of prey for replicability across different sites in Peninsular Malaysia.

Considering the severe decline of large prey in most of Peninsular Malaysia's forests, there is a need for an immediate start-up of breeding programs for large prey (e.g., bearded pigs, sambar, gaur or even banteng). As a crisis intervention, the release of captive spayed Javan deer or feral buffalo in areas where prey availability is low could also be considered. Currently no zoos in Peninsular Malaysia hold the bearded pig subspecies (*Sus barbatus oi*) found in Endau Rompin for breeding and reintroduction into the wild, which raises concerns for its long-term conservation if local populations decline further. It should be noted however, that Singapore Zoo maintains a small captive population and are keen to support future prey augmentation efforts, however.

Lack of prey availability forces tigers to expand their home ranges (Simcharoen *et al.* 2014), increasing the likelihood of human-wildlife conflict at forest edges and in agricultural landscapes. The severe depletion of wild pig including bearded pigs in the south of Peninsular Malaysia due to ASF has likely resulted in the increased death or removal of a

number of wild tigers due to: (1) tigers expanding home ranges and repeatedly preying on livestock (and even humans) as an alternative food source, which are subsequently captured or killed in a retaliatory manner, and (2) greater movement across fragmented landscapes in search of food, increasing the risk of vehicle collisions. Although a direct causal link between ASF and these incidences is difficult to establish, there has been a dramatic increase of human-tiger conflict cases and roadkill incidences involving tigers since the disease first spread in Peninsular Malaysia in 2022. This trend is particularly evident than in Perak, where at least 11 tigers have been reported captured or killed since 2023, in which five tigers were removed by PERHILITAN due to conflict with humans, three were killed by vehicles, one was shot dead by villagers, and two more found dead due to unknown causes (Perak State Parks Corporation, unpublished).

Wild boar is the most prolific breeder amongst the big cats' prey species, and its population decline has likely contributed to increased human-tiger conflicts, as well as reduced tiger breeding success and cub survival due to insufficient food for nursing females. For example, no new tiger breeding signs have been recorded in Royal Belum State Park since the ASF outbreak (WWF-Malaysia, unpublished; Perak State Parks Corporation, unpublished). Prolonged outbreaks are expected to further suppress wild pig populations and reduce the number of breeding big cats, unless prey populations are actively restored through captive breeding, release programmes, and habitat enrichment.

A combination of measures is needed to detect outbreaks and trigger timely management responses to manage future ASF outbreaks. These include improving biosecurity and regulating human movement from domestic pig-producing communities into forest edges and interiors to limit spillover; establishing early warning systems via improving surveillance on carcass detection that integrates ranger patrol and local community reporting; and ensuring safe disposal of carcasses at burial sites. Recovery measures should also include instituting temporary hunting bans until populations stabilise, *ex situ* breeding and introducing release programs in the wild for severely impacted sites.

Diseases directly impacting the three big cats

Among the pathogens reported in wild tigers, only CDV has been clearly associated with mortality that contributes to population declines in the big cats. In Malaysia, a follow-up study to the first detected case of CDV in tigers found CDV RNA in three common tree shrews (*Tupaia glis*), suggesting the potential role of small mammals as a carrier of the disease (Lazarus *et al*. 2025). Elsewhere, studies in Russia indicate that multiple wild carnivores may maintain CDV circulation in Amur tigers, although in other areas unvaccinated and free-roaming domestic dogs (Canis familiaris) are considered major CDV reservoirs (Gilbert *et al.* 2023). Hence, there is a critical need for more targeted studies to identify local CDV reservoir species, transmission routes, and CDV hotspots affecting Malayan tigers and other big cats, for the development of disease management and prevention systems. Surveillance of CDV via the collection of blood and preservation of serum should be mandatory and routinely incorporated into tiger handling protocols particularly in conflict mitigation, rehabilitation, or post-mortem examination (Gilbert *et al.* 2023).

Vaccination is the best means of mitigating CDV risk to big cat populations. Where domestic dogs are the primary source of CDV, vaccination can significantly reduce CDV transmission. However, this is ineffective if the infection is contracted through direct contact with wild animals that naturally maintains the virus in an ecosystem, as vaccines cannot be delivered to wildlife at the scale that is necessary to eliminate the virus. The development of oral baiting approaches to vaccinate wild tigers may be an option that needs to be explored (Gilbert *et al.* 2023).

Human-wildlife conflict

Human-tiger/leopard/clouded leopard conflict—arising from livestock depredation, sightings near settlements and plantations—frequently leads to the legal removal of the animal by authorities, or retaliatory killings, with potentially significant consequences on local populations, especially within a site that has high forest-edge interfaces. Human-wildlife conflict mitigation remains very reactive and heavily focused on compensation for livestock depredation or death of humans, as opposed to tackling the underlying issues of habitat loss, fragmentation, and lack of prey. While some farmers use physical barriers like paddocks to reduce livestock losses, these are not widely implemented or standardised, limiting their overall effectiveness.

Malaysia has two wildlife conflict compensation mechanisms, one of which is the Property and Crop Damage Compensation Assistance Initiative (Bantuan Kerugian Harta Benda dan Tanaman Akibat Serangan Hidupan Liar), which covers losses and damages to agricultural crops, property, and livestock caused by wildlife. The assistance is generally provided as a one-off payment based on verified losses, with RM 10 million allocated in 2024 (Ministry of Finance 2023). The second is the Wildlife Attack Victims Assistance Trust Fund (Tabung Bantuan Mangsa Serangan Binatang Buas), which provides support for injury or death cases relating to wildlife encounters and attacks. Established under the *Financial Procedure Act 1957* [Act 61] and managed by the Social Welfare Department, the fund provides a relatively small compensation of up to RM20,000 for cases involving death or permanent disability.

However, both schemes face limitations. Extended delays for payments, partial coverage and low levels of compensation value, are likely to be main challenges in implementing financial aid for economic losses and support for victims of wildlife attacks. Though these form an important component of national strategies to manage human-wildlife conflict, there is a clear need for strengthening these programs, alongside long-term preventive strategies such as improved land-use planning, ensuring habitat protection, and sustained community engagement, these are essential prerequisites in managing human wildlife conflict beyond today.

CONCLUSION

Based on our review of the conservation status of the three large cats in Peninsular Malaysia, more information, policies, and initiatives exist for tigers compared to leopards and clouded leopards, reflecting the tiger's national prominence and critically endangered status. Although there are encouraging population estimates for the latter two species, more robust assessments—like those for the Malayan tiger—are needed to properly monitor their conservation status across priority landscapes. As all three species co-occur in the forests of Peninsular Malaysia, most tiger-focused initiatives will also benefit the other two species and broader wildlife conservation. Over the years, Malaysia has stepped up efforts to stem wildlife decline, but there is a need to evaluate effectiveness of these initiatives and identify gaps that need immediate attention. This includes deep-dive assessments of the National Tiger Task Force, Operasi Bersepadu Khazanah, the Community Ranger Programme, and EFT to better conserve forests and biodiversity. The National Tiger Task Force should focus on urgent key measures described in this paper, while developing adaptive mid- and long-term strategies that could be sustained over a longer period, ensuring it does not become a tick-box exercise. Ultimately, stronger political will at both State and national levels, with immediate action on prey recovery and habitat loss, coupled with adequate sustainable financing is critically needed to ensure that Malaysia's three large sympatric cats stand a chance to not only survive, but recover over the next few decades.

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