Emerging trends of the illegal wildlife trade in Mesoamerica

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SUPPLEMENTARY MATERIAL 1 Full list of the 25 suggested emerging trends in the horizon scan, ranked by their likelihood of occurrence. The top 15 trends are written in full, with short summaries of the other 10 suggestions.

(1) Criminal groups becoming more professional in wildlife trafficking Criminal activity in wildlife trafficking is becoming more organized and sophisticated (Pires et al., 2016), and is adapting quickly to emerging markets for wildlife products through globalization. Traffickers increasingly work as criminal syndicates with established networks and transport facilities. Advancements in technologies, such as the internet and mobile devices, open lines of communication for criminals to extend the reach and sophistication of their networks beyond the Americas. The infrastructure and networks used to traffic other illicit goods, for example drugs and livestock, can simultaneously be used for wildlife trafficking.

(2) New unofficial border crossing points being used as pathways for trafficking wildlife within the region New trafficking pathways across international borders are created by deforestation, construction of new infrastructure, and human population growth, leading to the colonization of previously uninhabited areas near borders. Traffickers use unofficial border crossing points on land and at sea, to circumvent border checks. In this way, wildlife species are moved across borders by traffickers, especially at night, through rivers, forests, human settlements and maritime routes. Further population growth will render these unofficial crossings, and the routes they serve, increasingly accessible.

(3) Digital platforms increasingly used for interaction in Mesoamerica A notable increase in information about illegal wildlife trade is reaching citizens in Mesoamerica, particularly through platforms such as Facebook, WhatsApp and Twitter. Facebook reports 40 million active users per month across the region (Facebook, 2017). The growing use of these online forums has increased exposure of illegal wildlife trade, providing citizens with the opportunity to report and advocate against wildlife crimes. The challenge will be to use social media to promote more action from citizens and responses from enforcement authorities to address illegal wildlife trade. Conversely, the availability and widespread use of these platforms will probably continue to support the sale of wildlife species through an online black market.

(4) High value tropical timbers face growing levels of exploitation Timber has been unsustainably exploited throughout Mesoamerica to meet the growing global demand for precious hardwoods for furniture and musical instruments. This high demand promotes a black market for certain tree species. Controls placed on species listed as threatened in the IUCN Red List and/or listed under CITES may have diversified demand to other timber species that could subsequently become threatened. For example, there has been a notable increase in demand for rosewood species (Vaglica, 2016) such as cocobolo *Dalbergia retusa*, which has added to existing pressures on hardwood species. An increasingly varied range of timber species may be unsustainably exploited and require protection.

(5) Rare and newly identified species of amphibians and reptiles increasingly targeted by pet traders and collectors Market demand has continued and increased for New World species, which includes all Mesoamerican reptiles and amphibians. There is high demand for lizards (*Abronia* spp.*, Ctenosaura* spp.*, Heloderma* spp.) from Guatemala and Mexico, and for frogs and toads (e.g. *Dendrobatidae* spp.*, Atelopus* spp.*, Agalychnis* spp.*, Centrolenidae* spp.) from Panama and Costa Rica. Newly discovered, rare and restricted-range species are most at risk of extinction (Auliya et al., 2016) as a result of increasing demand from domestic and international markets (Altherr et al., 2016). Amphibians and reptiles seized abroad (mainly in the USA and Europe) generally end up in foreign collections and are not returned to their countries of origin. The region is particularly vulnerable to illegal wildlife trade given the large numbers of known species (> 1,200 reptile and amphibian species included in the IUCN Red List 2018), the limited capacity to implement regulations for the 32 CITES-listed species (CITES, 2019) and the regularity with which new species are discovered.

(6) International demand for wild meat and traditional medicine threatening marine species There is a growing international demand for products used in Traditional Asian Medicine and as seafood. Marine species that were historically rarely targeted in Mesoamerican waters, such as glass eels and sea cucumbers, are now being harvested unsustainably and illegally, particularly for the Asian market, where these species are highly valued. The fact that closed seasons are not synchronised or established in neighbouring countries, for example in the case of sea cucumbers in Mexico and Belize, makes it difficult to apply controls and opens opportunities for illegal practices. The lack of historical data on the population and harvesting of these species in the region renders monitoring and evaluation, and thus the setting of sustainable catch limits, problematic. Trafficking of such species to Asian countries such as China will probably continue to increase.

(7) Chinese multinational corporations creating more links to Asia Investment in Mesoamerica from Chinese multinational corporations has increased since the 2000s, but especially in the 2010s, with the construction of roads, airports, railways and other infrastructure. Free trade agreements between Asia and Latin America have grown (Estevadeoral et al., 2014) and China has invested USD 250 billion into Latin America and the Caribbean during 2015–2019 (Dollar, 2017). This has resulted in an increase in the movement of goods and people between Mesoamerica and Asia and may create pathways for wildlife trafficking. The increasing population of Chinese nationals within Mesoamerica (Mazza, 2016) is expected to lead to a rise in domestic demand for certain wildlife products.

(8) Increasing demand for birds and small mammals in the pet trade Birds of the family Psittacidae (parrots, parakeets and macaws) and small mammals maintain strong buyer demand and are increasingly targeted for the illegal pet trade. Trafficking of species within these groups is driven by shifting trends in regional and international markets (i.e. what is considered fashionable at a point in time). Although the level of interest in particular species may vary, the continued high demand for these groups in general, coupled with the decimation of wild populations through other environmental pressures, poses a threat to their survival and requires greater vigilance.

(*9) Land clearance increasing access to wildlife species for trade* Deforestation and construction of new infrastructure have increased access to previously isolated wilderness areas within Mesoamerica. The resulting increased proximity of people and wildlife, exacerbated by high rates of human population growth and associated rural and urban expansion, can facilitate access to, and exploitation and transportation of wildlife species.

Large-scale agricultural development across the region, such as oil palm in Honduras and Guatemala, sugar cane in Belize and Guatemala, and cattle ranching in Nicaragua, Honduras and Guatemala, amongst others, will probably lead to further land clearance and loss of habitat for many species already facing numerous threats.

(10) Timber traceability evolving at the sawmill level Timber traceability mechanisms have evolved with a focus upon long-term forest logging concessions, especially those with certifications from, for example, the Forest Stewardship Council. However, tracing timber is problematic when illegally cut from protected areas, extracted under short-term or fraudulent timber licences, or from areas cleared by large-scale agricultural developers. Once at the sawmill, timber from protected species can be mixed with other non-protected species and laundered into the regional and international legal trade. Weak enforcement of laws and regulations, low detection and prosecution rates, and small penalties, provide little deterrent against the harvest of protected species. Timber traceability methods are therefore evolving to address laundering at sawmills.

(11) New trade routes expanding wildlife trafficking pathways internationally Mesoamerica has expanded its global economic reach to additional markets, with the negotiation of several trade agreements across new regions (World Bank, 2013). These new connections have opened trade routes and potential markets for wildlife products and live trade. The economic growth of destination countries also creates more opportunity to use these trade routes for the trafficking of valuable wildlife species. Although the USA is the largest importer of wildlife from the region (UNEP-WCMC, 2014), it is increasingly being used as a transit route to traffic wildlife species to these new international markets (Goyenechea & Indenbaum, 2015).

(12) Xylotron timber scanner advancing law enforcement capacity The Xylotron (Hermanson & Wiedenhoeft, 2014) is a timber scanner that is being trialled at a national and regional level by the Wood Forensic Laboratories in Guatemala City, Guatemala, and San Pedro Sula, Honduras, for automatically identifying the species of timber samples. This scanner can help tackle illegal logging by providing enforcement agencies with a more accurate method of wood identification and adding to a worldwide species reference database (Koch et al,, 2015). Designed at the U.S. Department of Agriculture Forest Product Laboratory, the Xylotron is being tested by several institutions and government agencies in Mesoamerica, with funding and technical support from the U.S. Forest Service.

(13) More accessible technology becoming available to combat wildlife crime More sophisticated technology has been coming into Mesoamerica, with options to access software on mobile phones and other devices. This exposure to technology facilitates greater use of geospatial tools such as *CyberTracker* (CyberTracker Conservation, Cape Town, South Africa), *ArcGIS* ([company,) and GPS trackers disguised as wildlife (Baraniuk, 2017), which can assist with anti-poaching efforts and commercial timber tracking on the ground. Since Belize piloted the Spatial Monitoring and Reporting Tool in a marine environment for the first time in 2014, this technology is increasingly being adopted across Mesoamerica and has been used in terrestrial and marine sites in Belize, Guatemala, Honduras, Nicaragua, Costa Rica and Mexico.

(14) Smaller wildlife species being targeted by traffickers Experts have observed an increased demand for smaller wildlife species, presumably facilitated by the fact that these are easier to transport without being detected and harder to identify by law enforcement agencies. Species that have been targeted have included miniature orchids, reptiles, amphibians, spiders and

insects for hobbyists, collectors and the pet trade. It is possible that the global trend towards urbanization and associated shift to smaller living spaces has been driving the demand for these smaller species (Reuter & Mosig, 2010).

(15) Satellite technology being used to trace illegal logging at the source As the value of sustainable forest management is being recognized, there has been an increased development of timber traceability systems. The advancement in satellite technology in particular has provided the opportunity to improve monitoring of natural resource use in remote areas. For example, the UK Space Agency awarded a GBP 5.3 million grant to Guatemala in 2017 to develop satellite remote sensing and Global Navigation Satellite Systems for the detection and analysis of forest cover loss (British Embassy Guatemala City, 2017). In addition to providing intelligence for enforcement agencies, this technology could also potentially extend traceability to other commercially exploited wildlife species.

(16) Less investment reaching Mesoamerican wildlife species Wildlife species with declining populations in Africa and Asia have benefited from improved levels of protection and enforcement. Although more conservation attention is given to these species, demand for wildlife products shows no signs of abating. This could result in a shift to species occurring in the Mesoamerican region, where enforcement is currently weaker and therefore obtaining wildlife products is easier and lower-risk. One example is the increased demand for sea cucumbers and American eels. It is also possible that tiger bones could be substituted by bones of jaguars or other Mesoamerican felids.

(17) Wildlife threatened by diets of new Asian settlements The arrival of new Asian settlements in parts of the region has seen an increased local demand for wildlife species such as crocodiles, manatees and other marine wildlife, to be used as food or in Traditional Medicine. This could lead to unsustainable consumption patterns of previously unexploited species from across Mesoamerica.

(18) Venomous and poisonous species targeted for biomedicine The demand for venomous snakes and poisonous frogs has increased for use in biomedicine. Toxins can be gained from the venom or poison of these species and used in scientific research. This bioprospecting is also occurring in other animals such as spiders and some marine species.

(19) Green judiciary improving environmental justice There has been an increasing focus on strengthening the justice system with regard to environmental crime, with the aim of improving prosecution rates and ensuring that adequate sentences are imposed. For example, considerable progress has been made in recent years in Northern Guatemala, through the creation of specialist courts and the training of judiciary in environmental crime cases.

(20) Cruise ships and private boats being used as vehicles for trafficking wildlife Cruise ships and private boats can provide an easy way for traffickers to transport wildlife that cannot be traded legally, as the thoroughness of port inspections varies among different Mesoamerican countries and ports. Generally, few checks are carried out across the region on private boats, cruise ship tourists and even fewer on cruise staff, and traffickers can thus select routes to avoid controls. It is also possible that wildlife or wildlife products may be sourced legally, but illegally transported without the appropriate permissions.

(21) Salamanders being targeted for the pet and medicine trades There is a developing interest for salamanders within the illegal pet trade. Because their microbiome has medical

properties, salamanders have also been targeted for trade in medicine. The salamander population has already declined as a result of infection with the chytrid fungus *Batrachochytrium salamandrivorans* and any additional pressures from the illegal trade put the species at risk of extinction.

(22) Improving economy driving regional demand for wildlife species The improvement of the economy within the region and the associated growth of a middle class population have resulted in households having more funds available to purchase illegally sourced wildlife products. This could lead to increasing regional consumption of wildlife, such as sea turtle eggs, iguana, conch and shark meat, reptile skins and valuable hardwoods. The development of this trade can remain undetected when it stays within national borders.

(23) Sniffer dogs being trained to detect wildlife species Sniffer dogs have started being used in the region, mainly in Costa Rica, for identifying trafficked timber such as mahogany and cedar wood. This has the potential to extend to the identification of other wildlife species and could follow the example of sniffer dog programmes in Uganda and Galapagos. As with other regions that use sniffer dogs in law enforcement, it may be a challenge to focus on the trafficking of wildlife species rather than prioritizing other illicit goods such as drugs.

(24) Clandestine airports being used for trafficking wildlife Clandestine airports and small aeroplanes can provide an alternative method for trafficking wildlife. Some reports were made of roads being closed off to be used as informal landing strips. The higher cost of this method of transportation increases the price of the products and is most likely reserved for higher valued commodities. In instances where air strips are built for this purpose, they are sometimes found in protected areas, where they are closer to targeted species.

(25) Rooster fights and curio trade driving demand for marine turtle shells There have been some reports of a recent increase in the demand for hawksbill turtle *Eretmochelys imbricata* shell cuttings in areas such as Panama. The shells of this Critically Endangered marine turtle are carved and used as artificial spurs in rooster fights, and for jewellery in the curio trade.

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