


WILDLIFE TRAFFIC RESEARCH

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Introduction

The scope of work of this consultancy:

1. Assessment of scientific and technological innovations for IWT monitoring and law enforcement
2. Stakeholder mapping of key players, including demand and supply side, on IWT in the Philippines
3. Review of valuation studies (demand analysis and economic valuation opportunity costs, and use and non-use values) on top ten species in IWT based on confiscation records of the DENR-BMB for the last 10 years and current online trade, as inputs to demand reduction measures and policy development; and,
4. Preparation of selection criteria, and recommendation on priority species for economic valuation studies, Communication, Education and Public Awareness (CEPA) and demand reduction measures.

This report covers all 4 deliverables. This was written in a "FAQ format". The following are the major sections of the report:

1.0. Review of Literature.
2.0. Key findings
2.1. What is the demand?
2.2. Wildlife most traded illegally
2.3. Who are the stakeholders in IWT?
2.4. IWT Buyer profiles and purchases
2.5. What are the drivers of IWT? Why do they buy?
2.6. What are the usual channels? Where do they buy?
2.7. What are consumer demand studies in the Philippines?
2.8. What are the technology applications in IWT monitoring and law enforcement?
3.0. Key take-aways and Recommendations

1.0 Review of Literature.

Fifty_publications were reviewed. These papers were grouped according to the following themes that emerged: 1. Consumer Research Summarizing Demand, 2. Animals most traded illegally; 3. Buyer profiles and purchases; 4. Drivers of IWT; 5. Trade channels; 6. PH consumer demand studies (See Table 1.). There is a dearth of published literature on IWT in the Philippines, most of which are reports (grey literature). These were used to assess our current understanding of global and national IWT trends. Table 1 below provides a template for tracking published literature on IWT.

Table 1. Summary table of papers reviewed

Theme	Country	Key topic	Publication and 35 apps/systems evaluated (Please see section)
1. Consumer Research Summarizing Demand	Southeast Asian countries (India, Thailand, Indonesia, China, Vietnam,Singapore), UK, Norway, Colombia, Brazil	Scale of IWT; Statistics of wildlife demand; Corruption; Link of cultural/traditional practices to demand; Concerns in animal welfare in the context of wildlife crimes;	van Uhm (2012); Sollund & Maher (2015); WWF (2006); Oxford Martin School, (2006); Nijman, (2010); Sobrevila, (2016); Challender et al (2014); Burgess et al (2018); Wyatt et al (2017); UNODC (2010); Kurland et al (2017); Baker et al (2013); World Bank (2018) ; Goh and O'Riordan (2007); Shipping et al (2006); Oldfield (2003), World Bank (2014); Global Environment Fund (n.d.), Dduffy & Humphreys (2014)
2. Animals most traded illegally	Philippines, China, Vietnam, Thailand, Indonesia, Malaysia	Non-native species; On legalizing a certain trade; wildmeat demand in Vietnam; bats hunted for bushmeat;	Lawson & Vines (2014); USAID Wildlife Asia (5 June 2018); Drury (2011); USAID Wildlife Asia (12 June 2018); Mickleburgh et al (2009); Nijman (2010); TRAFFIC (2015); Wittman et al (2017); Krishnasamy and Stoner (2016); Jenkins et al (2018); Mickleburgh et al (2009)
3. Buyer profiles and purchases	China, Thailand, Vietnam	Key consumer profiles; kinds of wildlife products commonly purchased; purpose of buying wildlife products;	USAID Wildlife Asia (5 June 2018, 12 June 2018); Siriwat & Nijman (2018); Challender et al (2014); Vique (2018); CITES (2019); Burgess et al (2018); Sobrevila (2016); Mulliken and Crofton (2008); Phelps (2015); Phassaraudomsak, and Krishnasamy (2018); Hinsley et al (2015); Vigue (2018);

		consumer behavior	Vogler et al (2017); Hanley et al (2017);
4. Drivers	China, Vietnam, Thailand	What entices people from buying wildlife products?; Socioeconomic standing; aesthetics, souvenirs, etc.; medicinal properties; functional and symbolic properties to the individual owner/buyer	USAID Wildlife Asia (5 June 2018); USAID Vietnam (Dec 2018); USAID (n.d.); Truong et al (2016); Lawson & Vines (2014)
5. Trade channels		Efficiency of transportation and logistics sectors; HealthMap Wildlife Trade; export nodes; wildlife trade data; trade hubs;	TRAFFIC (2015); Clifton & Rastogi (2016); Hansen et al (2012); Patel et al (2015); Belmaker (2018); Nijman (2010); Aloysius (2019), IUCN et al 2015
6. PH consumer demand studies		Reptiles in the PH sold through private FB groups; WildLEAP; IWT in the PH	Sy (2018); Mayuga (2018); Asian Development Bank (n.d.); Canlas et al, 2017

2.0. Key Findings:

2.1. **What is the demand?**

The magnitude at which wildlife is harvested and traded since the 1990s is staggering. For example, some 88 million wild orchids, 6.2 million wild-caught live birds, and 7.5 million live-caught reptiles were traded globally between 1996 and 2001 (WWF, 2006). In the study conducted by Nijman in 2010, an estimated 34 million animals were traded globally from year 1998-2007 alone. Since the 2010 study of Nijman, the wildlife trade seemed to be a continuously expanding business (van Uhm, 2012). On a global perspective, environment and natural resource crimes is a growing industry worth $213 billion (World Bank, 2014). In countries like the United Kingdom, Norway, Colombia and Brazil, the scale of the Illegal Wildlife Trade (IWT) was currently estimated to be worth between 6 and 20 billion dollars annually (Sollund & Maher, 2015). To illustrate the magnitude of the trade, Table 2 below

shows the major exporter and importer countries for major taxa groups during this period all over Southeast and the Pacific region.

The most traded animals reported are the seahorses (15.95 million individuals) and reptiles (17.43 million) 1998-2007 (Nijman in 2010). China and Hong Kong are the largest consumer of wildlife trade in Southeast Asia, followed by EU and USA. Developing countries like Thailand, Viet Nam, Indonesia, Malaysia and Philippines are the common source of the wildlife products and probably also serve as transit route for illegal products passing to exporting countries like China and Japan.

Table 2. Volume of globally traded wildlife 1998-2007 indicating origin and destination (Nijman in 2010).

Species Group	Purpose	Origin	Destination	Number of Traded Individuals
Butterflies				
Birdwings	Curio market	Indonesia, Malaysia, China Philippines	EU and USA	306,0000
Seahorses				
Seahorses	Traditional medicine	Thailand, Viet Nam, Indonesia	China, Hongkong SAR, Taiwan, Poland	15.95 million
Fish				
Napoleon Wrasse **Arapaima** **Bala shark** **Arowana** **Harlequin rasbora**	Aquarium trade, food market	Malaysia, Indonesia	China, Hongkong SAR	73,000
Reptiles				
Softshell turtle **Box Turtle.** **Cobra** **Pythons** **Monitor lizard** **Crocodile** **Geckos**	Turtles for their meat and carapaces for Traditional Chines Medicines, Snakes, lizards and crocodiles for their skins and as pet	Indonesia, Malaysia	Singapore, EU, Japan	17.43 million
Mammals				
Macaques ***Macaca sp*** **Leopard cat** ***Prionailurus sp.***	Skins for biomedical industry, Pangolin meat	China, Malaysia, Indonesia	EU, Singapore	388,000

Pangolin *Manis sp.*	and scales for Traditional Chinese Medicine			

The diversity of animals and plants coupled with cultural practices such as traditional medicine in Asia and rapid urbanization makes this region predisposed or susceptible to wildlife trade. Asia, particularly China and Southeast Asia, are focal points for the supply and demand of certain wildlife products such as ivory, reptile skins and live reptiles (Wyatt et al., 2017). In 2010, there was a global average of 92 ivory seizures a month, equivalent to about 3 per day. The following graph (Figure 1) indicates the quantities of ivory seized annually worldwide between 1989 and 2009 (United Nations Office on Drugs and Crime, 2010). Its total amounts to more than 361 tons of ivory.

Ivory is believed to protect its owner and enhance their power and popularity. Common ivory products are for accessories, amulets and sacred statues, spiritual items, or decorative. Reasons for purchase are mostly spiritual and aesthetic. Ivory users, particularly those who purchase, hold a stronger perception of the its potential benefits. Tiger products, on the other hand, have a narrower price range than ivory. They are said to protect the user from physical and supernatural harm. Like ivory, tiger products are purchased for spiritual purposes, seconded by social image. The source of beliefs are either ancestral or online searches and discussions. The USAID Wildlife Asia (2018) reports that the purchase/trade of ivory products is perceived as acceptable to 10% of Thais. Three percent say that they will probably/definitely buy ivory in the future. Majority of those who use/own tiger products made the purchase themselves. Spiritual items are most popular. Apart from online channels, purchasing transactions take place often in amulet markets/temples, followed by relatives/friends/acquaintances. Compared to non-users, users perceive more benefits to tiger products.

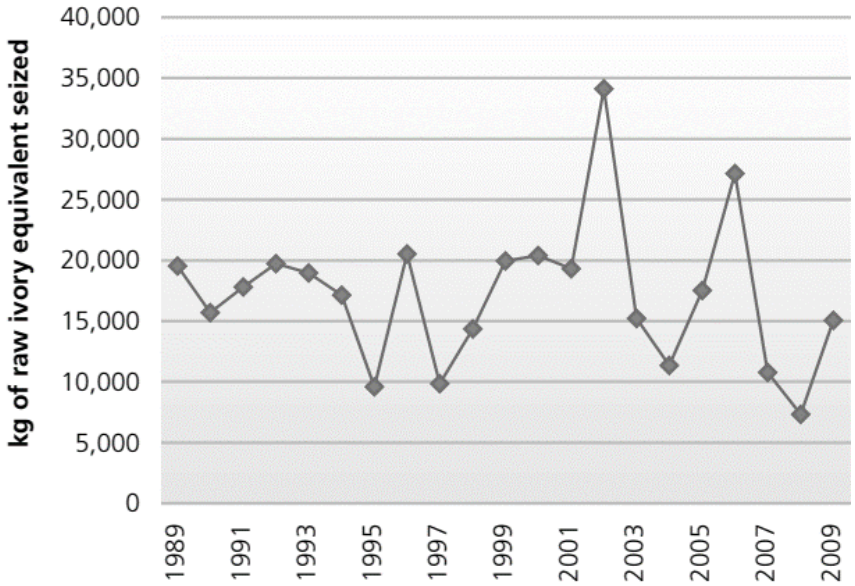

Figure 1. Quantities of ivory seized annually and recorded in the elephant trade information system from 1989-2009. Source: United Nations Office on Drugs and Crime (2010). *The*

globalization of crime: A transnational organized crime threat assessment. United Nations publication.

Rapid economic development has led to a rise in disposable income in many Asian countries, thus increasing the demand for wildlife products (Oxford Martin School, 2016). Wildlife crimes, based on a few conservation literatures, are placed among more traditional crime categories. Crimes that concentrate in time and space, among products, along certain routes, and at particular facilities (Kurland et al, 2017). Corruption is a key facilitator of this (IWT) profitable and pervasive global black market, but limited research has explored exactly what that corruption looks like and how corruption enables wildlife to be trafficked. Whilst it is known that Individual corrupt acts enable wildlife trafficking to happen corrupted structures (the criminal justice system, and economic and political foundations) in some societies enable trafficking to happen and also increase the resilience of trafficking to reduction measures (Wyatt et al 2017).

An emerging issue associated with efforts to combat these criminal activities is animal welfare i.e. pre and post operations/seizure or post operation rehabilitation. In a review paper by Baker et al (2013), IWT was analyzed according to three welfare impact categories: 1) animals that were killed on-site; 2) captured, transported, and killed; and 3) used and alive (See figure 2). Improving animal welfare was the least likely recommendation in cases wherein the animals were killed on site, and it was the most likely recommendation where animals were used alive.

This study clearly underlined the issue that animal welfare needs to be seen not as an isolated peripheral interest but as associated with wider concerns that conspicuously affect our collective future and that collaboration between conservationists and animal welfare advocates might prove mutually beneficial. This way, human health and animal welfare levers might be better developed to influence trade in a way that benefits people and wildlife

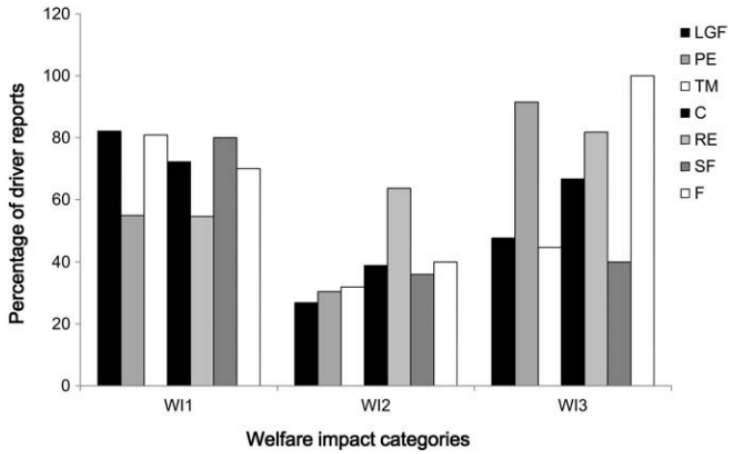

Figure 2. Welfare Impact categories. Source: Baker, S., Cain, R., van Kesteren, F., Zommers, Z., D'Cruze, N. & MacDonald, D. (2013). Rough trade: Animal welfare in the global wildlife trade. *Bioscience, 63(12)*: 928-938. Abbreviations: LGF = luxury goods and food; PE = pets and entertainment; TM = traditional medicine;

The complexity of the IWT issue is worsening as legality is often ambiguous and regulation efforts are frequently hampered by corruption (Oxford Martin School, 2016). As

species become scarcer, their rarity can make them more attractive, further increasing their demand. However, wildlife trade should be seen as just one of the actors in this complex interaction (Nijman, 2010). Proposed interventions need to fundamentally change consumer behavior while disrupting the IWT routes at the same time (Sobrevila, 2016). Notwithstanding the need for integrated approaches to address the IWT, it is by understanding human behavior that we can begin to target consumers to change their preferences and purchasing behavior (Challender et al., 2014; Burgess et al., 2018). To combat wildlife crimes, the World Bank, along with the Global Environment Facility, developed the Global Wildlife Program (GWP) in 2018. Twenty national projects in Africa and Asia are what the GWP is comprised. These select countries are provided technical assistance and coordination delivered by the WBG and the UN Development Programme (UNDP). The Philippines is a part of the GWP.

2.2. Wildlife most traded illegally

To meet the increasing demand from growing middle classes worldwide, elephants and rhinos are primary targets of poachers and armed non-state actors across Africa (Lawson & Vines, 2014). In Thailand, Ivory is perceived as an acceptable product in the market. So are tiger parts and products (USAID Wildlife Asia, 5 June 2018). Wildmeat in Vietnam is a major demand driven by the need for animal protein in the absence of common livestock sources (Drury, 2011). The sale of pangolin, tiger, rhino horn, and elephant/ivory products are prevalent in several Chinese major cities (USAID Wildlife Asia, 12 June 2018). Bats hunted for bushmeat are rampant across Asia and Pacific Island regions (Mickleburgh et al., 2009).

Between 1999-2009 (Table 3), majority of confiscated illegally traded animals were reptiles which originated from Malaysia and Indonesia whilst the Philippines appears to be a major source for corals. Pangolins are the most illegally traded mammals in the world, consumed for their meat as delicacy, scales for its traditional medical values and their skins for making leather products. The key findings below (Figure 3) show the summary of seizures for period 2010-2015 by Heinrich et al published as TRAFFIC Report in December 2017.

Table 3. Illegally exported wildlife within Southeast Asia for the period of 1999 -2009. As cited by Nijman (2010)

Taxa	Origin and period	Remarks
Seahorses	Indonesia	August 2009: Approx. 1,000,000-2,000,000 individuals, , dried, confiscated in Poland
Monitor Lizards	Malaysia	Nov –Sep 2009: Approx 15,332 individuals
Geckos	Indonesia	Nov 2006: Approx 1,200,000; illegally exported in dried specimen
Tortoises	Indonesia, Malaysia	2008: Approx 2,022,000; illegal; export
Snakes	Malaysia, Indonesia, Myanmar	1999-Jan 2009: Approx 500,160; exported through Ruili, China
Owls	Malaysia	Feb-Jan 2009: Approx 1,500
Pangolins	Indonesia, Vietnam, Thailand	2006-Jan 2009: 9,575; Seized in China

Corals	Malaysia, Philippines	Sep 2007-Feb 2009: Approx 45,000 kg; confiscated in UK, Argentina and USA

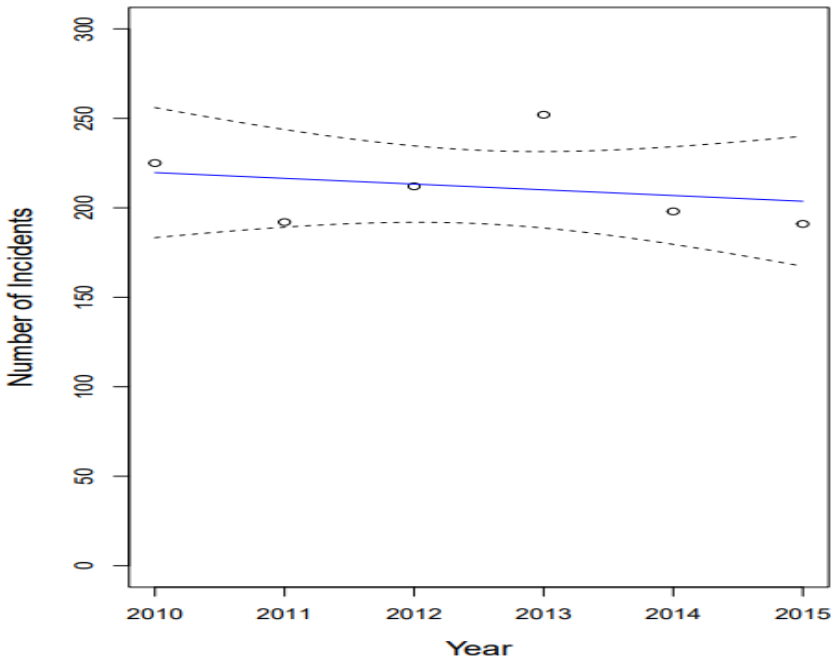

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Figure 3. Source: Wittman, S., Ross, T.A., Shepherd, J.V., Challender, C.R., W.S., D. & Cassey, P. (2017). *The global traddicking of pangolins: A comprehensive summary of seizures and trafficking routes from 2010-2015.* TRAFFIC: Petaling Jaya, Selangor, Malaysia.

In the Philippines, based on the records of confiscated animals (DENR 2010-2019), a total of 45,796 specimens belonging to 192 species were confiscated within a 10-year period or an annual average confiscation of ca.4,500 specimens. It must be noted here that many entries in the database have questionable entries specifically on the identification (Latin and English/common names).

The total estimated value of these confiscated wildlife is PhP 132,596,230. These specimens belong to various taxonomic groups and the breakdown is as follows: 75 species of birds (n=4,103 specimens), 66 species of reptiles (n=30,864 specimens where 9,228 pieces are marine turtle eggs), 24 species of mammals (n=3,462 specimens), 20 species of arthropods (n=6,266 specimens), 5 species are plants (n=1,006 specimens) and 2 species are amphibians (n=113 specimen). Birds reptiles and arthropods are the most traded species (see Figure 4 below). In terms of species richness of confiscated specimen, birds (75 species) is highest, followed by reptiles. In terms of volume, reptiles constitute ca.67% of all the confiscated specimens. By sheer volume alone, half of the estimated value of confiscated wildlife is attributed to the reptiles (See Table 4). At the species level, the geckos, pangolins, hill myna and Asian terrapins make the top five most confiscated wildlife (Table 5). In terms of value, the top ten wildlife such as the pangolins, popular exotic parrots and mynas, turtles (Table 6) constitute 97.7% of the total estimated value of all confiscated wildlife in the recent 10 year period.

Consistent to many reports, the confiscation hotspots appear to be NCR, Palawan, Calabarzon and Regions 3, 7, 11 and 13 (see Figure 5). However, there seems to be a constant decline in the number of confiscations annually from the baseline on 2010 but with moderate spiking in 2017-2017. This may be attributed to the high demand for reptiles (Figure 6). There is also a marked improvement from the 2010 baseline, in the response towards IWT by the filing of appropriate cases.

Table 4. Estimated value of confiscated wildlife per taxonomic group.

Taxonomic group	Sum of Estimated Cost
Reptile	110,201,630
Bird	68,827,800
Mammal	47,330,200
Arthropod	4,886,350
Flora	1,074,600
Amphibian	275,650
Grand Total	**232,596,230**

Table 5. Top ten most traded species based on quantity/volume criteria

Species	Quantity confiscated
Gekko gecko	7558
Manis culionensis	3143
Gracula religiosa	1492
Cuora amboinensis	1153
Trachemys scripta elegan	993
Siebenrockiella leytensis	990
Eretmochelys imbricata	882
Nepenthes spp.	616
Tanygnathus lucionensis	496
Cypripedium reginae	347

Table 6. Top Ten species based on value criteria

Species	Sum of Estimated Cost
Manis culionensis	43,970,500
Cacatua galerita	31,835,000
Cuora amboinensis	10,061,000
Cacatua moluccensis	8,320,000
Probosciger aterrimus	7,904,000
Eretmochelys imbricata	7,226,000
Gracula religiosa	7,165,000
Cacatua goffiniana	5,220,000

Chelonia mydas	5,080,000
Siebenrockiella leytensis	2,503,000
Grand Total	**129,554,500**

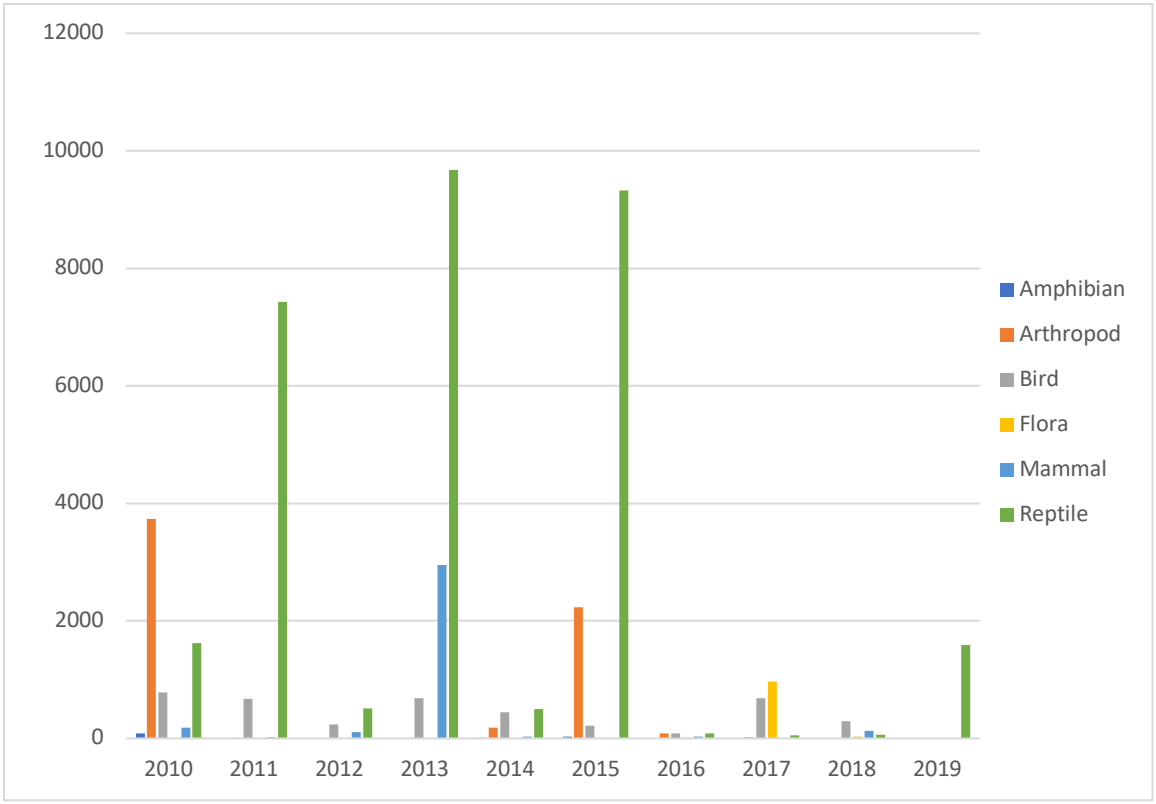

Figure 4. Annual confiscations per taxonomic group in the Philippines

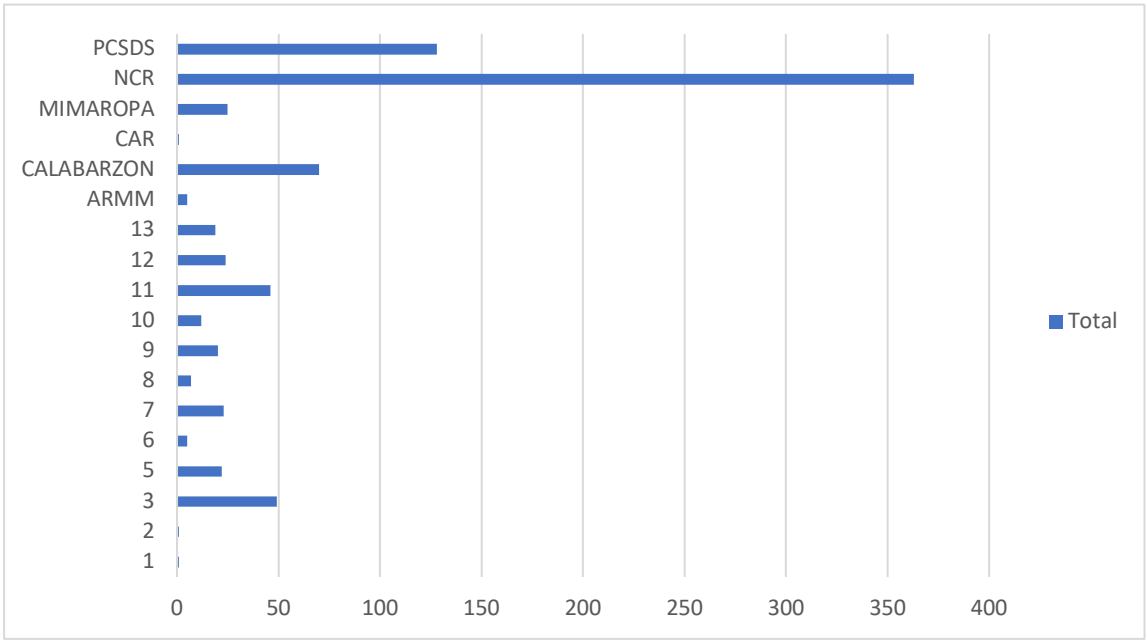

Figure 5. Number of confiscations per region

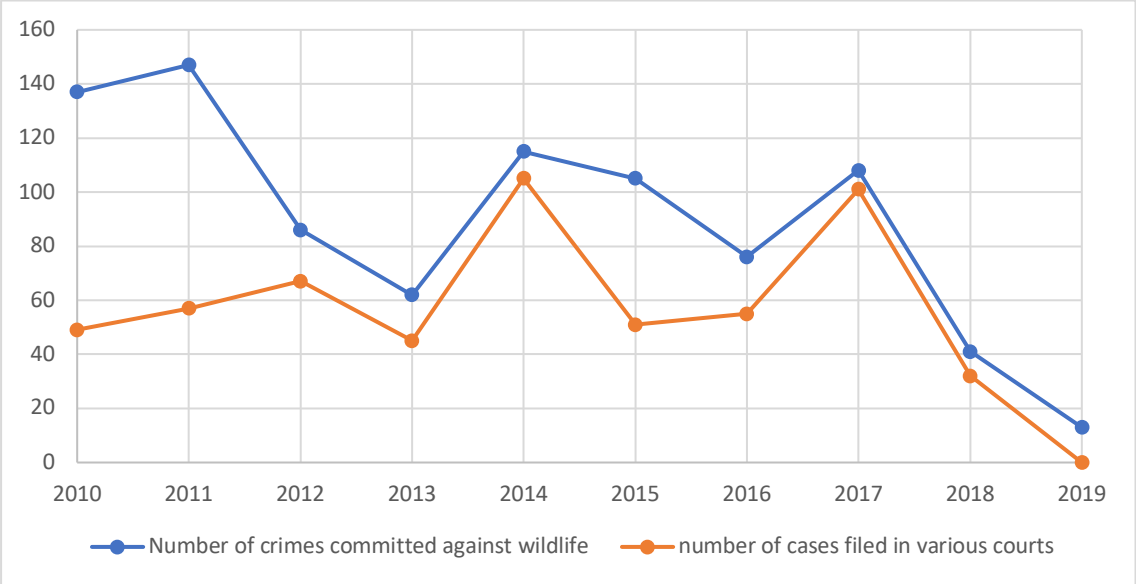

Figure 6. Annual trend in the legal action on confiscated specimen

2.3. Who are the stakeholders in IWT?

The Philippines is both a consumer, source, and transit point of wildlife that is illegally traded, threatening endemic species populations, economic development, and biodiversity. According to Asian Development Bank (ADB), the cost of IWT in the Philippines is estimated at PhP50Billion pesos or roughly $1Billion dollars. This estimate includes the market value of the wildlife and resources, their respective ecological role and value, and damage to habitats incurred during poaching, and loss in potential ecotourism revenues.

Stakeholders are defined as the people and organizations who are involved in or affected by an action or policy and can be directly or indirectly included in the decision making process (Freeman 1984; Annan 2007; Sterling et al. 2016, in Vogler et al, 2017). Illegal wildlife trade encompasses a broad spectrum of commodities traded domestically and internationally, with different methods of smuggling, transit routes, transport mode and markets (TRAFFIC-Southeast Asia, and Asch, 2016). In addition to these channels, Voglet et al (2017) referred to “hidden stakeholders”. These are those whose incomes and/or livelihoods depend on the use of a natural resource, but whose participation in public stakeholder decisions is not normally considered. Voglet et al (2017) further explained that when discussing a topic such as the trade in a particular species, hidden stakeholders could include hunters, collectors, fishers, and squatters. Illegal poachers and dealers in black market wildlife trade represent a more extreme category of “hidden stakeholders,” and their influence on the conservation of endangered species may span multiple international boundaries.

According to a report of the Interpol-UN Environment in 2016, the generic wildlife crime supply chain as shown in Figure 7 (adapted from WWF/Dalberg, 2012) involves a significant number of actors across the various phases of source, transportation, processing and sale; including poachers, intermediaries to facilitate smuggling, couriers, logistics specialists, traders and wholesalers.

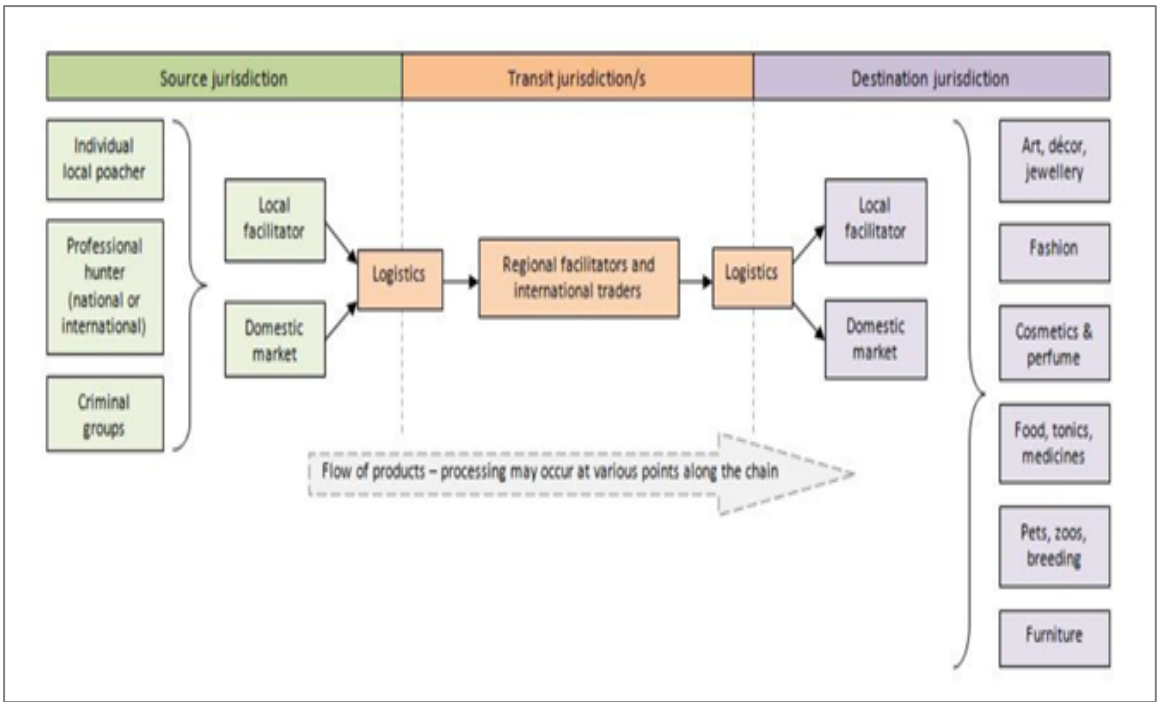

Figure 7. Generic flow of the illegal wildlife trade supply chain

The stakeholders in IWT in the Philippines and elsewhere are identified by sector. For example, these sectors involve the regulators (government, the supply sector (mostly the hidden stakeholders), the transport and logistics sector, the demand sector, the civil society organizations and the influcers sector (See Table 7). To fully understand the relationship of the different stakeholders, Table 8 shows the viewpoints and different perspectives of the stakeholders in illegal wildlife trade.

Table 7. Identified stakeholder in IWT

Sector	Identified Stakeholder
I. Government	National Government
	Local Government Units
	Judiciary and Prosecution
II. Supply Sector	Poacher
	Breeder
	Middlemen
	Underground retailer
	Wildlife-related business
III. Transport and Logistics	Freight Companies
	Ports
	On-call transit company
IV. Demand Sector	Consumer
V. NGO/PO	NGO/PO
VI. Online/Social media Platform	Online/social media platform

Table 8. Summary of stakeholders' roles and level of support in IWT.

Stakeholder	Stakeholder Interest(s)	Level of Support on Illegal Wildlife Trade	Notes and Strategies on obtaining support or reducing obstacles
National Government*	Implementation of national policy; Catalyst of political will and convening power.	Strongly against	Needs strong support from other stakeholders
Local Government Unit	Provide local policy and craft measures to protect the wildlife with in their respective jurisdiction	Strongly against	Provide training and other resources in fighting IWT
Poachers	Hunting and capturing of illegal wildlife is done either for livelihood or sport	In favour	Information, Education Campaign of RA 9147 Provision of alternative livelihood for poachers trading illegal wildlife as a means of income
Breeders	Captive breeding is done for the preservation of wildlife. However, some circumstances may result to laundering of illegally caught wildlife for commercial profit.	Mixed; members of group are split	Information, Education Campaign of RA 9147 Strict regulation and monitoring of Philippine law enforcement agency and concerned government agency
Middlemen	Facilitates the selling of illegal wildlife from poachers to black market for commercial profit	In favour	Information, Education Campaign of RA 9147 and other relevant laws and regulations
Underground retailers	Sell the illegal wildlife through various means (e.g., social media, exotic and normal pet shops).	In favour	Information, Education Campaign of RA 9147 and other relevant laws and regulations

Stakeholder	Stakeholder Interest(s)	Level of Support on Illegal Wildlife Trade	Notes and Strategies on obtaining support or reducing obstacles
Wildlife-related businesses	Sell and/or buy wildlife / wildlife products	Mixed; buyers and sellers are split.	Information, Education Campaign of RA 9147 and other relevant laws and regulations
Freight Companies	Possible collusion with middlemen on the transportation of illegal wildlife for commercial profit. But generally, most freight companies are against the use of their facilities on illegal wildlife trading.	Mixed; members of group are split	Provision of capacity building training for illegal fraudulent cargo used for illegal wildlife trade Training of personnel on the wildlife trade regulations.
Ports (airports, seaports)	Possible collusion with middlemen on the transportation of illegal wildlife for commercial profit. But generally, ports are against the use of their facilities on illegal wildlife trading.	Against	Provision of capacity building training for illegal fraudulent cargo used for illegal wildlife trade Training of personnel on the wildlife trade regulations.
On-call transit company	Possible collusion with middlemen on the transportation of illegal wildlife for commercial profit. But generally, drivers on the on-call transit companies are unaware of the transactions	Mixed	Provision of capacity building training for illegal fraudulent cargo used for illegal wildlife trade Training of personnel on the wildlife trade regulations.
Social Media/Online Platform (e.g. Facebook)	Against the use of their platform for illegal wildlife trade	Strongly against	Inclusion illegal wildlife trade amongst its security filtering through

Stakeholder	Stakeholder Interest(s)	Level of Support on Illegal Wildlife Trade	Notes and Strategies on obtaining support or reducing obstacles
			monitoring and reviewing of its content as well as encourage other users to report any such illegal trade
Consumer / Buyers	Patronise wildlife and wildlife products	In favour	Information, Education Campaign of RA 9147 and other relevant laws and regulations; Change in consumer-behaviour; demand-influencing campaigns should go-beyond awareness raising
Judiciary and Prosecution	Administers the criminal justice system	Strongly against	Provide standard monitoring, reporting and documentary forms to facilitate the prosecution of wildlife-related cases
Non-Government Organization/People's Organization	Advocate against the illegal wildlife trade through programs/activities of the organization	Strongly against	Include to participate in government formulation of policies against illegal wildlife trade

Figure 9 shows the result of the stakeholder grid analysis. A stakeholder grid is a tool that visualizes the relative influence and level of interests of each of the stakeholders group (Vogler, et al., 2017). This tool can also help identify potential group coalition. The result suggests that the hidden stakeholders (poachers, breeders, Middlemen, underground resellers and the buyers), although have high interest in the wildlife for the trade, have very low power or influence over policies and decision. The inverted Z analysis here shows the nexus between buyers and poachers. The current hypothesis of changing buyer's behavior is

still valid and this change of behavior will have a lasting impact on the supply side. However, the shift or change behavior on the part of consumers might take long (as these are expected). It would be strategic if the work program of changing behavior of consumers is done simultaneously with changing the behavior on the supply side (and ultimately the entire 'hidden stakeholders' sector) with the institutional and economic support of local governments and the national government.

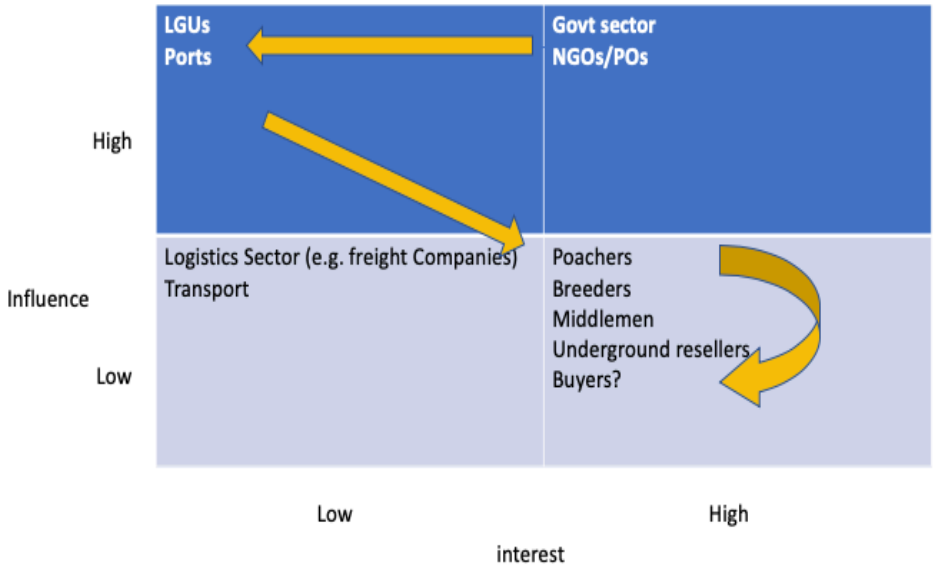

Figure 9. Stakeholder grid

Notes on the Roles of the different Stakeholders in the Philippines

1. Government Sector. The government serves as the catalyst of political will and convening power. It also coordinates and mobilizes the funds of programs and projects. Identified below are the different government agencies involved and its roles in wildlife law enforcement.

1.1. Department of Environmental and Natural Resources (DENR). DENR manages and protects the country's natural resources. (EO 292 and EO 192, Sec. 4)

1.1.1. Biodiversity Management Bureau (BMB). BMB is responsible for the protection, development and preservation of national parks, marine parks, game refuges and wildlife. (EO 192, Section 16); BMB also formulates and recommends policies, guidelines, rules, and regulations for the preservation of biological diversity, genetic resources, and endangered Philippine flora and fauna. (EO 192, Sec. 18(b).

1.1.2. Forest Management Bureau (FMB). FMB recommends policies and/or programs for the effective protection, development, occupancy, management, and conservation of forest lands and watersheds. FMD also regulates the utilization and exploitation of forest resources including wildlife, to ensure continued supply of forest goods and services. (EO 192, Section 13.a)

1.1.3. Environment Management Bureau (EMB). EMB implements the rules and regulations pertaining to the conduct of environmental impact assessment for every project that has adverse impact on the environment. (EO 192, Section 16)

1.2. Department of Agriculture (DA). DA promotes agricultural development by providing the policy framework, public investments, and support services needed for domestic and export-

oriented business enterprises. (EO 292, Book IV, Title IV, Chapter I, Section 2). It also protects all declared aquatic critical habitat, all aquatic resources, including but not limited to all fishes, aquatic plants, invertebrates and all marine mammals, except dugong. (RA 9174, Sec.4)

1.2.1. Bureau of Fisheries and Aquatic Resources (BFAR). BFAR enforces all laws governing the conservation and management of fishery resources, except in municipal waters. (RA 8550, Sec. 65). It formulates and enforces all rules and regulations governing the conservation and management of fishery resources, except in municipal waters. (RA 8550, Sec. 65)

1.2.2. Bureau of Plant Industries (BPI). BPI recommends plant quarantine policies, and prescribes rules and regulations for the prevention, control, and eradication of pests, diseases, and injuries to plants and plant products. (EO 292, (EO 292, Book IV, Title IV, Chapter 4, Section 19.3). The Plant Quarantine Officers shall inspect all carriers, passengers, crew, luggage and incoming mails to determine the presence of plants, plant products and other materials capable of harboring plant pests as well as potential animal pests. Officers shall also examine imported plants, plant products, and other materials capable of harboring plant pests as well as potential animal pests and administer necessary measures to insure effective implementation of the provisions of Chapter 5, Title 4 of EO 292.

1.3. Department of Finance. Department of Finance is in charge with the formulation, institutionalization and administration of fiscal policies in coordination with other concerned subdivisions, agencies and instrumentalities of the government.

1.3.1. Bureau of Customs (BOC. BOC prevent and suppress smuggling, pilferage and all other economic frauds within all ports of entry; supervise and control exports, imports, foreign mails, and the clearance of vessels and aircrafts in all ports of entry; and prevent and prosecute smuggling and other illegal activities in all ports under its jurisdiction; (EO 292 s. 1987; Book IV, Title 2, Chapter 4, Sec 23)
1.4. Department of Justice (DOJ). DOJ acts as both the legal counsel and prosecution arm of the government. It administers the criminal justice system in accordance with the accepted processes consisting in the investigation of the crimes, prosecution of offenders and administration of correctional system. (EO 292, Title III, Section 1)

1.4.1. National Bureau of Investigation (NBI). NBI detects and investigates crimes; acts as a national clearing house of criminal records and other information; gives technical assistance to all prosecuting and law enforcement agencies, the courts and party litigants; coordinates with other national or local police agencies in the investigation of crimes; collects intelligence data and coordinates with other intelligence agencies, including Interpol; and assists in the implementation of RA 9147. (Republic Act No. 157, as amended by EO 94 series of 1947)

1.5. Department of Interior and Local Government (DILG)
Promotes peace and order, ensures public safety and further strengthens local government capability aimed towards the effective delivery of basic services to the citizenry. (RA 6975 Section 2 as amended by RA 8551)

1.5.1. Philippine National Police (PNP) (Republic Act 6975, Section 24)
Investigates and prevents crimes, effects the arrest of criminal offenders, brings offenders to justice and assists in their prosecution.

Exercises the general powers to make arrest, search and seizure in accordance with the Constitution and pertinent laws.

Detains an arrested person for a period not beyond what is prescribed by law, informing the person so detained of all his rights under the Constitution.

Performs such other duties and exercises all other functions as may be provided by law, such as the National Integrated Protected Area System Act and Wildlife Resources Conservation and Protection Act.

1.5.2. Local Government Units (LGU)
Adopt measures to safeguard and conserve land, marine, forest and other resources of the province, city, and municipality.

1.6. Department of National Defense. Department of National Defense maintains law and order throughout the country; and performs other functions as may be provided for by law. (EO 292, Book IV, Title VIII)

1.6.1. Armed Forces of the Philippines (AFP. AFP is responsible in rendering assistance when called upon by the National Anti-Environment Crime Task Force in the latter's performance of its duties under Executive Order No. 515. (EO No. 515, Section 1); responsible in promoting and advancing the national aims, goals and interests and policies. (EO 292, Book IV, Title VIII, Chapter 6, Section 33.2); and in charge with the performance of other functions as may be provided by law or assigned by higher authorities. (EO 292, Book IV, Title VIII, Chapter 6, Section 33.4).

1.7. Department of Transportation and Communication (DOTC). DOTC is in charge of the promotion, development and regulation of dependable and coordinated networks of transportation and communications systems as well as in the fast, safe, efficient and reliable postal, transportation and communications service

1.7.1. Philippine Coast Guard. Philippine Coast Guard enforces or assists in enforcing, all applicable laws upon the high seas and territorial waters of the Philippines. (PD 601, Sec. 2); prevents and suppresses illegal fishing, illegal gathering of corals and other marine products, smuggling, other customs frauds and violations of other maritime and fishery laws that may be committed within the waters of the Philippines and, for this purpose, surveillance and inspection by the Philippine Coast Guard may be made on vessels entering and/or leaving Philippine territory; and enforces laws, promulgates and administers rules and regulations for the prevention of marine pollution within the territorial waters of the Philippines in coordination with the National Pollution Control Commission.

1.7.2. Philippine Ports Authority (PPA). PPA provides security to cargoes, port equipment, structure, facilities, personnel and documents: Provided, however that in ports of entry, physical security to import and export cargoes shall be exercised jointly with the Bureau of Customs. (EO No. 513, Section 2(a)); enforces rules and regulations promulgated by the Authority pursuant to law, such as the Wildlife Resources Conservation and Protection Act. (EO No. 513, Section 2(e)).

1.7.3. Manila International Airport Authority (MIAA). MIAA exercises administrative supervision and control over all international airports in the Philippines Regulates the entry to, exit from and movement within the Airport; and enforces rules and regulations promulgated by the Authority pursuant to law.

1.8. Palawan Council for Sustainable Development (PCSD. PCSD oversees the implementation of RA9147 in the Province of Palawan. Considering that PCSD has the jurisdiction over the province, the following are delegated function to the council instead of DENR: (a) **designation as management and scientific authorities for International Trade in Endangered Species of Wild Fauna and Flora, and (b) determination of threatened species**

2. Transport and Logistics Sector

The illegal wildlife trade typically involves several players working in source, transit and consumer chain. The transportation and logistics sector is the backbone of global trade and becoming increasingly vulnerable to exploitation by illegal wildlife traffickers. Traffickers heavily rely on this sector to smuggle illicit wild animals and wildlife products. The sector can therefore play a critical role in being the eyes and ears of enforcement agencies, helping identify and strengthen key risk points in the supply chain, complementing the suite solutions of government and the international community (TRAFFIC, 2015) see Figure 10.

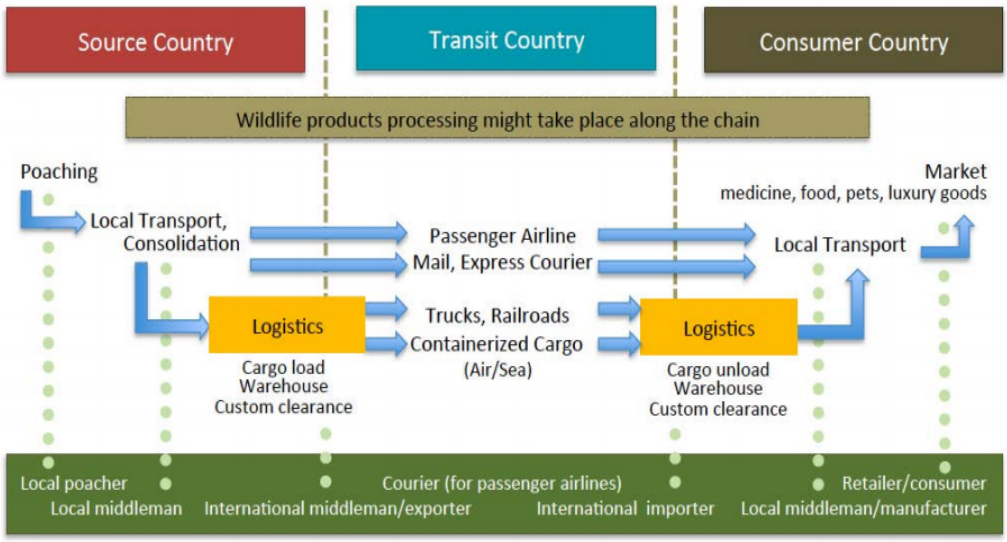

Figure 10. Generic international illegal wildlife trade chain and methods of transportation (TRAFFIC 2015)

Passenger airlines are being used for small shipments of live animals or high-value, low-weight animal products typically hidden in carry-on or checked-in luggage, or on passenger. Aircargo carriers and courier are being used for larger shipments of either live animals or their products/derivatives. National airmail and express parcel service companies are also utilized for sending relatively small and light parcels containing wildlife. Shipping lines, on the other hand, are being used for bulky and heavy weight consignments generally mixed with legal commodities in sealed containers (TRAFFIC, 2015). In the Philippines, a study conducted by Sy (2018), showed that traders from other regions or provinces used freight courier and airport cargos to ship wildlife and wildlife products by concealing it and mis-declaring contents (Ong, 2017). In the same study, others are also documented utilizing on-call transport company to deliver illegal wildlife to buyer. In some cases, drivers of on-call transport company might be unaware of the contents of the items they are shipping. Thus, it is significant to note that personnel in freight and transport companies should be well-informed of the wildlife trade regulations.

2.4. IWT Buyer profiles and purchases

Demand for illegal wildlife products is directly proportional to the population increasing and the economy growing (Sobrevila, 2016). USAID Wildlife Asia (2017) reported that that the number of people consuming wildlife products in China (10 percent of the population surveyed in Beijing, Shanghai, Guangzhou, Hangzhou, Nanning and Kunming had purchased pangolin products) , Thailand (11 percent of those surveyed in the greater Bangkok area bought medicine or products made from wildlife), and Vietnam (4.2 percent of the population surveyed had bought or consumed rhino horn in the past year) are significantly large enough to drive markets for wildlife products in these countries. The same study further postulates that there are two key drivers for the consumption demand: 1) affirmation of status and wealth; and, 2) belief that wildlife products have medicinal or health value. For example, ivory consumption is mainly driven by the concern for status and wealth while tiger products are mostly valued for their perceived medicinal/health benefits. Pangolin and rhino horn are associated with both drivers. Consumption for medicinal value is correlated with consumption for status.

In a similar study done in China, people purchase all these wildlife products as gift to someone for various reasons. Except for tiger products, which are mostly used to cultivate a relationship. Purchases are often self-made decisions and unplanned. There are more deterrents than drivers to purchase, indicating an awareness of the illegality of these wildlife products(Table 10). The sources of their awareness come from the internet. In addition, buyers are more likely to travel outside of their own country (USAID Vietnam, December 2018).

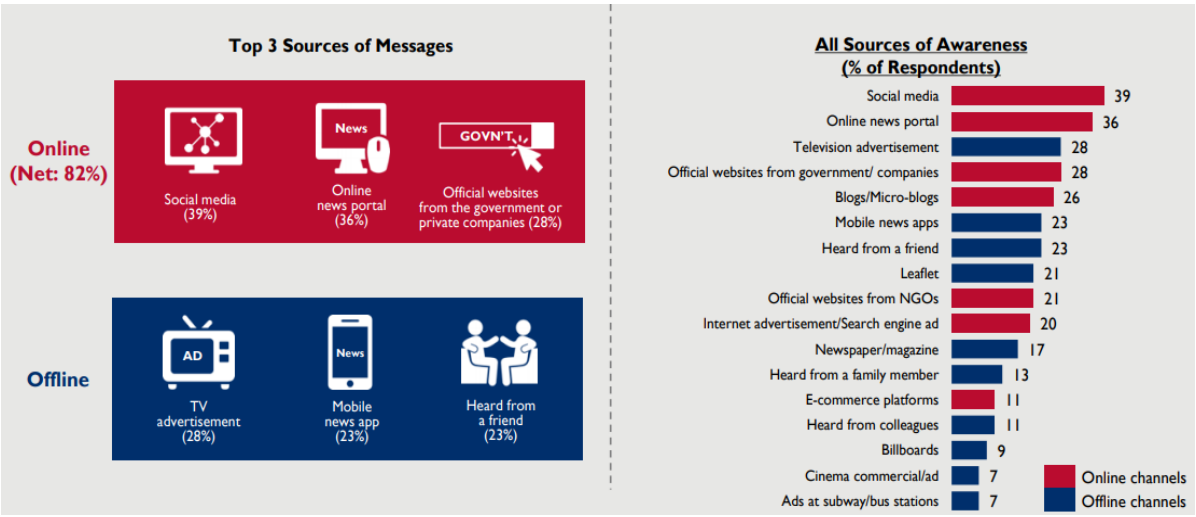

Figure 11. Sources of awareness. Source: USAID Wildlife Asia (12 June 2018). *Research study on consumer demand for elephant, pangolin, rhino and tiger parts and products in China*. PowerPoint Presentation.

The infographics above (Figure 11) is sourced from a research study by USAID Wildlife Asia (12 June 2018) on consumer demand for elephant, pangolin, rhino and tiger parts and products in China. They present buyers' profiles for all four key species, main purchases by species, awareness on existing agreements and regulations of the said protected species, purchase decisions, and the sources of their awareness.

Table 9. Summary of global seizures and trafficking routes of Pangolins

Rank	Country/Territory	No of incidents	Commodity Quantities		
			Scales Weight (Kg)	Body Parts Weight (Kg)	Whole Weight (Kg)
1	China	342	16,291	2,290.4	6,407.5
2	US	127	5.1	2,119.1	--
3	Viet Nam	90	7,487	2,119.1	19,1225.3
4	Malaysia	60	10,534.3	--	5,061
5	Hong Kong SAR	57	7, 147.6	--	600
6	Thailand	56	1,222.2	--	61
7	Lao PDR	44	1,914	--	61
9	Nigeria	41	6,372.7	26.2	10.4
9	Indonesia	40	4,103.4	--	45,140.3
10	Germany	38	666.5	26.2	--

Source: Heinrich, S., Wittman, T.A., Ross, J.V., Shepherd, C.R., Challender, D.W.S., and Cassey, P. (2017). *The Global Trafficking of Pangolins: A comprehensive summary of seizures and trafficking routes from 2010–2015*. TRAFFIC, Southeast Asia Regional Office, Petaling Jaya, Selangor, Malaysia.

China and the United States are the largest consuming country/territories worldwide for pangolins for the past 6 years. China was the main destination for large scale shipments of scales and whole animals. Scales of pangolins are popular as ingredient for various Chinese traditional medicines.

Pangolins are still heavily trafficked worldwide despite being included in the CITEs-listed species. This may be due to poor or ineffective implementation of the convention agreement. According to Ibanga, (2017), many reports have documented that many CITES member countries have not enacted specific legislation to implement the CITES treaty, instead these countries rely on general wildlife laws to control trade in CITES-listed species that do not usually conform to CITES requirement resulting to the diminishing effectiveness of the treaty.

Like animals, plants are being traded legally and illegally for their medicinal and ornamental use. In the study of Jenkins et al (2018), nearly 30,000 species are documented to have medicinal and aromatic uses. Around 60-90% of these medicinal and aromatic plants in international trade are collected from the wild. In China, 70% of plants in trade are obtained from the wild. The study of Mulliken and Crofton (2008) also pointed out that wild plant species form the foundation of health practices in large part of Asia, particularly traditional practices in China and Tibet. Compounds such as reserpine taken from snakeroot and paclitaxel from Himalayan Yew are important pharmaceutical ingredients in Europe and North America. The

study also revealed that medicinal plants in trade across India are collected in Alpine regions of Nepal. Jatamansi and Kutki rhizomes are in demand and are collected in large volumes by collectors who supply middlemen to large-scale wholesalers in Nepal and India. Raw Materials are often transported on to wholesale markets in Delhi, Amritsar and Kolkata for onward sale.

In study of Phelps (2015), wild-collected ornamental plants, primarily in the family Orchidaceae are widely traded across Southeast Asia for their exquisite beauty and fragrance. The surveys, which were conducted in four of the largest wild plant markets in Thailand and at the country borders with Myanmar and Lao PDR recorded 348 species of orchid for sale. The study also revealed that there is already a growing online trade for these wild plants for medicinal orchids consumption in Vietnam and China.

Building effective strategies in order to influence the behavior of a consumer means it is necessary to identify target groups and understand their motivations and values, and how those influence their decision making (Vique, 2018). According to Burgess et all (2018), 85 demand reduction initiatives were delivered from 2010 to 2015. Most involved broad communications (LCD displays, PSAs, banners and posters, etc.). Most of the initiatives are related to ivory in China. Rhino horn activities were focused in Vietnam.

2.5. What are the drivers of IWT? Why do they buy?

Demand for pets is one of the key drivers of wildlife trade (Siriwat & Nijman, 2018). In this instance, otters have become an addition to that demand .

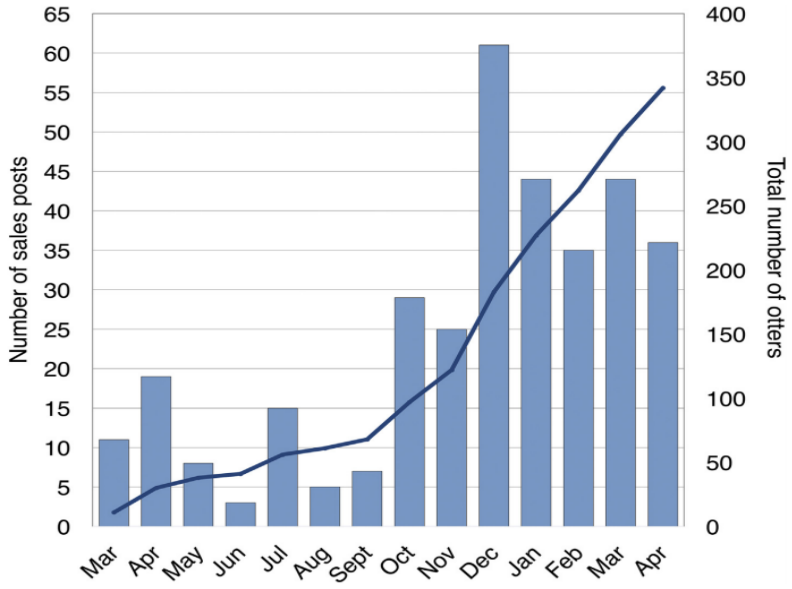

Figure 12. Number of illegal pet trade on social media. Source: Siriwat, P. & Nijman, V. (2018). Illegal pet trade on social media as an emerging impediment to the conservation of Asian otter[s] species. *Journal of Asia-Pacific biodiversity, 11*: 469-475.

The figure (Figure 12) above displays the number of sales posts advertising otters over time (bars) and the cumulative number of individual otters posted for sale (line) from March 2017 to April 2018. All four other species found in Asia are globally threatened populations

and of international conservation concern. Despite the fact that otters are protected under Thai legislation, the sales advertisements were very much targeted toward a domestic clientele.

Table 10. Driver and deterrents for purchasers of ivory, rhino horn, pangolin and tiger parts and products

Drivers	Deterrents
Rarity	Link to crime and trade in drugs and guns
Brings good fortune	High risk of buying fake products
Brings good health, well-being	Penalty for violating laws
Reflects purity and spirituality	Expensive
A good investment	Personal risk

Source: USAID Wildlife Asia (12 June 2018). *Research study on consumer demand for elephant, pangolin, rhino and tiger parts and products in China*. PowerPoint Presentation.

In Southeast Asia, people purchase ivory products and rhino horn because it is thought to be a status symbol and an important ingredient in traditional medicine (Lawson & Vines, 2014). Males in Vietnam believe in the supposed health benefits of using rhino horn. Natural cleansing and hangover cures were the most common reasons (Truong et al., 2016). Ivory is believed to protect its owner and enhance their popularity (USAID Wildlife Asia, 5 June 2018). These beliefs stem from ancestral origins, although more modern are online searches and forums. Like ivory, tiger products are purchased for spiritual purposes, seconded by social image. Indicator of societal status and medicinal properties are the leading drivers for purchase of wildlife products (USAID, n.d.).

2.6. What are the usual channels? Where do they buy?

Illegal wildlife trade runs through a course of different key actors involved, each with varying motivations, interests, power, and legitimacy (Clifton & Rastogi, 2016). Most purchases are done via private individuals. Some buyers receive their products overseas during leisure trips. Retail stores and traditional medicine pharmacies also sell elephant, rhino, and pangolin parts/products (USAID Vietnam, December 2018). Online marketplaces that can be easily traced usually migrate to social networking sites (Mayuga, 2018).

Figure 13. global monitoring web service system on illegal wildlife
Source: Hansen, A., Li, A., Joly, D., Mekaru, S. & Brownstein, J. (2012). Digital surveillance: A novel approach to monitoring the illegal wildlife trade. *PLoS ONE, 7(12)*.

In 2012, HealthMap Wildlife Trade, an automated web crawling service system, was introduced to monitor reports on illegally traded wildlife (Hansen et al., 2012). Currently the most comprehensive and freely available tool for monitoring the IWT, it obtained 858 reports from 89 countries. India, United States, South Africa, China, and Vietnam had the highest number of reports. Species from 118 categories were documented, with mammals being the most commonly reported.

The transportation and logistics sector is heavily abused by traffickers of wild fauna and flora and their products. They are willing to help combat wildlife smuggling. However, any activity to prevent the illicit trade must consider its cost-effectiveness (TRAFFIC, 2015). Trade flows suggest a focus on legislation and interdiction activities to decrease the supply exported (Patel et al., 2015). On the other hand, countries identified as key import nodes should put emphasis on improving baggage screenings at ports and airports to apprehend traders.

Online Wildlife Trade Worldwide

Illegal online trade in Southeast Asia involved both native and non-native species. The world wide web becomes the new platform facilitating these illegal exchanges. Below is the summary of key findings from in-depth review of research studies related to Illegal Wildlife trading using the social media platforms, particularly the use of Facebook by traders. Findings include records on mostly traded wildlife species globally.

Table 11. Records of mostly traded wildlife in social media in Thailand

Group	Scientific Name	Conservation Status
Mammals		

Sunda Slow Loris	*Nycticebus coucang*	Vulnerable (VU)
Common Palm Civet	*Paradoxurus hermaphroditus*	Least Concern (LC)
Squirrel	*Sciuridae*	Most species are Least Concern (LC)
Reptiles		
African Spurred Tortoise	*Centrochelys sulcata*	Culnerable (VU)
Green Iguana	*Iguana iguana*	Least Concern (LC)
Ball Python	*Python regius*	Least Concern (LC)
Birds		
Red-whiskered Bulbul	*Pycnonotus jocosus*	Least Concern (LC)
Common Hill Myna	*Gracula religiosa*	Least Concern (LC)
Shikra	*Accipiter badius*	Global: Least Concern (LC); Europe: Vulnerable (VU)
Black-winged Kite	*Elanus caeruleus*	Least Concern (LC)

Source: Phassaraudomsak, M. and Krishnasamy, K. (2018). *Trading Faces: A rapid assessment on the use of Facebook to trade in wildlife in Thailand.* TRAFFIC, Petaling Jaya, Selangor, Malaysia.

Illegal wildlife trade on Facebook is active on Thailand due to increasing market. There is weak law enforcement from government agencies to monitor IWT trade in social media platforms. No clear intervention from the Thai government to address the increasing Online IWT. Illegal traders using Facebook increases probably due to the fact that enforcers have the difficulty to track the detailed information on buyers, location of pick up or delivery. Facebook private message as means of negotiation provide illegal traders and possible buyers ease during transaction (Phassaraudomsak, and Krishnasamy,2018).

Table 12. Most common species offered for sale online in Peninsular Malaysia

Mammals			
Leopard Cat	*Prionailurus bengalensis*	Least Concern (LC)	Endemic
Sunda Slow Loris	Nycticebus coucang	Vulnerable (V)	Endemic
Birds			
Black-shouldered kite	*Elanus caeruleus*	Least Concern (LC)	Endemic
Crested Serpent-eagle	*Spilornis cheela*	Least Concern (LC)	Endemic
Barn Owl	*Tyto alba*	Least Concern (LC)	Endemic
Hill Myna	*Gracula religiosa*	Least Concern (LC)	Endemic

Source: Krishnasamy, K. and Stoner, S. (2016). Trading Faces: A Rapid Assessment on the use of Facebook to Trade Wildlife in Peninsular Malaysia. TRAFFIC. Petaling Jaya, Selangor, Malaysia

In Peninsular Malaysia, study of Krishnasamy and Stoner, (2016) showed that there is a high demand for local wildlife as pets. Results of the 5-months period of rapid assessment by TRAFFIC to 14 Facebook groups in Peninsular Malaysia also revealed that more than 60% of the species recorded during the monitoring were endemic to Malaysia, with 93% of the recorded species protected from hunting under the Malaysian Wildlife Act 2010. Wildlife species that were illegally traded were live and mostly juvenile. Facebook became a popular platform for illegal traders because its free and they are able to avoid taxes and the need to

undergo any form of inspection by complying with regulations, such as applications for permits and license. Malaysian Government recognized the problem and have committed greater efforts and resources to address illegal wildlife trade. Civil society as well as the private sectors increase their vigilance to combat the problem.

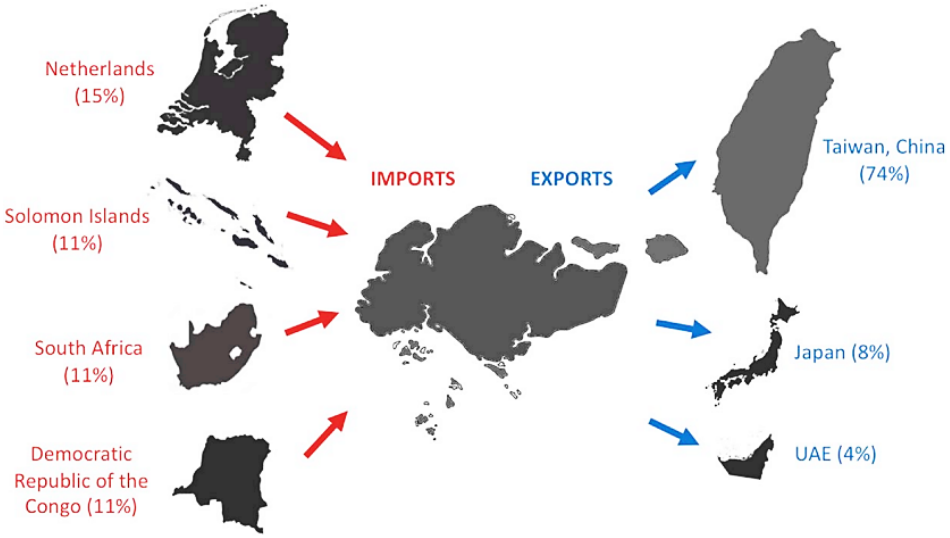

Figure 14. Singapore's top import and export countries for CITES-listed parrots from 2002-2016. Source: Aloysius, S.L.M., Yong, D.L., Lee, J.G. & Jain, A. (2019). Flying into extinction: Understanding the role of Singapore's international parrot trade in growing domestic demand. *Bird conservation international*: 1-17.

Singapore is the largest importer of CITES-listed birds in Southeast Asia, contributing to 18% of imports in the region (Aloysius et al, 2019). Its position as a center of IWT has been going on for decades. However, its decline in CITES-listed bird trade since 2005 is consistent with the global drop in trade volume shortly after the European union (EU) imposed a ban on wild-caught birds. The avian flu outbreak is also attributed to the decline.

2.7. What are consumer demand studies in the Philippines?

There are a few notable studies that touch on consumer demands in IWT. Emerson Sy's (2018) concentrated study on the illegal trade of live reptiles through the use of Facebook. Out of 90 selected Facebook groups in the study, 2245 unique live reptile advertisements from 115 taxa involving a minimum of 5082 individuals were posted by 1046 users within a three-month period. The top three commonly traded reptiles are the ball python, Burmese python, and leopard gecko. 60 of the 115 taxa are internationally regulated by CITES.

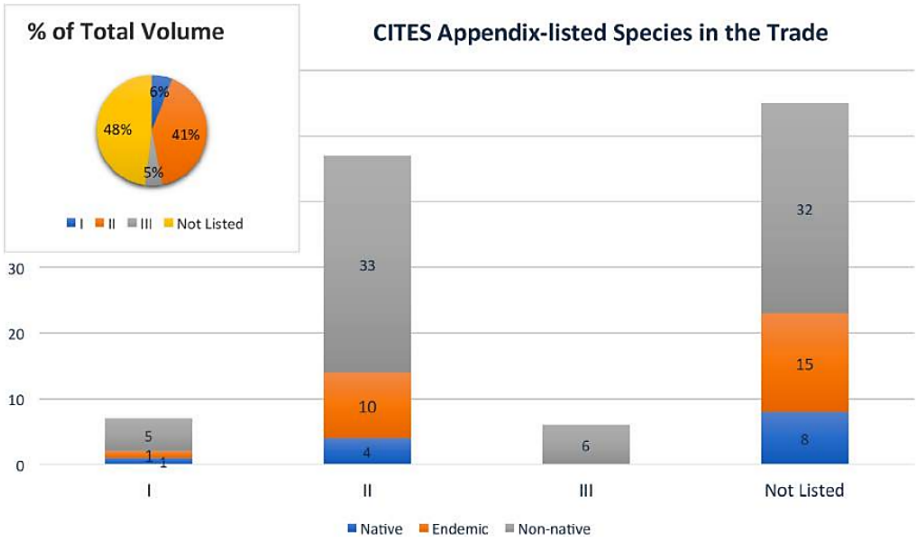

Figure 15. CITES Appendix-listed species in the trades Source: Sy, E. (2018). *Trading faces: Utilisation of Facebook to trade live reptiles in the Philippines*. TRAFFIC Publishing: Selangor, Malaysia.

Buyers have a stronger preference for non-native species for their variety and survivability. The study also identified two kinds of online traders. One sells commonly available captive bred species, while the other sells both captive bred and wild-caught species. Using online platforms like Facebook for IWT is expected to continue and increase patronage among consumers. Traders benefit from keeping anonymous since they can establish transactions securely and discreetly.

Canlas et al (2017) supports Sy's study where in 18 out of the 20 most traded taxa (for reptiles and birds) are non-native species. They are widely bred in captivity throughout the country, and represented 80% of the data. Canlas' research also showed that wildlife hobbyists and traders appeared to specialize in particular taxa.

In Mayuga (2018), to help combat IWT in the Philippines, the Department of Environment and Natural Resources recently compiled a 10-year national Wildlife Law Enforcement Action Plan (WildLEAP 2018-2029). It is in line with the Philippine Biodiversity Strategy and Action Plan and serves as the national road map to address wildlife crimes and guide to prioritizing enforcement activities.

2.8. What are the technology applications in IWT monitoring and law enforcement?

Table 13. Summary of 36 technology solutions to aid in combatting illegal wildlife trade.

Name	Description	Proponent	Link	Pros	Cons	Rank
Spatial Monitoring and Reporting Tool (SMART)	The Spatial Monitoring and Reporting Tool (SMART) consists of a software application that enables collection, storage, communication, and evaluation of ranger-based data on patrol efforts, patrol results, and threat levels. The SMART tool is open source, real-time queries based on computer analysis by relevant enforcement authorities.	ZSL, Panthera, WWF, North Carolina Zoo, WCS, Frankfurt Zoological Society, Global Wildlife Conservation, Peace Parks Foundation	http://smartconservationtools.org/	Free and open-source Available in multiple languages (software available in ten languages, the manual in eight) Designed for, and customizable by, users at the site level Supports implementation across national networks of protected areas Puts sophisticated analysis and standardized, automated reporting in the hands of conservationists without requiring extensive technical capacity	While it holds rangers and monitors accountable for where they go, it relies on trust for reporting of observations The software alone will not improve protection, basic enforcement capacity, equipment (e.g. computer and GPS) and infrastructure are required Although SMART was designed to operate in difficult or remote environments, technical support from experts for training and set up enables more successful implementation Restore failed error when upgrading	1

Name	Description	Proponent	Link	Pros	Cons	Rank
				Supported by a long-term sustainability plan and a global partnership Being built to perform in both connected and disconnected environments Built-in capacity building and user-support network The data collected can be entered directly into the desktop application (if monitors use a GPS and paper data sheet) or imported directly via mobile devices (enabled through the Cyber Tracker plugin) If a ranger logs such an observation on his SMART-configured mobile	from lower version to new.	

Name	Description	Proponent	Link	Pros	Cons	Rank
				device, the observation and the alert are automatically sent to the Connect server via the device's cellular network (if available) so that colleagues are notified and respond to the situation.		
BioMon (Biodiversity and Threats Monitoring) App	BioMon App is a simple, intuitive and integrated data-capture and data-analytics mobile application tool to support biodiversity monitoring programs of civil society organizations. This app builds from the success of the Lawin system by the Department of Environment and Natural Resources (DENR) by improving the software design for field data capture and data analytics. Its functionality can engender communities and civil society organizations to increase the scope and coverage of areas under protection.	Center for Conservation Innovations PH Inc.	https://conservation-innovations.org	Easy to use. Built to perform in both connected and disconnected areas or sites in Philippines.	Device compatibility issue (works only on Android mobile phones with version 6.0 and latest).	2

Name	Description	Proponent	Link	Pros	Cons	Rank
CyberTracker	CyberTracker is the most efficient method of GPS field data collection. You can use CyberTracker on a Smartphone or Mobile Device to record any type of observation.	CyberTracker	https://www.cybertracker.org/	As the software was the first available for smartphone-based community monitoring, it has a large community of online trouble shooters who can help support new initiatives; Electronic field guides are available for species identification, as is a large bank of wildlife icons for different biomes; Software is not reliant on transmission of forms by internet or local area network, therefore set up and maintenance costs are reduced; Icon-based wildlife surveys are very intuitive for data collectors and can transform expert tracking skills into scientific, geo-	Survey designers do not require programming skills, but they do need to be comfortable with using a fairly complex interface when designing the forms (see figure below), this means that community's may not be able to use the software without external support and influence; Digital forms cannot be used across digital devices without being first adapted for screen widths. The software alone will not improve protection, basic enforcement capacity, equipment and infrastructure are required.	2

Name	Description	Proponent	Link	Pros	Cons	Rank
				referenced observations. CyberTracker also enables advanced users to connect to server databases and allows remote synchronization from Smartphones and Mobile Devices. Data can be synchronized remotely to Online databases such as Esri ArcGIS Online.		
iNaturalist	iNaturalist is a citizen science project and online social network of naturalists, citizen scientists, and biologists built on the concept of mapping and sharing observations of biodiversity across the globe. iNaturalist may be accessed via its website or from its mobile applications	iNaturalist	help@inaturalist.org https://www.inaturalist.org/	Connects remote communities with a body of engaged experts and enthusiasts online; improving species observations in the field to research grade datasets; Interfaces with international web	Limited automated visualization and data analysis capabilities beyond being able to summarize species observations on a map, this presents a barrier to communities wishing to see quick feedback on their data capture;	2

Name	Description	Proponent	Link	Pros	Cons	Rank
				platforms for the conservation of species, such the IUCN red list and the Global Biodiversity Information Facility Get connected with a community of over 400,000 scientists and naturalists who can help you learn more about nature! What's more, by recording and sharing your observations, you'll create research quality data for scientists working to better understand and protect nature The approach is scalable globally as it is simple, it requires only very basic web skills to set up a “project” and equally basic smartphone skills	Access to internet is needed to consolidate data, even if the data observations can be collected in the field offline; Only Spanish and English currently supported; Data is publicly available on a global server, so communities would not be able to restrict access to data collected; Inappropriate for an illiterate society and high dependency on text.	

Name	Description	Proponent	Link	Pros	Cons	Rank
				to download the app onto a smartphone		
Global Forest Watch	Global Forest Watch (GFW) is an online platform that provides data and tools for monitoring forests. By harnessing cutting-edge technology, GFW allows anyone to access near real-time information about where and how forests are changing around the world.	Global Forest Watch	gfw@wri.org	A dynamic online forest monitoring and alert system that empowers people everywhere to better manage forests. GFW is free and simple to use Enabling anyone to create custom maps Analyse forest trends, subscribe to alerts, or download data for their local area or the entire world Users can also contribute to GFW by sharing data and stories from the ground via GFW's crowdsourcing	Forest Watcher App crashes in some android devices.	3

Name	Description	Proponent	Link	Pros	Cons	Rank
				Thousands of people around the world use GFW every day to monitor and manage forests, stop illegal deforestation and fires, call out unsustainable activities, defend their land and resources, sustainably source commodities, and conduct research at the forefront of conservation. tools, blogs, and discussion groups.		
Wildlabs.net(Website and online community)	WILDLABS.NET is a community of conservationists, technologists, engineers, data scientists, entrepreneurs and change makers. Information, ideas, tools and resources are shared to didscover and implement technology-enabled solutions to some of the biggest conservation challenges facing our planet.	WILDLABS in association with United for Wildlife	https://www.wildlabs.net/	WILDLABS aims to build and support an active cross-sector community of conservationists and technology experts who use the WILDLABS online platform to: **Share** information to increase	The platform is a collection of shared resources/information and case studies only.	3

Name	Description	Proponent	Link	Pros	Cons	Rank
				transparency and reduce replication of effort **Ask and answer** questions to share best practice, to increase efficiency and effectiveness of technology deployment to address conservation challenges **Collaborate** to improve existing technologies or develop new technologies that address identified conservation needs.		
Wildscan	WildScan is a comprehensive species identification and response mobile application designed to combat wildlife trafficking. The application is designed to help front-line enforcement agencies, wildlife conservation officers, and the	Freeland	http://www.freeland.org/programs/wildscan/	WildScan provides a complete range of services related to animal telemetry	Needs to be updated.	4

Name	Description	Proponent	Link	Pros	Cons	Rank
	general public correctly identify, report and handle marine, freshwater and terrestrial animals caught in illegal wildlife trade. WildScan places critical information on endangered species at the fingertips of those who need it most and provides a tool to report wildlife crime. WildScan contains a comprehensive species library with more than 250 endangered animals commonly smuggled into and throughout Southeast Asia, a global hotspot for wildlife trafficking. The application will be available for free on Android devices with multiple platform and language support available in 2015.			WildScan use many tools to search and track animals. Designed to help law enforcement officials respond to wildlife trafficking Helps law enforcement agencies and the public to quickly and easily identify protected species by providing photos, information and critical clues aid in identification. Contains information on relevant contacts, temporary care instructions and a tool to report suspected wildlife crime. Reports can be forwarded to a local law enforcement agency allowing		

Name	Description	Proponent	Link	Pros	Cons	Rank
				anyone to report wildlife crime wherever they are, with the internet facility, allowing for a quick and effective tool to help stop the illegal trade.		
Map of Life	What species live here? What is that living thing? And where else does it occur? Find out with the Map of Life app, putting the most advanced geographic biodiversity knowledge at your fingertips. The app builds on a global scientific effort to help you discover, identify and record species worldwide. Birds, mammals, frogs, reptiles, butterflies, dragonflies, bumblebees, fish, trees ... tap into an unrivalled and growing database covering 30,000+ species worldwide, and add to it yourself!	Map of Life	info@mol.org	Provides the status and location of a certain species although some species are not present in the app. Most of the information of a certain species Discover and identify species around you and worldwide: Get a list of species around you or your next destination together with information to identify and learn about them.	Many species are missing. (None of the big mammals were listed as options to drop on the map)	5

Name	Description	Proponent	Link	Pros	Cons	Rank
				Forgot that big guide book on your hike? Map of Life has you covered and already done much of the identification work for you! Record your sightings: Seen something noteworthy you want to share or build your own list of species for a site? Record your observations in the app, share them with friends or engage with them online at mol.org. Your records may help researchers fill critical gaps for conservation and species monitoring. Engage with species and their ranges: Learn about how data		

Name	Description	Proponent	Link	Pros	Cons	Rank
				like yours can make a difference.		
Timby	TIMBY (This is My Backyard) is a suite of interconnected digital tools that help teams tackle complex problems with unparalleled speed and security.	TIMBY Productions Inc.	info@timby.org	The Timby Android App is a secure mobile reporting application that allows on-the-ground reporting anywhere in the world. **Engage**. Simple, secure and systematic reporting from the frontline, anywhere in the world. **Monitor.** Find connections between events and individuals over space and time. Follow and resolve grievances with transparency. **Communicate.** Share reports,	The current the system runs on Android only.	6

Name	Description	Proponent	Link	Pros	Cons	Rank
				blogs, stories and forms for maximum impact GPS automatically records location Built-in video tutorials Change API URL to use with any app Automatic logout after 5 minutes Compatible with Orbot Proxy from the TOR Project Record video, audio or take photos Easy sync with web dashboard Record of all reports kept in app End-to-end encryption		

Name	Description	Proponent	Link	Pros	Cons	Rank
				Export encrypted zip file to SD card		
Wildlife Alert	Military personnel often choose wildlife products as souvenirs for family and friends. The Wildlife Alert app can help military personnel identify products made from animal fur, skin, horns, or ivory and provides guidance on what items can or cannot be traded.	Wildlife Conservation Society	https://apps.wcswildlifetrade.org/	Easy-to–use diagnostics to discern real products from fake products Simple questions to guide the user to several animals from which to select a match Detailed descriptions of 75 commonly traded and/or highly endangered species Close up photos of furs, skins, antlers, horns and ivory as well as multiple photos of animals in the wild Great for end-users who have	It would be great for the app to connect to another reporting app to submit sightings or instances of illegal trade. Data syncing can take a while.	6

Name	Description	Proponent	Link	Pros	Cons	Rank
				no technical knowledge in ecology, biology, or taxonomy. The yes or no questions, basic questions with photos lead to one straight answer in identifying the at-risk species. Amazing design, simplified but captivating nonetheless. Provides a straightforward answer to end-user (Do Not Allow / Allow Trade) End users can sync their app to Wildlife Alert's database for the most up-to-date information.		

Name	Description	Proponent	Link	Pros	Cons	Rank
Environmental Crimes Fusion Cell (Mapping)	C4ADS produces an interactive and constantly updated map that tracks large-scale ivory seizures, ammunition used in poaching, and written reports and other information on ivory, tiger, and timber supply chains. The map and accompanying analysis, freely available to law enforcement and shipping professionals, can help under-resourced conservation organizations fight transnational trafficking syndicate.	C4ADS	http://www.c4adswildlife.org/	Range of analytical programs including various forms of GIS, social media, and statistical tools. The platform provides actionable information to combat transnational environmental criminal networks. The platform bridges the gap between the traffickers which work around legal loopholes and conservation organizations combating their trade.	It requires advance GIS skills. The Fusion Cell Web Platform can't be reached.	7
Wildlife Witness	Wildlife Witness lets you report illegal trade. It makes it simple for you to watch out for wildlife and be part of the solution!	Taronga Conservation Society Australia	web@zoo.nsw.gov.au	Everyone and anyone can be the voice for the voiceless flora and fauna Easy to navigate	Not accurate for receiving a report	8

Name	Description	Proponent	Link	Pros	Cons	Rank
				Citizens can provide useful and complete data in filing reports of illegal trade (includes photos, location, type of trade and business, etc.) Provides relevant and detailed information on reporting (list of threatened species, tips on reporting) Data collected will be used in assisting management decisions for prioritizing action, increasing enforcement, and improving legislation.		
Life Watch	Lifewatch Greece is a research e-infrastructure for biodiversity data and data observatories of Greece and the Mediterranean Sea. A selection of the developed e-Services and Virtual	Hellenic Centre for Marine Research (HCMR)	hcmrandroiddev@gmail.com	The user can visualize data from selected citizen science projects on a map and explore	The user can visualize datasets from the Mediterranean only	9

Name	Description	Proponent	Link	Pros	Cons	Rank
	Labs are available as user friendly mobile applications.			information about each observation (list of species, scientific names, classification, habitat etc). Serves as a database for biodiversity data. Good data organization; makes use of alphabetized lists with proper definitions and descriptions for each tech used.	App interface feels cluttered. Some sections in the app can't be accessed, no reason provided. I was unable to explore the full features of the app. When selecting videos under each bio-data page, the app freezes and shuts down. .	
Biodiversità	The Regional Centre for Biodiversity of the Lombardy Region has established a Regional Network for the collection of reports useful to the scientific monitoring of the species in the area.	Regione Lombardia	supporto@biodiversita.lombardia.it	Reporting and photographing species described in prepared cards of flora or fauna (campaigns), after validation by the expert, it contributes to the enrichment of the Regional Observatory Database on Biodiversity	Text or phrases in the app are Italian language Database does not contain photos only. One must be armed with Google Translate when navigating the app – Loads a lot when navigating each section.	10

Name	Description	Proponent	Link	Pros	Cons	Rank
				Good text information database on the species being monitored..		
Niti Luli Citizen Observatory	The Niti Luli Citizen Observatory Android App allows citizens (local & tourists) to collect key data from the field ranging from biodiversity sightings, to human wildlife conflict locations to the updating of fences and roads.	Upande Limited	info@upande.com	Niti Luli's mission is to provide the virtual space for a 'permanent community meeting' of local communities, government agencies, NGOs and donors, and to simplify communication and sharing of information to make natural resource management responsive to community needs. App allows users to see other submitted data on conservation projects, conflict issues, and species sightings.	Text or phrases in the app are African language only. Some sections require downloading another app to access (which doesn't make much sense...) So-so design. Clean but not necessarily aesthetic enough to allow the end-user seamless navigation from the homepage.	

Name	Description	Proponent	Link	Pros	Cons	Rank
				Provides interesting insights across various environmental sectors (agriculture, weather, conservation, etc.)		
GeoSurvey	The app was built to help to gather the information, spatial data (points, lines, areas) together with the attributes and image field easier. The app also functions like a handheld GPS in addition adds many new features to make the most of the power on the smart phone, your tablet.	GFD	geosurvey.dev@gmail.com	GeoSurvey saves time for fieldwork by making good use of features built into the smartphones GPS, digital compass, cameras, sensors, etc. Adding projects in the app (as per its main functionality), is quite easy.	The app doesn't show map Keeps crashing! The homepage is an image of 2 thumbtacks on a map. Doesn’t provide the user much information or navigation cues. Not certain about the apps intended outcomes for the end user .	
Flowers of Sahyadri	Flowers of Sahyadri' is an application for searching and identifying 2200 species of flowering plants found in Sahyadri, the biodiversity hot-	Reality Premedia Systems Pvt Ltd	angelo@realityinfo.com	Excellent detailed information in their flower database.	Loading the images can take a while.	

Name	Description	Proponent	Link	Pros	Cons	Rank
	spot of north western ghats of India. It has 2 modes viz. 'Search' and 'Identify'. In search mode, from botanical or common name, it displays image, botanical and ecological characters of the selected species.			Information provided can be well-understood by a layman. Easy on the eyes.		
find & log animals and plants	We hope that this software can bridge the skilled observing community with a rapidly growing smartphone market. Such an active community could highly increase the input of current local biodiversity information into GBIF with huge benefits for the scientific community.	Code For Nature	anymals.org@googlemail.com	This app shows plants and animals that live in your area (based on your phone's GPS coordinates) if they have been previously spotted there. The list of species are listed by their scientific names. Real-time tracking of the species given the end-user's location. The database provides ready links to useful reference sites. (Granted, it's Wikipedia but	It needs to allow you to actually find animals by a certain location.	

Name	Description	Proponent	Link	Pros	Cons	Rank
				still...) The app provides taxonomic filters for those not familiar with species. End-users can easily download data to their phone.		
EnvironMentor	EnvironMentor is a mobile application developed by the Department of Environment and Natural Resources (DENR). It mentors incumbent and incoming officials on facts, figures, issues and concerns in the Department. It is a dashboard of all critical environmental information in a particular location that can be accessed both by DENR personnel and the general public. It is mobile application that utilizes GPS technology to summon relevant data in the area like geohazard maps, land classification, land cover and others.	DENR - Office of the Asec. for Anti-Corruption	denr.hrdis@gmail.com	Integration and overlaying of various information in one map; Identifies one's location and the information on the same area; Inclusion of contour lines;	Need to be updated Android Marshmallow and above. Missing or hard-to-find legends; Missing zoom in and zoom out buttons; No export functionalities for outside use of data; Buttons not in an on-off layout; Signs out when the search button is used; Use of bright colors in its interface	

Name	Description	Proponent	Link	Pros	Cons	Rank
Bhutan Biodiversity Portal	Curious about all the different species present near you? See a plant or an animal species you want to know about, document and share? The Bhutan Biodiversity Portal (IBP) Android app now allows you to map Bhutan's precious biodiversity through citizen science. Access to the app is via a simple registration and login process.	India Biodiversity Portal	sdema06@gmail.com	Browse Observations' feature to see details of any species of birds, mammals, reptiles, amphibians or fish that have been sighted and submitted from near your location Endemic and important species present in Bhutan were geo-tagged	Boring interface; Makes use of the web to display the interface; Buttons are either non- functioning or not use- friendly; Unsure whether the database is up- to-date; Little to no details of the displayed data; No export functionalities for outside use of data; The interface freezes when adding layer to the basemap; DENR's EnvironMentor is more user- friendly than BBP	

Name	Description	Proponent	Link	Pros	Cons	Rank
Spartan Camera Management	Spartan Camera Management Mobile app you can view photos and videos taken by your Spartan GoCam just seconds after the photo and videos was taken. Request and download unlimited HD photos, play a slide show, view a status report, view and update the settings for your camera right from your mobile device.	Frontier Pursuits	support@spartancamera.com	This app is a great addition for security and surveillance use. Spartan GoCam will capture images of thieves and intruders, and deliver them to mobile device seconds later. Use of HD photos and videos to catch poachers/ intruders; Acts as a CCTV but mobile; Connectivity as data can be accessed real-time by other people when granted access	Bug issues with image display. Missing function to alert the person/s concerned;	
Mobile phones using acoustic traps [No specific name for equipment]	Using networks of recycled mobile phones with solar panels and antennas that act as sensors, the Rainforest Connection is tracking illegal logging in Borneo. The phones, mounted in waterproof cases throughout the forest, record a	Rainforest Connection	https://rfcx.org/	The RFCx player enables you to live stream the sounds of the rainforest through your mobile device, anytime	360 videos stopped working and crashing the app. Accuracy of the live feeds	

Name	Description	Proponent	Link	Pros	Cons	Rank
	nd transmit sounds associated wi th illegal activity, such as plane o r truck engines, chainsaws, explosions, and gunfire, to a clou d- based server for analysis. The de vices make it possible to catch ill egal loggers in the act of cutting down trees.			and anywhere. Listen in for rare screechy birds, laughing gibbons and the occasional amazon parrot! Helps in recycling old/discarded mobile phones, and put them into good use	Dispatch of patrol team to catch illegal loggers real- time is the challenge for this project; Inter-connectivity of phones for tracking purposes is not mentioned as one of the capability of the technology	
Turtle Trac ks (3D printed eggs with GPS tracker and SIM card)	Turtle Tracks aims to help stop th e international trade in sea turtle eggs by putting 3D printed dummy sea turtle eggs equipped with a GPS tracker, SIM card, and power pac k in nests. It intends to generate maps to show how and where th e eggs are traded to better unde rstand the demand and route, an d make results available to law	Paso Pacifico & Du rrell Institute of Co nservation and Eco logy	http://www.gizm odo.co.uk/2017/ 02/3d-printed- fake-turtle-eggs- use-gps-to- track- poachers/	The idea isn't to punish poachers but to test the technology as a means of future law enforcement, and hopefully also to deter would-be poachers from taking more eggs. Tracking down buyers of stolen eggs; Baseline data for international laws on illegal egg trading; 3D printed eggs look	GPS tracker, SIM card and power pack are high-cost units. Can easily be overpowered by scanning technology; Expensive to build and plant the decoy	

Name	Description	Proponent	Link	Pros	Cons	Rank
				identical to the real ones; Perfect environmental application of 3D printers and long-lasting batteries; Maps showing routes of the egg trading		
ThruVis (Scanners for airports)	Digital Barriers has been deploying a small, compact, lightweight camera technology around the world called ThruVis. Together with customs agencies, ThruVis screens people in real time and at a distance, as they are walking through various locations. It is meant to screen concealed, anomalous objects on the person, whether it's metal, ceramic, plastic, paper currency and ivory- even a bag full of tropic fish. ThruVis has been deployed in northern Europe and the Americas, as well as at some of the busiest customs agencies in South East and Central Asia.	Digital Barriers	https://www.digitalbarriers.com/thruvis	ThruVis is screening for concealed, anomalous objects on the person, whether it's metal, ceramic, plastic, paper currency and ivory- even a bag full of tropic fish, Added security to prevent wildlife trafficking especially in high-traffic airports; Contactless medium for detection;	Added cost in airport security; Human (customs staff) negligence will make the scanner deemed useless	

Name	Description	Proponent	Link	Pros	Cons	Rank
				Prevents random inspection and dependence to voluntary declaration by passengers		
Thermal imagery cameras [No specific name for equipment]	WWF and FLIR partnered to create thermal imagery cameras to remotely track illegal entry into parks and protected areas. Placed on the perimeter of conservation areas, along roadways and footpaths, the cameras send automatic alerts to rangers when they detect poachers entering a protected area. The cameras' software enables them to distinguish between natural movements, like swaying branches, and human motion. It has been deployed in Kenya's Masai Mara National Reserve and five miles of the border road.	WWF & FLIR	https://www.worldwildlife.org/stories/wwf-develops-a-new-technology-to-stop-poachers-in-their-tracks http://www.flir.com.hk/cs/display/?id=52223	This is the first time that infrared cameras and human recognition software have been used to monitor a park's boundary for conservation and anti-poaching efforts. Lesser time in patrolling a vast protected area;	Expensive since long range infrared sensors only detect a maximum distance of 5 meters; To install at random segment of a protected area's border will not be very effective; Needs a team of patrol to catch the poachers	

Name	Description	Proponent	Link	Pros	Cons	Rank
Hejje	In India, officials launched an app called Hejje that allows rangers to use smartphones to track tiger movements and notate important landscape features such as water levels, forest fires, and suspicious human activity through instant photo messaging. Park officials can respond in real time.	Bandipur Tiger Reserve H.C. Kantharaj & KeyFalcon Solutions of Bangalore	http://www.thehindu.com/news/national/karnataka/hejje-mobile-application-for-tracking-tigers-launched/article5649714.ece#	Faster management decisions and information relays; Better documentation The staff using the mobile application can take photographs and the application will instantly deliver it to the headquarters where senior officials can take decisions based on real-time information relayed from the ground.	Not an open-source software Use of manual detection during routine patrolling by staff	
Virtual Watch Room & Eyes on the Sea (Satellite imagery)	Using real-time satellite imagery and tracking, Eyes on the Sea and the Virtual Watch Room system can identify vessels that are acting suspiciously so authorities can take action to stop illegal fishing.	Pew Charitable Trusts & Satellite Applications Catapult	http://www.pewtrusts.org/en/research-and-analysis/fact-sheets/2015/01/virtual-watch-room	Benefits the legitimate fishermen; Can provide information of paths of fishing vessels for security/safety purposes	Not an open-source software Difficulty in patrolling; Patrolling still depend on the countries governing the area	

Name	Description	Proponent	Link	Pros	Cons	Rank
				Baseline data for international laws on illegal fishing The data is encrypted and hence, secured and information will be accessible only to authorized staff.		
Unmanned aerial vehicles (UAV)	The UNEP Global Environmental Alert and other publications report the use of UAVs (also called drones) for conservation. Drones have been used to monitor the activity of orangutans in Southeast Asia, monitor alligator populations in the Everglades, and poaching for rhinos in Kenya.	Various: Save the Rhino	https://na.unep.net/geas/getUNEPPageWithArticleIDScript.php?article_id= 113	Drones offer a relatively risk-free and low-cost manner to rapidly and systematically observe natural phenomena at high spatio-temporal resolution. Reaches even hard-to-reach areas for man	The volume of data that drone sensors collect need to be stored, processed and analyzed, causing severe procedural bottlenecks that need to be solved. Privacy issues might arise along the flight path. Needs to be recharged more often due to short battery life of most models.Risk of collisions in mid-air	

Name	Description	Proponent	Link	Pros	Cons	Rank
Wildlife Guardian	Wildlife Guardian is used for the identification of animals and animal products in China. Launched initially in 2011, the app has strong support from the CITES Management Authority of China, Anti-smuggling Bureau of China Customs and China Wildlife Conservation Association. It provides a platform that allows users to identify 475 species by selecting the correct match for up to five body parts or features, and provides the user with guidelines to identify wildlife products from ivory to big cat claws.	Wildlife Conservation Society	https://newsroom.wcs.org/News-Releases/articleType/ArticleView/articleId/5723/Stopping-Wildlife-Crime-Theres- An-APP-For-That.aspx	The main features of this mobile tool, like computer-guided species ID and law, GPS geolocation and regulations cookbook, bring all necessary data to officials to decide whether or not to let an item through an import checkpoint. Accessibility due to smartphone app compatibility Allows simple identification based on app instructions Easier reporting of crimes against wildlife Provides expert assistance through image upload Coordination with law enforcement for better tracking and security Geolocation using built-in GPS	If that does not work, the app outsources the request to external scientists who usually provide an answer within 24 hours. Reliability in animal identification Coverage limited currently to China	

Name	Description	Proponent	Link	Pros	Cons	Rank
RhODIS® and eRhODIS	The DNA- and IT-based Rhino DNA Indexing System (RhODIS®) and Electronic Rhino DNA Indexing System (eRhODISTM) provide forensic tracing for African rhinoceroses and their parts (including horns), linking parts back to source animals and criminals to specific crimes. The project aims to increase its impact through development and validation of an internationally available rhinoceros' nuclear DNA analysis kit. The DNA analysis of ivory, when compared with DNA-based mapping of elephant populations, allows investigators to pinpoint the origins of illicit ivory and focus enforcement on high-risk areas.	University of Pretoria, Samsung	http://www.sciencemag.org/content/early/2015/06/18/science.aaa2457.full.pdf	The capacity to use DNA barcoding to identify any specimen in a few hours is already a reality. Species identification of endangered wildlife, quarantine pests, and disease vectors are just a few areas in which DNA barcoding is enabling researchers, enforcement agents, and consumers to make informed decisions in much shorter time frames. Serve as tool in differentiating	High skills of DNA analysis and coding are required. Coverage limited currently to African countries Currently is still under further development Needs further profiling prior to application	

Name	Description	Proponent	Link	Pros	Cons	Rank
				legal and illegally acquired horns in stockpiles Help trace the origin of the horn in African Countries Provides information on possible high-risk areas for better law enforcement Assist in investigations against poachers and related crimes Uses forensic evidence to establish link between crime and victim		
International Barcode of Life (DNA barcoding)	DNA barcoding allows researchers to identify species from very small fragments of genetic material. The International Barcode of Life is an initiative of scientists and conservationists in 25 countries, including the Philippines through the UP Institute of Biology, is cre	University of Guelph	http://www.barcodeoflife.org/content/about/what-dna-barcoding	As of 2014, DBL has already generated DNA barcodes from 83 species from the Philippines, which include birds, fishes, snails, and nematodes, with	High skills of DNA analysis and coding are required. False negatives could result to wrong interpretation of results	

Name	Description	Proponent	Link	Pros	Cons	Rank
	ating a global DNA barcode librar y of species.			more barcodes expected in the coming years. Can be used in environmental monitoring and assessment Applicable to various organisms including plants and animals alike Help in assessing origins of wildlife and exotic products Simplifies the identification of organisms and related species	Current application is limited in scope	
Hand-held / DNA sequencer	The hand-held nanopore DNA sequencer's goal is to fully automate DNA sequencing and species ide ntification at a crime scene in ap proximately one hour rather than days. This could be used to test blood stains on the machete of a poacher, identify bushmeat from endangered animals such as chi mpanzees at local markets, and	University of Leices ter & Oxford Nano pore Technologies	http://www2.le.a c.uk/offices/pres s/press-releases/2016/m ay/using-portable-nanopore-dna-sequencers-to-combat-wildlife-crime	The device will also reduce the inconvenience to legitimate traders and raise awareness of the extent and diversity of illegal trade.	The device alone will not improve wildlife protection; hence basic capacity is required. High cost per reading	

Name	Description	Proponent	Link	Pros	Cons	Rank
	even detect the frequent illegal substitution of products derived from protected species in the caviar trade.			Shortens time needed for DNA analysis Portable and low-cost instrument Readily available to interested individuals Provides real-time DNA analysis	Error rate is possibly high and biased	
Wildleaks (Website and online community)	Wildleaks, translated into 16 languages, allows users to anonymously report wildlife crimes all over the world. The site has provided law enforcement and journalists with valuable information on crimes related to ivory, rhino horn, big cats, apes, pangolins, birds, and timber. WildLeaks is the world's first whistleblowing initiative dedicated to wildlife and forest crime.	Elephant Action League	http://wildleaks.org/	The site's strength is its anonymity, so tippers won't have to fear possible repercussions if they were found out. Anonymous reporting of wildlife crimes Enhanced security due to Tor technology Accessibility through web platform	Its weakness is that, as the Guardian points out, many rural communities lack internet access, which limits WildLeaks' reach. Authenticity of information is subject to further validation Use of platform produces technological risks Does not guarantee security of whistleblower to	

Name	Description	Proponent	Link	Pros	Cons	Rank
				Promotes transparency on key wildlife issues	societal/general risks	
Global Database of Events, Language, and Tone (GDELT) (Realtime network diagram and database)	Funded through Google, GDELT tracked broadcast, print, and web media from across the globe for three months to map wildlife crime. The result is an interactive map that allows users to explore media on rhino poaching in South Africa, elk poaching in Canada, wildlife trafficking in Croatia, and overfishing in Brazil		http://www.gdeltproject.org/	GDELT monitors the world's news media from nearly every corner of every country in print, broadcast, and web formats, in over 100 languages, every moment of every day. Open-access tool Accessibility through web platform Harness data even from minor information sources Produces a dynamic and interactive map	It requires high analytical skills. Reliant on existing data on the internet and media stations Language translation from different sources might result to data discrepancies	

Name	Description	Proponent	Link	Pros	Cons	Rank
				Real-time mapping of wildlife crimes which can lead to better law enforcement Can help in identifying high-risk areas for wildlife Availability is not limited to certain countries and is available in 65 languages		
Healthmap Wildlife Trade (Database)	The HealthMap Wildlife Trade database, developed by, similarly uses media accounts to track trends in wildlife crime to identify important geographic choke points along the illegal wildlife trade chain to help law enforcement interdict traffickers.	Nikkita Patel, the University of Pennsylvania	https://www.wired.com/2015/06/using-news-reports-track-wildlife-black-markets/	To identify the key exporter, intermediary, and importer countries and the countries where enforcement activities and educational campaigns might most effectively disrupt the networks. Summarizes network and composition of	Reliant on existing data on the internet Text-mining algorithm is based on English and Japanese language only No validation is made on informal data	

Name	Description	Proponent	Link	Pros	Cons	Rank
				illegal wildlife trade Identifies geographic choke points for better law enforcement Accessibility through web platform Data availability is not limited to specific countries		

3.0. Key take-aways and Recommendations

3.1. Consumer demand research

Much of the published information on consumer research have zeroed in on the big 5: rhinos, elephants, tigers, pangolins and turtles. These are, by far, the most traded wildlife globally based on the volume criteria. The USAID Wildlife Asia work is, by and large, the most comprehensive and authoritative work on consumer demand research because it identified target groups consuming specific species and have linked these to the various consumers' motivations and values, and how those influence their decision making. Such study is clearly lacking in the Philippines.

It is recommended that same methodological approach (designed by USAID Wildlife Asia) in determining consumer demand be adopted in the Philippines (See Annex 1. Recommended survey instrument developed for the Philippines study). Once the DENR, through this research, has established who the consumers are and what their consumption patterns are, DENR will be able to induce the target market to stop consuming. In order to understand who those consumers are, the coverage and representation of the sample groups should include general public, academics, NGO workers, community leaders etc in the major areas of confiscations – NCR, Calabarzon, Palawan, Regions 3,11,and 13. Based on the results of the research, new behaviour change campaigns that talk directly to the consumer, using appropriate communication channels and messages that target each consumer group will be crafted.

There is an urgent need to tackle the problem from a consumer's perspective in order to reduce demand for wildlife products particularly in the urban areas near the source areas i.e. protected areas or key biodiversity areas. Accepting that changing people's behavior, however can take time, these behavioural change actions need to sit alongside ongoing/future protection work programs at the sites level – usually protected areas where the natural habitats for target species are. For example, behaviour change campaign to reduce the indiscriminate slaughter and consumption of endangered wildlife including flying foxes, hornbills, tamaraw, deers, hawksbill turtles, pangolins in Agusan Marsh, Siagao, Palawan, Mindoro etc. Anti-poaching measures and support for improved law enforcement can only do so much to combat illegal wildlife trade..

3.2. Stakeholder analysis

There is a global consensus that the best route to addressing IWT is to strengthen 'end-to-end enforcement' or tackling the entire supply chain from poacher to end user. To achieve this, there is a need to strengthen legislation and law enforcement capability at national, regional and global levels, with coordinated international responses across source, transit and destination countries. However, end-to-end enforcement will not be effective unless government engages with the communities living alongside the wild populations we seek to safeguard. It must also be recognized that the rhetoric about the importance of community engagement as a very crucial element of the response to IWT has received limited attention. The 'hidden stakeholders' are the most neglected players in the entire supply chain as enforcement is concentrated in the ports or markets. It is suggested that the project also considers developing a strategy that links other work programs of DENR (BMB) that deal with 'hidden stakeholders' which include the local communities. Driven by poverty in the rural areas, their proximity to and knowledge of wildlife, local communities have the propensity to participate in and support illegal hunting, collection and trafficking. However, they are also well placed to help prevent wildlife crime e.g. intelligence work by providing vital information or wildlife wardenship or guardianship.

Empowering communities should be one of the central strategies in addressing IWT. Experience (by the collaborative works of well-established NGOs such as WWF, CI, FFI) shows us that this can be done by engendering communities to prevent wildlife crime, by ensuring that they have the requisite skills, resources and incentives to engage in wildlife protection, support law enforcement groups, promoting sustainable livelihood initiatives, defusing wildlife conflict and strengthening local institutions. Therefore, it's about smarter enforcement, not just tougher enforcement i.e. more effective long-term deterrent than externally imposed top-down enforcement. Preventing wildlife crime at source and building capacity and leadership at site level are key.

3.3. Priority Species for economic valuation and CEPA

There is a consensus in the literature that IWT involves complex networks between transnational crime syndicates, poachers, armed non-state actors, traders and consumer. Mapping the links between the various actors or to look in detail at their operating practices has been a challenge. This may be a consequence of the fact that the trade is clandestine and therefore empirical evidence is limited. Another challenge is that usable data sets on wildlife trade and its impacts are extremely difficult to obtain. The trade is highly complex and its legal and illegal forms are often interconnected. There are a wide range of reasons why wildlife is traded illegally. Key motivations include: poverty in source countries; subsistence needs; and demand increase in consumer countries; the desire to improve financial well-being; income generation; corruption; poor law

enforcement and low penalties; lack of legislation in source countries; cultural practices and traditions; the desire to retaliate for direct losses due to wildlife.

Although it is clear that (based on confiscation records) the reptiles (represented by the gekkos, marine and terrestrial turles) mammals (represented by the pangolins) and birds (hill myna and parrots) are the most in-demand wildlife in IWT in the Philippines - in both the volume criteria and value criteria. Prioritizing species for economic valuation studies and CEPA based on this body of knowledge presented by the confiscation records might give an incomplete picture. It is recommended that the result of this prioritization be triangulated with the result of the consumer demand study. By doing this, one can confirm if there is indeed a demand for these top species domestically. These will then be subject to the behavior change campaign.

3.4. Technology for IWT monitoring and enforcement

This analysis of technologies for IWT are intended to help practitioners identify and implement technologies that can aid them in their work, driving tangible results and conservation benefits.

The following are recommendations:

Define the technology solution need. Any decision to invest in and implement a technology solution should be based on a clearly identified need. Including new technology solutions without considering the demand this will place on human and financial resources, and whether they will deliver added value. A needs assessment with the relevant members of staff and partners will enable open discussion of the costs and benefits of the technologies under consideration, and an informed decision on how to proceed. Once the needs are identified, these needs /requirements can be matched with the reviewed technology solutions in section XXX.

Develop cross-sectoral partnerships to assist effective implementation. To increase the likelihood of success and attain real efficiencies in combatting IWT, it will be important to build technology solutions into existing intra/inter-agency partnerships. However, introduction of a new technology often demands significant financial and human resource investment. This may also demand changes to work practices and/or acceptance of an unfamiliar tool. It is essential, therefore, that all those affected have a clear understanding of the purpose of the technology, or it will be a challenge to secure support for investment in, or regular use of, any new system.

Build capacity to use the technology solution. Technologies are an enabler rather than solutions in themselves. Unless there is human resource with the skills to use the technology solutions/system will not substantially improve monitoring efforts unless the data is correctly captured, collected, curated and analysed. The key strategies will be the provision of practical training to ensure that those expected to use the technology solutions have the skills to do so effectively. Staff turnover is a common issue amongst the partners so it is very important that the relevant skills are transferred to the new member(s) of staff. The other strategy is to identify Technology Champions who will help to sustain enthusiasm for the use of the new tools, and can

play a trouble-shooting role should any technical issues arise or other members of the team have questions about the technology of equipment.

Stakeholder participation in technology design and implementation. Customising existing ones for a specific conservation purpose is highly recommended if the option of a bespoke system is expensive. A collaborative and iterative approach to developing or enhancing existing technologies solutions involving all key stakeholders, particularly the intended users of the technology, in the process of project design through contribution of feedback and recommendations, will help to build understanding and confidence in the proposed technology. It will also enable expectations to be identified and managed appropriately and ensure that the resultant technology is designed and implemented in a way that best meets the expectations of the user.

Increase capacity for Data and Information management. Key addressing IWT is data management, data curation and data analysis that will inform management actions. As agencies use the technology solutions, it shall be DENR's role to manage the data and transform this to usable information. The ease of data retrieval, data interrogation and data sharing must conform with standard data management and retrieval systems used by international bodies such as TRAFFIC, IUCN, etc. In this report, I have suggested a data structure that will improve the data retrieval and analyses (see Annex XXX Excel file).

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