Understanding and solving the South-East Asian snaring crisis

Snaring is one of the simplest but most destructive hunting techniques. Snares, cheap to produce and easy to set in large numbers, are the predominant form of hunting across large areas of South-East Asia. Snares are indiscriminate, wasteful, and cruel. For terrestrial species in South-East Asia, the increasing use of snares – principally to feed urban demand for wildlife meat – is among the most significant causes of population declines. Across eleven protected areas in the region, the authors document ranger patrols removing a total of 371,056 snares between 2005 and 2019. However, owing to the low detectability of snares and the large size of many of the region's protected areas, which are invariably understaffed, the number of snares removed is likely only a small fraction of total snares present. To effectively address the drivers of snaring, governments and civil society organizations need to urgently improve the effectiveness of anti-poaching patrols generally, and specifically strengthen legislation to allow law enforcement officers and rangers to deter snaring within protected areas. Robust and evidence-based behaviour change programs to reduce commercial demand for wildlife meat should simultaneously be developed.

South-East Asia is at the centre of the global wildlife extinction crisis, with more threatened species across almost every taxonomic group than any other comparable region (Benítez-López *et al.*, 2017; Leung *et al.*, 2020). Habitat loss and the unsustainable consumption and use of wildlife are driving the extinction crisis in South-East Asia (Duckworth *et al.*, 2012; Hughes, 2017). Hunting, largely to supply expanding commercial trade, constitutes perhaps the largest current threat to wild vertebrates in the forested areas of South-East Asia (Harrison *et al.*, 2016). Hunting is so pervasive and intense that even where areas of good quality forest remain, there is increasingly near total loss of certain groups of taxa, particularly large mammals and turtles. Substantial areas of forest throughout mainland South-East Asia have lost many of the previously present species of ground dwelling mammals (Harrison *et al.*, 2016; Tilker *et al.*, 2019). Such areas tend to have one thing in common: widespread snaring. Snares are rudimentary traps often set in large numbers by commercial poachers to capture animals for the illegal wildlife trade (Gray *et al.*, 2018). For terrestrial species in South-East Asia, the increasing use of snares – principally to feed urban demand for wildlife meat – is among the most significant causes of population declines (Gray *et al.*, 2018; Belecky and Gray, 2020).

Snaring is one of the simplest but most destructive hunting techniques practised in South-East Asia. Snares are cheap to produce and easy to set in large numbers, with home-made wire, nylon or cable snares the predominant form of hunting across large areas of South-East Asia. Such snares can be produced quickly and cheaply, using materials for which there is an inexhaustible supply, and can remain active in the forest almost indefinitely. Easier access into protected areas due to transportation infrastructure development means that fresh wildlife products can be sent to urban centres, where demand for wild meat is high, quicker than ever before. As such, the volume of snares in South-East Asia's forests is phenomenal (Belecky and Gray, 2020).

Because snares can capture all animals unfortunate enough to encounter them, they are the terrestrial equivalent to the drift-nets

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that have devastated marine and freshwater biodiversity. Depending on the type of snare used, anything and everything on the forest floor, from tortoises to elephants, is vulnerable. Because snares can catch such a wide variety of species, they continue to be placed even after the most commercially valuable species become rare in a given area. In this way, snares continue to remove individuals from the population even when that population becomes severely depressed, thus preventing the natural recovery of overexploited species. The effort of setting snares is so low, and the cost so minimal, particularly for nylon or wire snares, that there is negligible disincentive to stop hunters from placing them. Indeed, many snares are set and never checked, with a significant proportion of the animals caught in them left to rot in the snare (Lindsey *et al.*, 2011).

Snares have been singled out as one of the cruellest means of hunting, given that animals can sometimes languish for days or weeks in a snare before dying from their injuries, dehydration or starvation (Noss, 1998; Gray *et al.*, 2018). Even when an animal does escape a snare, it will often perish later from infection caused by the injury, or starve due to the fact that the injury has limited its ability to walk, forage or hunt (Figure 1). A recent study from Zimbabwe, for example, highlighted the cruel and wasteful nature of snaring: more than 60% of the animals found in snares were decomposed and thus unrecovered and wasted (Mudumba *et al.*, 2020). In addition to the suffering and animal welfare issues, the mortality from snaring is significantly impacting animal population dynamics and group and family structure (Loveridge *et al.*, 2020).

Figure 1. Globally threatened animals snared in South-East Asia. Clockwise from top-left: Dhole (*Cuon alpinus*), Cambodia © WWF-Cambodia; Malayan sun bear (*Helarctos malayanus*), Malaysia © WWF-Malaysia / Lau Ching Fong; Asian elephant (*Elephas maximus*), Cambodia © WCS-Cambodia; Tiger (*Panthera tigris*), Malaysia © WWF-Malaysia / Lau Ching Fong.

The impact and scale of snaring in South-East Asia

In many South-East Asian protected areas, rangers and forest guards remove snares which they encounter during routine enforcement patrols. We collated data on the number of snares removed during enforcement foot patrols from 11 protected areas in five South-East Asian countries (Cambodia, Indonesia, Lao PDR, Malaysia, Viet Nam) between 2005 and 2019 (Table 1). There were between three and 10 years of data collected per site. Across all patrolled sites a total of 371,056 snares were removed (approximately 53,000 per year).

Unfortunately, this huge number of snares removed is only the tip of the iceberg. Foot patrols typically only cover a small proportion of each protected area each year. Given the large size and challenging terrain of many South-East Asian protected areas, remote or difficult to access sections may rarely be visited by enforcement rangers. Studies have also shown that snare detectability, even by relatively well-trained and motivated rangers patrol teams, can be low. Snares are usually small, concealed and spread across vast, remote areas, making them difficult to find and remove. An experimental study that attempted to quantify frequency of snare detection involved a group of Cambodian protected area personnel who were instructed to search prescribed 1×1-km grid cells for 'dummy' snares, which had been set by the researcher in collaboration with local hunters. Slightly fewer than 40% of available snares were detected in evergreen forest sites, while just over 20% of snares were detected in mixed forest sites (O'Kelly *et al.*, 2018). A similar study in the same protected area suggested snare detection probability was ~25% within a 0.25 km^2 area during a 60 minute search

Table 1. Numbers of snares removed by law enforcement rangers from select protected areas in South-East Asia between 2005 and 2019.

Site	Size (km^2)	Snares (total removed)	Snares removed per year (average)	Data period
Srepok Wildlife Sanctuary, Cambodia[1]	3,730	12,600	1,260	2010–19
Phnom Prich Wildlife Sanctuary, Cambodia[1]	2,700	7,219	1,444	2015–19
Seima Wildlife Sanctuary, Cambodia[2]	2,990	8,477	942	2010–18
Chhep - Kulen Promtep, Cambodia[2]	5,500	10,789	2,158	2014–18
Cardamom National Park, Cambodia[3]	5,546	195,206	19,521	2010–19
Nam Et Phou Loey NPA, Lao PDR[4]	3,000	1,144	191	2010–15
Nam Pouy NPA, Lao PDR[5]	2,500	240	80	2016–18
Nakai Nam Theun NPA, Lao PDR[6]	3,445	3,400	850	2016–19
Hue-Quang Nam Saola Reserves, Viet Nam[7]	320	127,057	14,229	2011–19
Royal Belum State Park, Malaysia[8]	1,175	1,272	212	2014–19
Kerinci Seblat National Park, Indonesia[9]	6,500	3,652	365	2005–14

Data sources: [1]WWF-Cambodia; [2]WCS-Cambodia; [3]Gray *et al.* (2018) and Wildlife Alliance Annual Reports (https://www.wildlifealliance.org/financial-reports/); [4]Gray *et al.* (2018); [5]WWF-Laos; [6]Anoulak Annual Reports (https://www.conservationlaos.com/resources/our-annual-reports/); [7]WWF-Viet Nam; [8]WWF Malaysia; [9]Risdianto *et al.* (2016).

by trained rangers (Ibbett *et al.*, 2020). As such, the number of snares removed per year by patrol rangers is likely only a very small fraction of the total snares within a protected area (Belecky and Gray, 2020).

The huge number of snares in protected areas across South-East Asia is impacting many of the most threatened mammal species in the region. The dry savannah forests of eastern Cambodia support the largest global population of banteng (*Bos javanicus*; Figure 2), a globally endangered species of wild cattle, which is also an important prey species for tiger (*Panthera tigris*) and leopard (*P. pardus*) (Gray *et al.*, 2012; Rostro-García *et al.*, 2018). Between 2010 and 2020 the banteng population in the core protected areas of the Eastern Plains Landscape decline by 72% – at the same time the number of hunting snares detected by patrol rangers increased over a hundredfold (Groenenberg *et al.*, 2020). It is believed that this massive increase in snaring in the landscape, largely to poach smaller ungulates for commercial wildlife meat restaurants, was a significant driver of the decline in banteng numbers (Groenenberg *et al.*, 2020). High levels of snaring in the landscape have also directly contributed to the collapse of Indochinese leopard populations in the region: from 2009 to 2014, leopard numbers declined by 70%, primarily because of increased poaching pressure (Rostro-García *et al.*, 2016).

In the Annamite mountains of Viet Nam and Lao PDR – an isolated mountain range that supports exceptionally high levels of species endemism – threatened mammals including large-antlered muntjac (*Muntiacus vuquangensis*), Annamite striped rabbit (*Nesolagus timminsi*; Figure 2), and saola (*Pseudoryx nghetinhensis*) are severely impacted by snaring. Remarkably, all of these species were only described to science during the 1990s – and are now already facing extinction. None of these recently discovered species are specific targets for snaring, but are instead caught as by-catch in generalist snares. As a result of presumed populations declines, Annamite striped rabbit is IUCN-listed as Endangered, while large-antlered muntjac and saola are Critically Endangered (Timmins *et al.*, 2016; Timmins *et al.*, 2020; Tilker *et al.*, 2020). Due to the insidious impact of snaring across the Annamites, and the difficulty in curbing this activity, conservationists have highlighted establishing captively managed populations of these species as the best opportunity to prevent their imminent extinction (Tilker *et al.*, 2017).

Asian elephants (*Elephas maximus*) are the largest land mammal in Asia and are generally not deliberately hunted using snares. However, elephant calves are particularly susceptible to snare injuries on both their feet and trunks. In the Cardamom Rainforest Landscape of South-West Cambodia, camera-trapping

Figure 2. Two globally Endangered species impacted by the South-East Asian snaring crisis: Banteng (*Bos javanicus*; left), Cambodia © WWF-Cambodia; Annamite striped rabbit (*Nesolagus timminsi*; right), Vietnam © Leibniz-IZW / WWF-Vietnam CarBi Project / Hue SNR.

found that more than half of the elephant calves detected had severe injuries from what appeared to be wire snares around the base of their legs. Additionally, adult elephants were photographed with trunk injuries and lacerations that appeared to have been caused by snares (Un *et al.*, 2018). In peninsular Malaysia, organized commercial hunting gangs, primarily from Viet Nam and Cambodia, use large cable snares to target tigers and other large high-value species (such as the mainland clouded leopard [*Neofelis nebulosa*] and the Malayan sun bear [*Helarctos malayanus*]) which are now rare or locally extinct in parts of continental South-East Asia. Such hunting, also observed in Thailand, has been implicated in significant declines in tiger density in key Malaysian protected areas.

The examples described above highlight some of the impacts of snaring on threatened species in South-East Asia. However, snaring affects many more species and is estimated to impact species from 80% of families of South-East Asian land mammals (Supplementary Information Table 1). Many of these species, most notably ungulates and carnivores, have also been identified as amongst the highest risk mammal groups for zoonotic disease transmission. Wild pig (*Sus scrofa*) – a very commonly snared species in Cambodia, Lao PDR, and Viet Nam – has been found to host the greatest numbers of zoonotic pathogens of any species traded in Asian markets (Cantlay *et al.*, 2017). Masked palm civet (*Paguma larvata*) and Sunda pangolin (*Manis javonica*), both of which are often snared, have been identified as intermediary hosts for zoonotic disease transfers including SARS, coronaviruses and Sendai virus (Liu *et al.*, 2019). For this reason, addressing the snaring crisis is likely to reduce the probability of future zoonotic disease pandemics.

Solutions to the South-East Asian snaring crisis

Solving the South-East Asian snaring crisis requires multi-faceted and holistic approaches which enhance protected area management and law enforcement, advocate for legislative reform, shut down illegal wildlife trade and reduce demand for wildlife meat in urban areas. To be impactful in mitigating the threat of snaring, solutions need to be strategically developed to ensure that there is an explicit link between economic or other incentives and cessation of snaring. Incentives need to be accompanied by enforced compliance mechanisms, including a higher probability of apprehension of offenders, a higher rate of successful prosecutions and a higher likelihood that prosecutions will result in the handing down of punitive sentences. The strongest impact will likely come from approaches that first analyse the situation (*e.g.* protected area, landscape etc.) and then develop context-specific, multifaceted solutions that identify and address the motivations for hunting using snares, as well as improving criminal justice systems.

Engaging with local communities

In many cases, it will be essential to develop strong partnerships with local communities to reduce wildlife crime and snaring (Lewis *et al.*, 2011; Eshoo *et al.*, 2018). Indigenous peoples and vulnerable communities can depend heavily on South-East Asia's ecosystems, natural resources and wildlife for their health, livelihoods and well-being. However, where hunting is undertaken for subsistence or home consumption, available studies suggest that other methods (*e.g.* dogs and sling shots in Cambodia; blow pipes and spears in Malaysia; dogs, bows or guns in Myanmar) are often preferred over snares (Coad *et al.*, 2019; Evans *et al.*, 2020; Loke *et al.*, 2020). Given the significant stake indigenous peoples and local communities have in the long term maintenance of ecosystem functions, food security and cultural traditions, they are integral partners in any effective strategy to reduce snaring. These groups also have considerable influence over the landscapes they inhabit, which are more likely to overlap with the biodiverse areas which are most threatened by snare use (Garnett *et al.*, 2018). In general, conservation and anti-snaring strategies

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will be more efficient with the informed consent and support of such groups. The recognized rights of indigenous peoples often include the right to hunt on their lands using traditional and culturally preferred means. Such rights should be protected. However, use of snares should be clearly distinguished from traditional hunting methods when defining the scope of these unique rights in order to protect the forests and ecosystems that people depend on. Precautions must also be taken to prevent the commercial sale and trade of wildlife from indigenous lands.

Constraints to law enforcement

The primary current response to the South-East Asian snaring crisis is the removal of snares by patrol teams: a relatively easy and non-controversial activity. Unfortunately, huge piles of destroyed snares do not necessarily represent conservation success. Whilst removing snares does directly remove a threat to wildlife, in order for this to be effective snares must be removed at a higher rate than they can be set by hunters. The high volume of snares still being retrieved from the region's protected areas (Table 1) suggests this approach alone is insufficient. Given low staffing levels, the size of many protected areas, and the low detection probability of snares, only a small proportion of snares within an area can realistically be removed by patrols. Patrol strategy is often either too reactive (meaning ranger teams only go where threats are known to be highest) or too routine (meaning that ranger teams always patrol the same routes). In fact, one of the most significant deterrents to would-be offenders has been shown to be perceived risk of apprehension (Milner-Gulland and Leader-Williams, 1992). This requires every part of a given protected area to have some non-zero probability of being patrolled, at random intervals, even if this probability is extremely low, as will be inevitable with such large areas and limited resources. Rangers also rarely encounter people in the act of setting snares so it is difficult to identify perpetrators and ensure any punitive action is taken, particularly given that current legislative loop-holes mean penalties are insufficient (see below) and wildlife crime is often regarded as a minor issue by prosecutors (Nijman, 2017). Snares are also so cheap that they are easily replaced by poachers when removed by rangers, meaning this activity does not act as a strong deterrent for future snaring activities. All these factors mean that the overall impact of rangers removing snares is too low to entirely remove the threat posed to wildlife by snares. We therefore recommend that governments and civil society organizations do not depend on ranger patrols alone to reduce snaring sufficiently, and that these approaches need to be combined with a stronger judicial system and a high likelihood that those who are apprehended face appropriate penalties.

> "To effectively address the South-East Asian snaring crisis, the relevant legislation in all countries needs to be strengthened."

Legislative reform

To effectively address the South-East Asian snaring crisis, the relevant legislation in all countries needs to be strengthened. We analysed the legal prohibitions on snaring in each of eight large biodiverse countries in South-East Asia (Supplementary Information Table 2). This exercise highlighted a number of significant shortcomings, including that only one country (Malaysia) legally defines what constitutes a snare; only two countries (Malaysia and Viet Nam) guarantee a serious minimum penalty for any type of hunting by snares within a protected area; and only two countries (Malaysia and Thailand) explicitly prohibit the possession of snares in protected areas. None of the laws in the region include provisions that clearly prohibit the possession of materials (like metal wires or nylon ropes) that can be quickly fashioned into snares in protected areas. Based on these limitations, we provide a number of specific recommendations to strengthen anti-snaring legislation in Table 2.

Given the importance of areas outside protected areas for wildlife conservation in South-East Asia (Edwards *et al.*, 2011) there is a strong argument for an outright ban on snaring and a universal prohibition of snares as dangerous weapons. Whilst snaring is often used in the region by

farmers in the vicinity of their villages as a crop guarding mechanism (*i.e.* to prevent wild animals eating cultivated plants – see Coad *et al.* [2019]) these snares are still indiscriminate, and can kill many non-target (including endangered) species. Other means of preventing, or compensating for, crop damage by wildlife should be actively promoted.

Adequate prosecution and conviction rates for snaring crimes are also essential. This element speaks to the deterrent effect, for even strong laws will do little to prevent poaching if the poacher is aware that those laws are rarely enforced by certain links in the enforcement chain (including enforcement officers, prosecutors and judges). Indeed, problems in appropriately applying and consistently realizing penalties called for in wildlife protection laws often outweigh shortcomings in the content of the laws themselves (Wellsmith, 2011; Nijman, 2017). Efforts should be made to use additional legislation, beyond wildlife laws, to target wildlife traders and middle-men who are purchasing snared animals. These can include laws related to organized crime and money laundering. To understand the degree to which this is currently a problem – and to set out the strategy needed for improvements – all South-East Asian countries should track prosecution and conviction rates for wildlife crimes, including snaring crimes specifically. There is also a need for communicating increased legal penalties for snaring following any legislative reform. Any deterrent effect from new laws will be of little value if the contents of those laws are not widely communicated to those who they would most affect. Beyond the deterrent effect, it is also an issue of fundamental fairness. It would be highly unjust for a person to face drastically increased consequences if there was little attempt to communicate changes in wildlife laws. This communication can be done through multiple channels, including but not limited to posters, newspaper and social media ads, community meetings and television and radio announcements.

Table 2. Recommended legislative changes to strengthen judicial response to snaring.

Legislative change	Justification
Adjust minimum and maximum sentences and fines for snaring and snare possession. These should be set at a level that will provide a significant deterrent effect, even to well-financed commercial wildlife traders.	With half of the countries assessed having wildlife laws that are more than a decade old, it should be recognized that the threat posed by snares is clearer and more pressing than it would have been when those laws were originally drafted. Given that hunting is now conducted largely for commercial purposes, people who snare will often have significant financial backing. As such, it will be necessary for newly legislated fines and imprisonment periods to be adequate to deter such individuals.
Add provisions that would define snare possession or use as an attempt to hunt the most protected class of species that could be caught inside the protected area where its use was intended.	Snares are an indiscriminate hunting method and snares set for 'common' species can kill and maim Asian elephants, tigers, saola, and other highly protected species. It is a major oversight in current laws that those using snares must be caught red-handed with these species to face serious charges.
Introduce clear legal prohibition on possession of snares in protected areas. This prohibition should also extend to non-authorized personnel in possession of materials that can be quickly converted into snares within the boundaries of protected areas. This should include bans on the possession of wire and metal cables of all types, and in the absence of a clear legitimate use, bans on the possession of rope and nylon rope in quantities that could be converted into snares.	This is important given the improbability of catching a poacher in the act of setting a snare or retrieving an animal from a previously set snare. By criminalizsing the possession of materials used to make snares within protected areas, it will be easier for enforcement rangers to deter poachers.
Introduce laws that include strict liability provisions that place the burden of proof on the possessor of snares, or materials that can be used to make snares, and ensure adequate search and seizure powers for officials working within protected areas.	Illegal hunting of wildlife is rarely effectively prosecuted in South-East Asia, with legislative loop-holes often used to acquit offenders. Proactively addressing such issues is likely to strengthen cases against wildlife offenders.

Behaviour change

Conservation biologists are increasingly recognizing that Social and Behaviour Change Communications (SBCC), techniques widely used in the health and development sectors, could help to achieve conservation goals (Veríssimo, 2013; Shairp *et al.*, 2016). Such approaches, developed from the literature surrounding social marketing

and psychology, have been used to reduce demand for a range of goods, from electricity and water, to habit-forming drugs through (a) directly or indirectly changing the price of the good or its substitutes, and/or (b) influencing one or more non-price drivers such as the emotional reasons behind purchasing a product. A recent review of environmental SBCC projects found strong evidence that education, prompts and feedback interventions will result in positive behaviour change (Thomas-Walters *et al.*, 2020). We recommend the development of focussed SBCC programmes in key urban markets to reduce the consumption of wildlife meat. This will require

1. surveys to understand the scope and extent of wildlife meat consumption across South-East Asia to support the design of cost-effective SBCC campaigns;
2. development of location and consumer segment specific behaviour change modelling frameworks to address critical wildlife meat consumers across South-East Asia;
3. development of marketing frameworks in partnership with professional marketing and advertising agencies; and
4. role-out of marketing programmes together with robust monitoring and evaluation of campaign reach and impact on consumer behaviour choice. Robust baselines are also critical in order to understand the impact and results of behavioural change programmes.

Conclusion

Snares, whilst simple in construction, are having a devastating impact on South-East Asian wildlife. Demand from urban consumers in the region for wildlife meat, parts and products has dramatically increased in recent years, driving the spread of industrial-scale snaring (Sandalj *et al.*, 2016). Only a small proportion of hunting may be done for the subsistence of hunters and their families, with most snaring undertaken to supply this urban demand and associated markets and restaurants (Shairp *et al.*, 2016; Gray *et al.*, 2018; Belecky and Gray, 2020). Unless the South-East Asian snaring crisis is solved, many of the region's iconic species are likely to follow the tiger and the Javan rhino (*Rhinoceros sondaicus*) to local extinction (Brook *et al.*, 2014; Rasphone *et al.*, 2019). To effectively address the drivers of snaring, governments and civil society organizations in the region urgently need to improve the effectiveness of anti-poaching patrols generally, and specifically strengthen legislation to allow law enforcement officers and rangers to deter snaring within protected areas. Robust and evidence-based behaviour change programmes to reduce commercial demand for wildlife meat should simultaneously be developed. ■

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References

Belecky M and Gray TN (2020) *Silence of the Snares: Southeast Asia's snaring crisis*. WWF International. Available at https://is.gd/9ioKEL (accessed February 2021).

Benítez-López A, Alkemade R, Schipper AM *et al.* (2017) The impact of hunting on tropical mammal and bird populations. *Science* **356**: 180–3.

Brook SM, Dudley N, Mahood SP *et al.* (2014) Lessons learned from the loss of a flagship: The extinction of the Javan rhinoceros Rhinoceros sondaicus annamiticus from Vietnam. *Biological Conservation* **174**: 21–9.

Cantlay JC, Ingram DJ and Meredith AL (2017) A review of zoonotic infection risks associated with the wild meat trade in Malaysia. *EcoHealth* **14**: 361–88.

Coad L, Lim S and Nuon L (2019) Wildlife and livelihoods in the Cardamom Mountains, Cambodia. *Frontiers in Ecology and Evolution* **7**: 296.

Duckworth JW, Batters G, Belant JL *et al.* (2012) Why South-East Asia should be the world's priority for averting imminent species extinctions, and a call to join a developing cross-institutional programme to tackle this urgent issue. *SAPIENS: Surveys and Perspectives Integrating Environment and Society* **5**: 77–95.

Edwards DP, Larsen TH, Docherty TD *et al.* (2011) Degraded lands worth protecting: The biological importance of Southeast Asia's repeatedly logged forests. *Proceedings of the Royal Society B: Biological Sciences* **278**: 82–90.

Eshoo PF, Johnson A, Duangdala S and Hansel T (2018) Design, monitoring and evaluation of a direct payments approach for an ecotourism strategy to reduce illegal hunting and trade of wildlife in Lao PDR. *PLoS One* **13**: e0186133.

Evans TS, Myat TW, Aung P *et al.* (2020) Bushmeat hunting and trade in Myanmar's central teak forests: Threats to biodiversity and human livelihoods. *Global Ecology and Conservation* **22**: e00889.

Garnett ST, Burgess ND, Fa JE *et al.* (2018) A spatial overview of the global importance of Indigenous lands for conservation. *Nature Sustainability* **1**: 369–74.

Gray TN, Prum S, Pin C and Phan C (2012) Distance sampling reveals Cambodia's Eastern Plains Landscape supports the largest global population of the Endangered banteng *Bos javanicus*. *Oryx* **46**: 563–6.

Gray TN, Hughes AC, Laurance WF *et al.* (2018) The wildlife snaring crisis: An insidious and pervasive threat to biodiversity in Southeast Asia. *Biodiversity and Conservation* **27**: 1031–7.

Groenenberg M, Crouthers R and Yogaland K (2020) *Population Status of Ungulates in the Eastern Plains Landcape* (Technical Report). Srepok Wildlife Sanctuary and Phnom Prich Wildlife Sanctuary, Cambodia. WWF Cambodia, Phnom Penh, Cambodia.

Harrison RD, Sreekar R, Brodie JF *et al.* (2016) Impacts of hunting on tropical forests in Southeast Asia. *Conservation Biology* **30**: 972–81.

Hughes AC (2017) Understanding the drivers of Southeast Asian biodiversity loss. *Ecosphere* **8**: e01624.

Ibbett H, Milner-Gulland EJ, Beale CM *et al.* (2020) Experimentally assessing the effect of search effort on snare detectability. *Biological Conservation* **247**: 108581.

Krishnasamy K and Zavagli M (2020) *Southeast Asia: At the heart of wildlife trade*. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia. Available at https://is.gd/5XQpy5 (accessed February 2021).

Leung B, Hargreaves AL, Greenberg DA *et al.* (2020) Clustered versus catastrophic global vertebrate declines. *Nature* **588**: 267–71.

Lewis D, Bell SD, Fay J *et al.* (2011). Community Markets for Conservation (COMACO) links biodiversity conservation with sustainable improvements in livelihoods and food production. *Proceedings of the National Academy of Sciences* **108**: 13957–62.

Lindsey PA, Romañach SS, Tambling CJ *et al.* (2011) Ecological and financial impacts of illegal bushmeat trade in Zimbabwe. *Oryx* **45**: 96–111.

Liu P, Chen W and Chen JP (2019) Viral etagenomics revealed Sendai virus and Coronavirus infection of Malayan pangolins (*Manis javanica*). *Viruses* **11**: 979.

Loke VP, Lim T and Campos-Arceiz A (2020) Hunting practices of the Jahai indigenous community in northern peninsular Malaysia. *Global Ecology and Conservation* **21**: e00815.

Loveridge AJ, Sousa LL, Seymour-Smith J *et al.* (2020) Evaluating the spatial intensity and demographic impacts of wire-snare bush-meat poaching on large carnivores. *Biological Conservation* **244**: 108504.

Milner-Gulland EJ and Leader-Williams N (1992) A model of incentives for the illegal exploitation of black rhinos and elephants: Poaching pays in Luangwa Valley, Zambia. *Journal of Applied Ecology* **29**: 388–401.

Mudumba T, Jingo S, Heit D and Montgomery RA (2020) The landscape configuration and lethality of snare poaching of sympatric guilds of large carnivores and ungulates. *African Journal of Ecology* DOI: 10.1111/aje.12781.

Nijman V (2017) Orangutan trade, confiscations, and lack of prosecutions in Indonesia. *American Journal of Primatology* **79**: 22652.

Noss AJ (1998) The impacts of cable snare hunting on wildlife populations in the forests of the Central African Republic. *Conservation Biology* **12**: 390–8.

O'Kelly HJ, Rowcliffe JM, Durant S and Milner-Gulland EJ (2018) Experimental estimation of snare detectability for robust threat monitoring. *Ecology and Evolution* **8**: 1778–85.

Rasphone A, Kéry M, Kamler JF and Macdonald DW (2019) Documenting the demise of tiger and leopard, and the status of other carnivores and prey, in Lao PDR's most prized protected area: Nam Et-Phou Louey. *Global Ecology and Conservation* **20**: e00766.

Risdianto D, Martyr DJ, Nugraha RT *et al.* (2016) Examining the shifting patterns of poaching from a long-term law enforcement intervention in Sumatra. *Biological Conservation* **204**: 306–12.

Rostro-García S, Kamler JF, Ash E *et al.* (2016) Endangered leopards: Range collapse of the Indochinese leopard (Panthera pardus delacouri) in Southeast Asia. *Biological Conservation* **201**: 293–300.

Rostro-García S, Kamler JF, Crouthers R *et al.* (2018) An adaptable but threatened big cat: density, diet and prey selection of the Indochinese leopard (*Panthera pardus delacouri*) in eastern Cambodia. *Royal Society Open Science* **5**: 171187.

Sandalj M, Treydte AC and Ziegler S (2016) Is wild meat luxury? Quantifying wild meat demand and availability in Hue, Vietnam. *Biological Conservation* **194**: 105–12.

Shairp R, Veríssimo D, Fraser I *et al.* (2016) Understanding urban demand for wild meat in Vietnam: Implications for conservation actions. *PLoS One* **11**: e0134787.

"Robust and evidence-based behaviour change programmes to reduce commercial demand for wildlife meat should simultaneously be developed."

Tilker A, Abrams JF, Mohamed A *et al.* (2019) Habitat degradation and indiscriminate hunting differentially impact faunal communities in the Southeast Asian tropical biodiversity hotspot. *Communications Biology* **2**: 1–11.

Tilker A, Long B, Gray TN *et al.* (2017) Saving the saola from extinction. *Science* **357**: 1248.

Tilker A, Nguyen A, Abrams JF (2020) A little-known endemic caught in the South-east Asian extinction crisis: The Annamite striped rabbit *Nesolagus timminsi*. *Oryx* **54**: 178–87.

Timmins RJ, Duckworth JW, Robichaud W *et al.* (2016) *Large-antlered Muntjac:* Muntiacus vuquangensis. The IUCN Red List of Threatened Species 2016: e. T44703A22153828. Available at https://is.gd/u4ueOg (accessed February 2021).

Timmins RJ, Hedges S and Robichaud W (2020) *Saola:* Pseudoryx nghetinhensis. The IUCN Red List of Threatened Species 2020: e. T18597A166485696. Available at https://is.gd/HK30kh (accessed February 2021).

Thomas-Walters L, McCallum J and Montgomery R (2020) A systematic review of conservation efforts using non-monetary, non-regulatory incentives to promote voluntary behaviour change. *SocArXiv Papers*. Available at https://osf.io/preprints/socarxiv/6dhaf/ (accessed February 2021).

Un ES, Nasak C, Hang C *et al.* (2018) Camera trapping in the Cardamom Mountain Landscape, Cambodia, reveals Asian elephant calves with severe injuries from wire snares. *Oryx* **52**: 409–15.

Veríssimo D (2013) Influencing human behaviour: an underutilised tool for biodiversity management. *Conservation Evidence* **10**: 29–31.

Wellsmith M (2011) Wildlife crime: The problems of enforcement. *European Journal on Criminal Policy and Research* **17**: 125–48.

Supplementary information

Supplementary Information Table 1. Terrestrial mammal families in South-East Asia impacted by the snaring crisis.

Family	English Name	Species in South-East Asia	Target for snaring	By-catch from snaring
Muridae	Mice, rats, gerbils	300	x	x
Cricetidae	Hasmsters, voles, lemmings	4	x	x
Sciuridae	Squirrels	94	x	x
Spalacidae	Bamboo rats	4	x	x
Hystricidae	Porcupines	7	x	x
Diatomyidae	Laotian rockrat	1	x	x
Soricidae	Shrews	67	–	x
Erinaceidae	Hedgehogs	7	–	x
Cercopithecidae	Monkeys	45	x	x
Hylobatidae	Gibbons	17	–	x

Supplementary Information Table 1. *Continued.*

Family	English Name	Species in South-East Asia	Target for snaring	By-catch from snaring
Tarsiidae	Tarsiers	10	–	x
Hominidae	Great Apes	3	–	x
Bovidae	Cattle	17	x	x
Cervidae	Deer	23	x	x
Suidae	Pigs	12	x	x
Tragulidae	Chevrotain	6	x	x
Moschidae	Musk Deer	2	x	x
Mustelidae	Weasels-Martens	18	–	x
Felidae	Cats	11	x	x
Canidae	Dogs	5	?	x
Herpestidae	Mongoose	6	x	x
Viverridae	Civets	13	x	x
Mephitidae	Stink Badgers	2	–	x
Ursidae	Bears	2	x	x
Prionodontidae	Linsang	2	–	x
Ailuridae	Red Panda	1	–	x
Leporidae	Rabbits	6	x	x
Ochotonidae	Pikas	2	?	?
Tupaiidae	Tree Shrews	20	x	x
Rhinocerotidae	Rhinoceros	2	x	x
Tapiridae	Tapirs	1	?	x
Manidae	Pangolins	3	x	x
Elephantidae	Elephants	1	–	x

Supplementary Information Table 2. Analysis of the legislation controlling snaring in eight South-East Asian countries.

Disclaimer: the analysis was limited to laws released at the national level only. Furthermore, there is a possibility that additional laws, regulations or guidelines that were not identified here have some role in the control of snaring activities.

	COUNTRY							
	Cambodia	Indonesia	Lao PDR	Peninsular Malaysia[1]	Myanmar	Philippines	Thailand	Viet Nam
Main controlling legislation	Law on Forestry, 2002; Law on Natural Protected Areas, 2008	Act of Republic of Indonesia No.5/1990 on Conservation of Living Resources and Their Ecosystems	Wildlife and Aquatic Law, No. 07	Wildlife Conservation Act, 2010	The Conservation of Biodiversity and Protected Areas Law (The Pyidaungsu Hluttaw Law No 12/2018)	Wildlife Resources Conservation and Protection Act; National Integrated Protected Areas System (NIPAS) Act of 1992 (Republic. Act No. 7586)	Wildlife Preservation and Protection Act B.E. 2562 (2019); National Park Act B.E. 2562 (2019)	Criminal code No100/2015/QH1; Decree No. 06/2019/ ND-CP on Management of Endangered, Precious and Rare Forest Plants and Animals and Implementation of CITES; Decree 35/2019/ND-CP
Most recent update of primary controlling legislation	2008	1990	2007	2010	2018	2001	2019	2015 and 2019
Does law mention snares by name?	NO	NO	NO	YES	NO	NO	NO	YES[2]
Does law mention traps by name?	YES	NO	YES	YES	NO	NO	YES	YES
Are either 'snare' or 'trap' defined in the law?	NO	NO	NO	YES	NO	NO	NO	NO
Is the use of snares in protected areas prohibited under law?	YES Snaring falls under 'hunting'	YES Snaring falls under 'catch, injure, kill'	YES Snaring falls under 'hunting'	YES	YES Snaring falls under 'hunting'[3]	YES Snaring falls under 'hunting' and 'collecting'[4]	YES Snaring falls under 'hunting'	YES

[1]Different wildlife protection statutes are in force in Sabah (*Wildlife Conservation Enactment 1997*) and Sarawak (*Wildlife Protection Ordinance 1998*). These laws are generally viewed as weaker than the Wildlife Conservation Act, 2010 (see Krishnasamy and Zavagli [2020]).

[2]Although not in the law itself, Resolution 05/2018/NQ-HDTP which guides the interpretation of the relevant criminal code provision (234) clarifies that: "Using prohibited hunting tools or equipment means use of weapons, poisonous arrows, explosives, toxins, tunnels, pits, plugs, big traps, trapping plugs, *snare traps*, electric traps, anchor traps, large iron teeth, or other dangerous tools and equipment prohibited from use for hunting by the competent authorities" (our emphasis). Note however, that the term 'prohibited hunting tools' used here, does not match the term 'banned hunting equipment' used in the criminal code.

[3]Hunting means "any method used to harm, catch or kill wildlife. This definition includes transporting wildlife without permission".

[4]Snaring falls under 'hunting' in section 20(a) of the *National Integrated Protected Areas System (NIPAS) Act* and 'collecting' in the *Wildlife Resources Conservation and Protection Act*.

Supplementary Information Table 2. *Continued.*

	COUNTRY							
	Cambodia	**Indonesia**	**Lao PDR**	**Peninsular Malaysia[1]**	**Myanmar**	**Philippines**	**Thailand**	**Viet Nam**
Are there minimum penalties for 'trapping / snaring' inside a Protected Area? [minimums for imprisonment and fines]	SPECIES DEPENDENT 1 year *and/or* 10 million Riels [~$2,400] for hunting rare species (Law on Forestry) 100,000 Riels [$24] (Law on Natural Protected Areas) 1 year *and/or* 15 million Riels [$3,600] for vulnerable, rare, for critically endangered wildlife species (Law on Natural Protected Areas)	NO[5]	SPECIES DEPENDENT 3 months – for prohibited category species only	YES[6] 50,000 ringgit [~$11,500] 100,000 ringgit [~$23,000] for the hunting of nine species afforded highest protection	YES 300,000 kyats [~$200] *and/or* jail time upon conviction 3 years for hunting a 'completely protected animals'	YES These vary based on protection category: *hunting unprotected species* – 10 days *and* 5,000 peso [~$100] *hunting critical species* – 2 years *and* 30,000 pesos [~$600] *killing unprotected species* – 6 months *and* 10,000 pesos [~$200] *killing critical species* – 6 years *and* 100,000 pesos [~$2,000]	SPECIES DEPENDENT 3 years *and/or* 300,000 bhat [~$9,500] for preserved (rare) wild animals	YES From 6 months to 3 years or from 50,000,000 VND to 300,000,000 VND [~$12,800]
Snare use prohibited outside protected areas	PARTIAL for rare and endangered species only	PARTIAL for protected animals only	PARTIAL for prohibition category species only	YES	PARTIAL for all classes of protected wild animals *and* for any animal without license	PARTIAL without permit or protected classes of species	PARTIAL for all preserved or protected wild animals	PARTIAL Some prohibition on snare use in other forest types (*e.g.* production forests)[7] and prohibited in natural forests
Possession of snares prohibited in protected areas	NO	NO	NO	YES	NO	NO	YES[8]	NO
Possession of materials that can be used to make snares prohibited in protected areas	NO	NO	NO	NO	NO	NO	NO[9]	NO

[5]Under Indonesian law only maximum sentences are defined. For snaring offences involving the capture or killing of a protected animal these would be "imprisonment up to a maximum of 5 years and a fine up to a maximum Rp. 100 million".

[6]Note that imprisonment is also stated as mandatory for these offences but no minimum timeframe is stated.

[7]As specified through Decree no No.156/2018/ND-CP on enforcement of a number of articles of the law on forestry.

[8]National Park Act B.E. 2562 (2019) Section 19 (7): "within the national park, *no person shall take in any gear for hunting or catching animal* or any weapon. Whoever acts in contravention of the provisions of Section 19 (7) shall be punished with a fine not exceeding 10,000 Baht" (our emphasis).

[9]This may depend on the interpretation of the term 'gear' in National Park Act B.E. 2562 (2019) Section 19 (7). No direct evidence of charges being brought against those possessing materials that could later be converted into snares was uncovered during this review.