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Project Title: Annual Illegal Wildlife Trade and Uses: Most Traded Items in the Families of Elephantidae and Rhinocerotidae over a 42-Year Period (1975-2017).

School of Environmental & Life Sciences

**Statement of originality:**

I declare that, with the exception of any statements to the contrary, the contents of this report/dissertation are my own work, that the data presented herein has been obtained by experimentation and that no part of the report has been copied from previous reports/dissertations, books, manuscripts, research papers or the internet.

Signed.....*S.Yildiz*..... Print name.....Sevim Yildiz.....

Date.....19/04/2019.....

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### ***List of Abbreviations***

African Elephant Conservation Act 1988	AECA
Appendix	Appx.
Communal Areas Management Programme for Indigenous Resource	CAMPFIRE
Convention on Biological Diversity	CBD
Department for Environmental, Food & Rural Affairs	DEFRA
Elephant Trade Information System	ETIS
Endangered Species Act of 1973	ESA
Illegal Wildlife Trade	IWT
International Fund for Animal Welfare	IFAW
Monitoring the Illegal Killings of Elephants	MIKE
National Norms and Standards for the Management of Elephants in South Africa	NNSMESA
National Parks and Authority of Zimbabwe	NPWAZ
Record Analysis Flora and Fauna in Commerce	TRAFFIC
The Convention on International Trade in Endangered Species of Wild Flora and Fauna	CITES
The National Environment Management Act of 2004	NEMBA
The World Conservation Union	IUCN
Traditional Chinese Medicine	TCM
Traditional Eastern Medicine	TEM
United Nations Office on Drugs and Crime	UNODC
Wildlife Conservation Society	WCS
World Wildlife Fund	WWF

### ***List of Countries***

Botswana (BW)	United States of America (US)	India (IN)
United Kingdom (UK)	Australia (AU)	Canada (CA)
Namibia (NA)	Thailand (TH)	Switzerland (CH)
Germany (DE)	Belgium (BE)	Austria (AT)
Zimbabwe (ZW)	Vietnam (VT)	Slovakia (SK)
South Africa (SZ)	Singapore (SG)	Netherlands (NL)
Japan (JP)	Malawi (MW)	Poland (PL)
China (CN)	Central African Republic (CF)	Zambia (ZM)
Congo (CO)	Hong Kong (HK)	Tanzania (TZ)
France (FR)	Italy (IT)	Cameroon (CM)
Israel (IL)		Somalia (SO)
Denmark (DK)		Mozambique (MZ)

## **Annual Illegal Wildlife Trade and Uses: Most Traded Items in the Families of Elephantidae and Rhinocerotidae Over a 42-Year Period (1975-2017).**

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### ***Abstract***

Illegal wildlife trade is one of the most potentially threatening crimes globally, listing at the third highest criminal activity, next to illegal drug and gun sales. Elephants and Rhinoceros are exploited for their charismatic features for human consumption, commodities, Chinese traditional medicine and profitable investment. This study aims to assess annual trade from 1975-2017 (42-year) to determine increase or decrease in trade activity. Statistical regression analysis showed annual trading activity was ( $p = 0.495$  Elephant) and ( $p = 0.032$  Rhinoceros). Elephants showed a stable increase over the years, whereas Rhinoceros showed an increase and decrease over the 42-year period. MIKE data was to determine if year impacted the percentage of illegal killings in elephants. There was a significant difference in trade levels. Transport routes and hotspots presented that Europe, Asia and Africa were the highest areas of the world to have popular trafficking routes. MIKE data with a ( $p = 0.036$ ) suggested a significant increase in illegal killings in Elephant over the time period of 15 years.

**Keywords:** Illegal wildlife trade, Elephant (Elephantidae), Rhinoceros (Rhinocerotidae), MIKE, hotspots, importation and exportation.

### ***Introduction***

Global trade in illegal wildlife is a potentially vast illicit economy (Bell, 2016), wildlife trade has fluctuated into a multibillion-dollar industry, which causes >40,000 elephant deaths (Samuel, *et al.*, 2018) and >65,000 rhinoceros' deaths since rhinoceros horn trade ban in 1976 (Crowfoot, 2011). This is despite decades of regulation from local governments, global political pressures and international conservation efforts (Enright, 2008). Involving the

unlawful harvest of live animals, parts and derived products of species (USFWS, 2018a). Wildlife trade comes in forms of skins, leather goods or souvenirs, food and traditional medicine (USFWS, 2018a). Species populations are being jeopardized by habitat loss, fragmentation, human-elephant conflict and illegal killing (UNEP *et al.*, 2013). Illegal wildlife commodities include; elephant ivory and rhinoceros' horn which are estimated at \$7 billion to \$10 billion annually (Bell, 2016).

The motivation for wildlife traders engaging in illegal activity appears to be economic gain, together with increasing demand that surpasses what markets can legally supply in several parts of the world; especially where recent economic growth is driving developments of households with disposable income. Countries including; China, United States and Western European countries like France, Italy, Spain, Germany (Bell, 2016), The United Kingdom (IFAW, 2018a) and Latin America (Martin, 2000) also Russia (IFAW, 2018a). Black markets are valued to represent a fifth of the global economic movement, however their response to policy is poorly understood as participants systematically hide their actions by masquerading illegal products as legal (Hsiang & Sekar, 2016). Corruption through document fraud (mis-declaring species, number, volume or origin on legitimate paperwork) Licences and permits can be changed (false documentation made legitimate) (Wyatt, *et al.*, 2018).

Illegal activity is ever growing and platforms via the internet are ever-expanding and gaining ground (CITES, 2018d), with improved access to the internet, discussion groups, mobile phones and others simplified ways of sharing trade information (Anon, 2009), such as websites where wildlife products are available and openly advertised, especially parts of 'rare' species, for instance elephants and rhinoceros (Williamson, 2004; IFAW, 2005; Wu, 2007; IFAW, 2008).



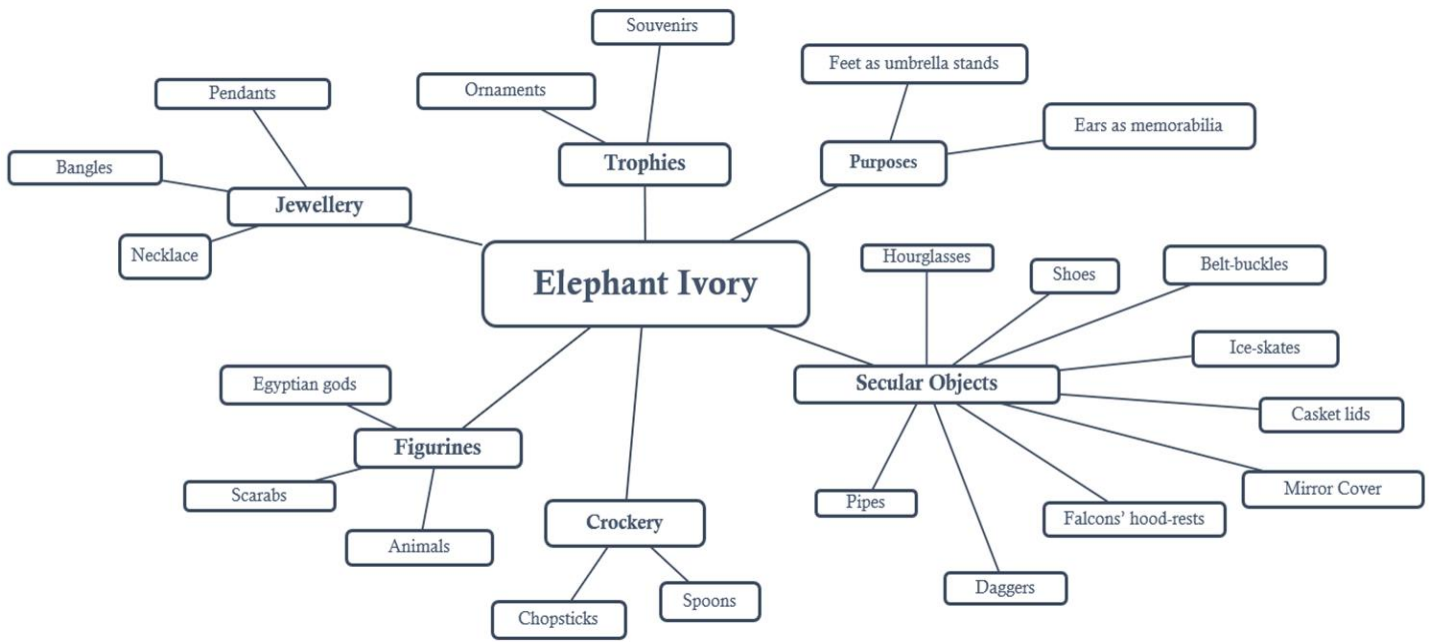


Figure 1a: Multiple uses of Elephant ivory

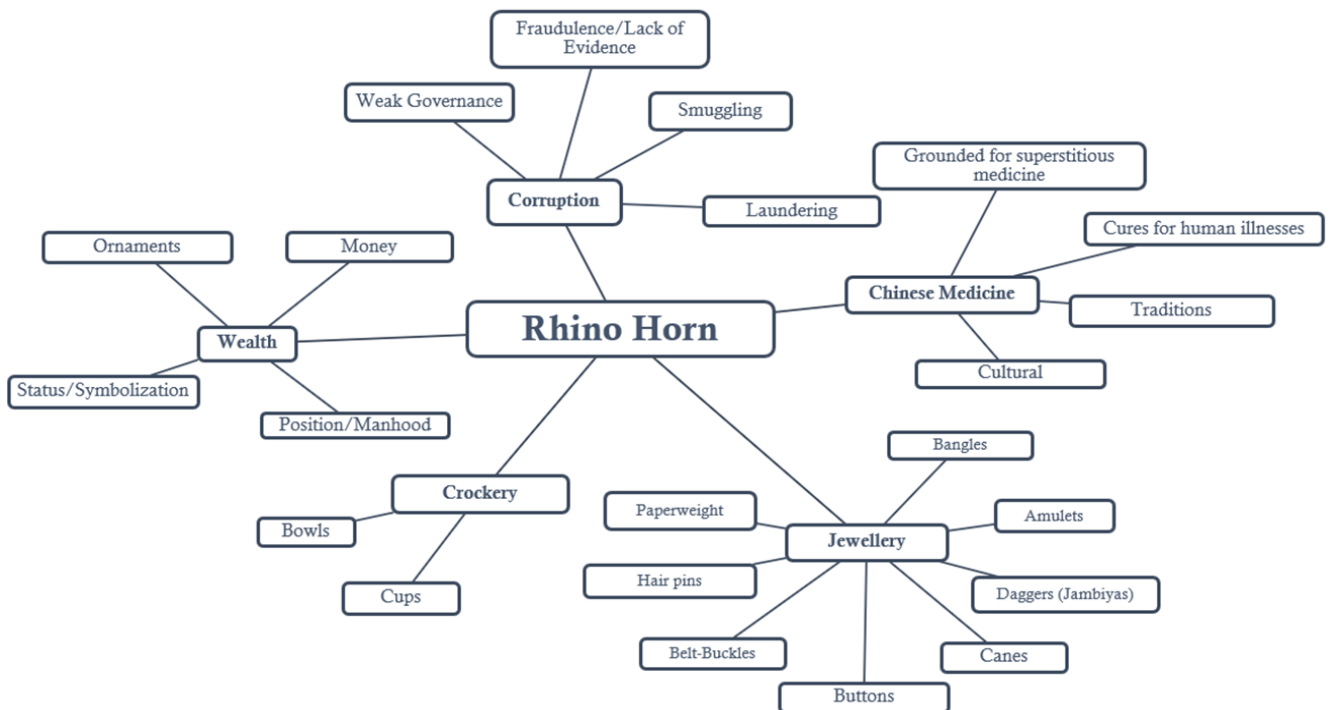


Figure 1b: Multiple uses of Rhinoceros horn

Exporting wildlife can cause millions of fauna and flora populations depleting due to being mere commodities (Coskun, 2003). Major ivory consumers are imperial courts or scholar-officials. Gratifying their tastes with the following items; assorted items were produced, figurines, ornaments, scholar articles, vessels and other idyllic objects (Gao & Clark, 2014). Revenue from species products can be used to provide income to rural communities that endure the costs of living with elephants (Biggs, *et al.*, 2017), human-elephant conflict (UNEP, *et al.*, 2013) crop raids, and fund conservation and development programmes (Biggs, *et al.*, 2017).

### **CITES**

CITES is a global treaty, which assesses the impacts on a global scale (Burn *et al.*, 2011). CITES (The Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments (CITES, 2018a). CITES prohibits the catchment and trafficking of endangered wildlife, which restricts traffickers from seeking illegal profits (Nyong, 2011). The aim is to ensure the international trade in illegal transportation of species items and derived products does not threaten their survival nor their populations (Douglas-Hamilton, 2013; CITES, 2018a). CITES was first drafted in the 1960s during international talks for regulations of wildlife trade. CITES was accepted in 1963 at a meeting of members of IUCN (The World Conservation Union) (CITES, 2018b) in Nairobi, Kenya (CITES, 2013a).

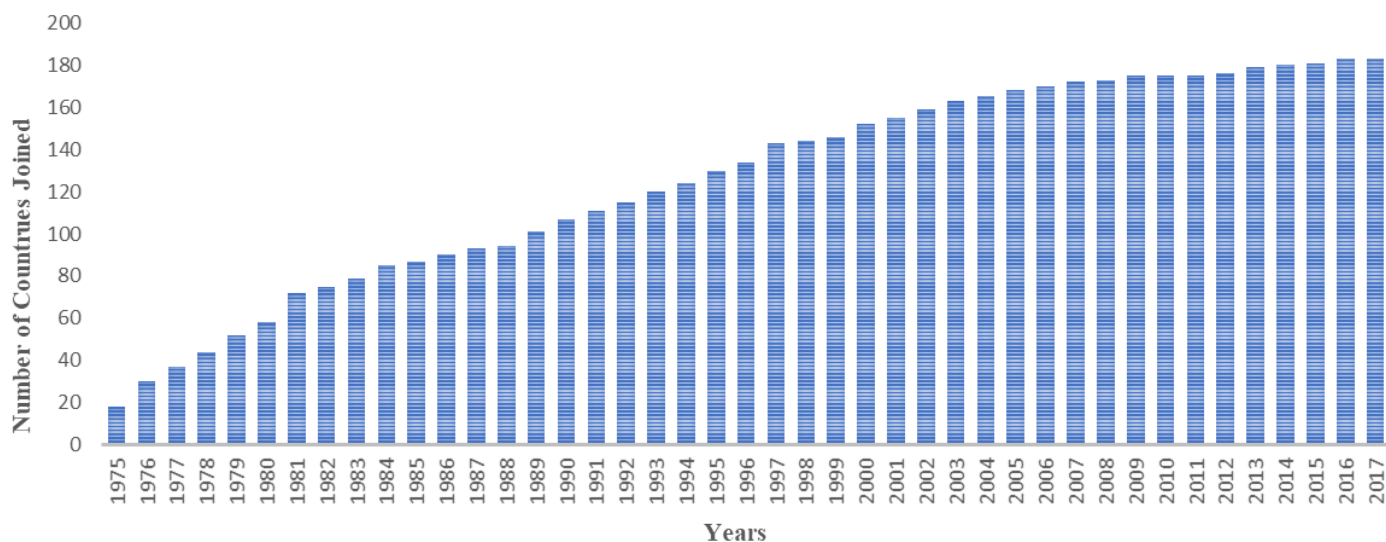


Figure 2a: Accumulation of countries entered CITES treaty 1975-2017.

CITES was originally signed by 21 nations in 1973 (Sheikh & Corn, 2016), then signed by representatives of 80 countries on 3<sup>rd</sup> March in 1973 at Washington D.C. CITES came into force on July 1<sup>st</sup>, 1975. Fig 2a (See above) demonstrates the accumulation of parties joined since CITES came into force in 1975. Today, CITES holds 183-member state (Also known as parties) agreement to the convention (Douglas-Hamilton, 2013; CITES, *et al.*, 2013b; CITES, 2018b). CITES secretariat is administered by the United Nations Environmental Programme (UNEP) in Geneva, Switzerland (CITES, 2018b).

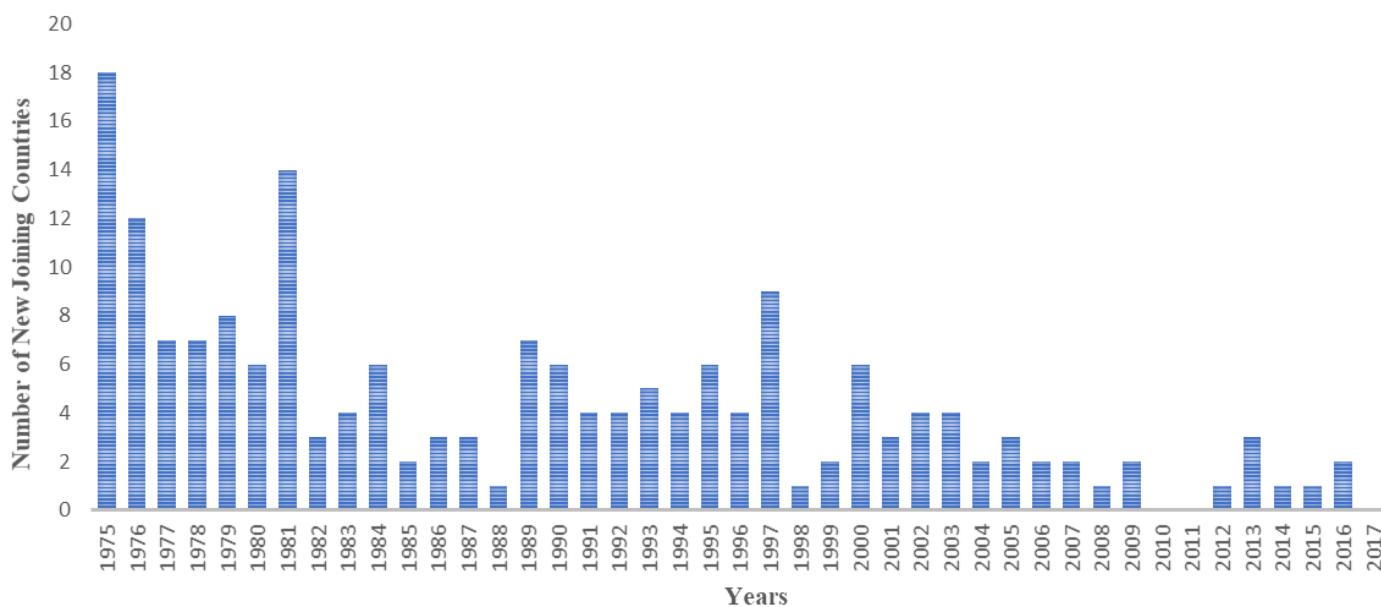


Figure 2b: Illustration of number of new countries joining CITES since come into force.

Each country which is referred to a party, must comply with both a Management Authority and Scientific Authority to move forward with the treaty. A Management Authority enforces that CITES listed species are legal for trade through the issuance of permits (European Union, 2010; USFWS, 2018b). A Scientific Authority defines whether the species being traded could be damaging to the survival of population in the wild, determining legal and illegal trade, to standardized permits that allow inspectors at exportation and importation ports to quickly authorise CITES specimens correctly (European Union, 2010; USFWA, 2018b) and specified (Martin & Parker, 1982). Appendices I, II, III were established – Appendix I provides the highest protection by banning all movements of trade in the product of endangered species, Appendix II – provides an intermediate level of protection rather than banning trade.

*Table 1a: Current Elephant and Rhinoceros status in the wild. (IUCN, 2019)*

<b>Species</b>	<b>Scientific Name</b>	<b>IUCN Status</b>
Asian Elephant	<i>Elephas maximus</i>	Endangered
African Elephant	<i>Loxodonta africana</i>	Vulnerable
Black Rhinoceros	<i>Diceros bicornis</i>	Critically Endangered
White Rhinoceros	<i>Ceratotherium simum</i>	Near Threatened
Javan Rhinoceros	<i>Rhinoceros sondaicus</i>	Critically Endangered
Sumatran Rhinoceros	<i>Dicerorhinus sumatrensis</i>	Critically Endangered
Indian Rhinoceros	<i>Rhinoceros unicornis</i>	Vulnerable

A limited amount of trade will be approved by a central authority or by individual governments, Appendix III – provides the least protection since it involves a mere identification of potentially threatened species (Khanna & Harford, 1996; CITES, 2018c; Santos *et al.*, 2011). Asian elephants (*Elephas maximus*) were listed as Appendix I in 1975, however African elephants (*Loxodonta africana*) were listed as Appendix III in 1976, swiftly up-listed to Appendix II in 1977, 12 years on (*Loxodonta. a*) was listed as Appendix I in 1989 (UNEP *et al.*, 2013), when the ban for ivory trade was enforced (Humane Society International, n.a). However, a few African states continue to sell ivory (Perlez, 1989) (Table 1b).

CITES agreed to a “one-time” ivory sale of stockpiles in 1999 and again in 2007-2008 (Leask, 2019). Elephants in Botswana (BW), Namibia (NA) and Zimbabwe (ZW) fell target to an international deal and were down-listed with restrictions to Appendix II in 1997 (Panjabi, 2014). But, in the same year members of CITES voted to a “one-time” experimental sale of 50 tonnes of raw ivory from (South Africa - ZA, BW, NA) to allow ivory stockpiles sales to Japan in 1999 (Humane Society International, n.a), without re-exportation (Stiles, 2004). In 2000, ZA elephants were down-listed with restrictions to Appendix II (Table 1b).

*Table 1b: Current Elephant and Rhinoceros appendix listings. (CITES, 2019)*

<b>Species</b>	<b>Appendix</b>	<b>Exception</b>
Asian Elephant	I	-
African Elephant	I/II	Botswana, South Africa, Zimbabwe are Appendix II
Black Rhinoceros	I	-
White Rhinoceros	I/II	South Africa, Swaziland are Appendix II
Javan Rhinoceros	I	-
Sumatran Rhinoceros	I	-
Indian Rhinoceros	I	-

Rhinoceros trade was banned in 1977 (Roach, 2013) with debates to allow permissible trade with restrictions to meet the great demand for rhinoceros horn (Panjabi, 2014). CITES included all rhinoceros subspecies in Appendix I (Sukpanich, 2013). In Asia, CITES listed Sumatran (*Dicerorhinus sumatrensis*), Javan (*Rhinoceros sumatrensis*) and Indian (*Rhinoceros unicornis*) as Appendix I. In Africa, listing is more complex with the black rhino (*Diceros bicornis*) especially with the western black rhinoceros (*Diceros bicornis longipes*) officially extinct in 2011 in Appendix I (Roach, 2013; Bornfree, 2019) and white rhinoceros (*Ceratotherium simum*) in Appendix I except for species located in ZA and Swaziland (SZ) are Appendix II (CITES, 2018c) the down-listing in ZA happened in 1994 and SZ in 2004 (Sukpanich, 2013). CITES aid global species conservation (CITES, 2013a).

### ***Rhinocerotidae Populations***

Populations of rhinoceros had suffered a dramatic drop in the latter years of 1970-80, especially for black rhinoceros (*D. bicornis*) With a decline from 70,000 individuals in 1970 to just 2,410 in 1995. Today between 5,042 to 5,458 remain in the wild due to conservation programmes across Africa (Aryal *et al.*, 2018) (Table 2a, b, c). Subspecies have equally dropped (Poachingfacts, 2018). With three species primally native to Asia: Sumatran rhino, Javan rhino and Indian rhino (Known as Greater One-Horned rhino). Including two species native to Africa: The Black rhino and the White rhino. All five species have been subjected to CITES trade prohibitions since the mid-1970s (Bell, 2016). Indian Rhino (*R. unicornis*) by 1900, <200 individuals remained, today >3,550 remain in the wild. White Rhinoceros (*C. simum*) recovered from just <50-100 in the early 1900s, today with an increase; there are numbers between 19,666 to 21,085. For Javan Rhinoceros (*R. sumatrensis*) only 67 and Sumatran Rhinoceros (*D. sumatrensis*) >80 remain (Poachingfacts, 2018). Rhinoceros located within Kenya are kept behind fences (Esmond & Martin, 1987) (Table 1c).

### ***Elephantidae Populations***

Populations of African elephant (*Loxodonta africana*) and Asian elephant (*Elephas maximus*) have declined drastically (Bennett 2015; Lusseau and Lee 2016). Asian elephant is native to Thailand (WWF, 2019a) China, India, Nepal and Viet Nan (IUCN, 2019d). African elephant is native to Zambia, Nigeria, Mozambique and Kenya within Central, West and South of Africa (IUCN, 2019e). 72% of African elephant (*L. africana*) populations declined from a thriving 1.3 million in 1979 to around 350,000 (Jackson 2013; Chase et al. 2016; Robson et al. 2017) primarily hunting for ivory trade (Milnergulland & Beddington, 1993). Similarly, Asian elephant (*E. maximus*) in the last 60 years have declined by 50%. Estimates ranging from 41,410 to 52,345 currently living in the wild (Chase et al. 2016; Choudhury et al. 2008). CITES banned commercial trade internationally in 1989 (Martin and Stiles, 2008) (Table 1c).

*Table 1c: Current Elephant and Rhinoceros Populations. (IUCN, 2019)*

<b>Species</b>	<b>IUCN Current Population</b>
Asian Elephant	Decreasing
African Elephant	Increasing
Black Rhinoceros	Increasing
White Rhinoceros	Increasing
Javan Rhinoceros	Unknown
Sumatran Rhinoceros	Decreasing
Indian Rhinoceros	Increasing

### ***MIKE (Monitoring the Illegal Killings in Elephants)***

In 1997, parties within the CITES treaty launched a global monitoring database (Biggs et al., 2017) called MIKE (Monitoring the Illegal Killing of Elephant). These were situated across 79 field site locations throughout Africa and Asia to track elephant poaching (Hsiang, 2016; Burn, Underwood and Blanc, 2011; CITES Standing Committee, 2012). The primary collection began mid 2002 (Hsiang, 2016; Burn, Underwood and Blanc, 2011; CITES Standing Committee, 2012). A database that collects, analyses poaching and mortalities (Biggs et al, 2017; the number of elephants illegally killed across the regions (Olivia & Porsch, 2015). These data points are collected by anti-poaching patrols and records include cause of death (i.e. illegally or natural causes) (Burn *et al.*, 2011).

### ***Causes of Trafficking***

Rhinoceros horn accelerated in value from \$35 per kilo to a storming \$9,000 per kilo in the early 70s and 80s (Ellis, 2005). Grounded Rhinoceros horn is exercised in medical remedies, this soared in value ranging from \$20,000 and \$30,000 per kilo (Ellis, 2005). However, Bell (2016) states rhinoceros' horn can go for as much as \$50,000 per kilo. Ives (2012) implies that in 2012, grounded horn is sold for \$55,000+ per kilo in Asia alone. Kolbert

(2014) adds that, in 2014 horn is \$25,000 a pound. Moving forward to 2014, rhinoceros' horn has been known to be worth more than gold or platinum in black-markets (Fedotov, 2014). Average retail price worth is \$65,000 per kilogram (Rolfes-sas, 2012), with an individual horn now valuing \$150,000 (Markar-Macan, 2013).

Elephant are also at risk for their commodities (Panjabi, 2014). In the mid-70s, ivory worth was estimated at \$6 per kilo. In 2014, the retail price Vira & Ewing (2014) states ivory value increased to more than \$3,000 per kilo. However, in Asia, per kilo of ivory is valued at \$850 (dailynewsegypt, 2014). United Nations Office on Drug and Crime (UNODC) stated smuggling activity imported to Asia from Eastern Africa was implied to be over \$31million (€23m) in 2011 (dailynewsegypt, 2014) but Sand (2013) suggests illegal trade in and from Asia and Pacific is worth \$20 billion annually, Nyong (2011) disagrees and states that endangered species traded exceed \$20 billion per year. Other sources suggest that ivory value ranges between \$1,000 and \$1,500 in Asian markets (Donaldson, 2014). Wexler (2011) says China has the largest market for ivory and has risen from \$157 per kilo during 2008 to \$7,000 per kilo in 2011. It was estimated by United Nations that ivory trade is \$100 million. Gettleman (2012) agrees that it is ten times worth an annual average income.

Wildlife trade can be trafficked in various approaches from items, commodities and species derivates (Broad *et al.*, 2003; Lee *et al.*, 2014) and can accumulate profitable outcomes on black-markets (Khanna & Harford, 1996), needed to inform status (Graham-Rowe, 2011; Milliken & Shaw, 2012). In Egypt, ivory is used to make trinkets, Egyptian gods, necklaces (Panjani, 2014). In Yemen and Oman rhinoceros' horn is carved for dagger handles (Enright, 2008). Rhinoceros' horn was exported from East Africa to Great Britain for walking sticks and door handles (CITES, IUCN, TRAFFIC, 2013). Chopsticks in China (Barrett, 2012), hourglasses, spoons and shoes (Beigbeder, 1965) even memorabilia and Indian wedding bangles (Wylie, 2008) and used in traditional Chinese medicine in East Asia and the Middle East (Graham-Rowe 2011).



Changing of circumstances allow traders to adapt to both illegal and legal trade (TRAFFIC, 2008). Small quantities are less favoured by smugglers (Underwood *et al.*, 2013). Larger quantities are much more favoured (Ferrier, 2008). Discovering new technologies to smuggle without detection (South & Wyatt, 2011; Wyatt, 2013; Challender *et al.*, 2015). Through means of briberies, smuggling, misdeclare quantities, false evidence, weak legislation (Wyatt and Cao, 2015). Those involved in such trade actions are not aware these items are prohibited (Alacs & Georges, 2008). Internet and social media have increasingly become the most used platforms to sell various items of illegal wildlife products (Harrison *et al.*, 2016), species of high value and profit (Sina *et al.*, 2016; Wyatt and Kushner, 2014; Wyatt, 2013).

### ***Illegal Trade and The Law***

Illegal wildlife trade, known as (IWT) is an illicit worldwide organisation that can threaten several taxonomic groups; mammals, fungi, plants and fish (Phelps *et al.*, 2016), impacts on the environment can affect livelihoods, national and food security, ecosystems and sustainable development (Dickson, 2008; Brashares *et al.*, 2014) and disease between livestock, wildlife (Cooney *et al.*, 2017) and biodiversity (Cooney *et al.*, 2015). Regulating trade requires strict enforcement, resources and time monitoring (Phelps *et al.*, 2010; Webber *et al.*, 2015). Without such, illicit wildlife trade prices increase (Rubino, Pienaar & Soto, 2018). IWT commonly target species of higher statue or profile (i.e. elephants and rhinoceros) (Phelps *et al.*, 2016).

*Table 2a: International wildlife laws and functions towards preventing illicit wildlife trade.*

<b>International Laws</b>	<b>Functions</b>
<b>African Elephant Conservation Act 1988 (AECA)</b>	Prohibits individuals from importing African elephant ivory into the United States, it also prevents the exportation of raw African elephant ivory from the United States (Bell, 2016).

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<b>Department for Environment, Food &amp; Rural Affairs (DEFRA)</b>	Restricts commercial importations, exportation and sales of ivory. However, DEFRA allows certain exemptions such as accredited museums, it will also be an offence to have possession, to sell and purchase (Dixon & Weiskotten, 2018).
<b>Elephant Trade Information System (ETIS)</b>	Created by CITES in 1997 (Fiona <i>et al.</i> , 2013), works by monitoring tracking of elephants for CITES (Cressey, 2013) globally (Fiona <i>et al.</i> , 2013). It also tracks illegal trading of elephants through seizures records (Stiles, 2008).
<b>Endangered Species Act of 1973 (ESA)</b>	Prohibits individuals of importing and exporting ivory; this restriction ranges from selling, transporting and commercial activity (Bell, 2016).
<b>Europol &amp; Interpol</b>	In partnership with Europol, Interpol promotes NGOs such as Environmental Crime Committee and Environmental Compliance and Enforcement Committee as contributors in emphasising the importance of monitoring wildlife trade (European Union, 2016).
<b>International Fund and Animal Welfare (IFAW) &amp; Environmental Investigation Agency (EIA)</b>	Working alongside Interpol are IFAW and Environmental Investigation Agency (EIA) who support projects such as Project Wisdom (European Union, 2016) Operation Worthy II (Interpol, 2019a) Operation Cobra II (Interpol, 2019b) – Project Wisdom, enhances law enforcement in disrupting international criminal routes of elephant ivory and rhinoceros’ horn (Interpol, 2019a). Operation Worthy II, supported by IFAW and Project Wisdom, prevents wildlife crime from all aspects (i.e. cross-border, multi-agency cooperation and organised intelligence) (Rosen, 2016). Operation Cobra II, tackles organisations involved in counterfeit and illegal medicines (Interpol, 2019b).

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<b>International Union for Conservation of Nature (IUCN)</b>	Provides data on illegal trade for CITES (IUCN, 2019a), in partnership with WWF - TRAFFIC (IUCN, 2019b) to defeat wildlife trafficking (IUCN, 2019c).
<b>The National Parks and Wildlife Conservation Act of 1973</b>	Restricts selling and displaying of elephant ivory for commercial purposes without certified permit (Martin, <i>et al.</i> , 2013).
<b>Trade Record Analysis of Flora and Fauna in Commerce (TRAFFIC) &amp; World-Wide Fund 1961 (WWF)</b>	Ensures wild species are not threatened by illegal trade, TRAFFIC focuses on the urgent trade issues, such as Elephant ivory and Rhinoceros horn (WWF, 2019b). WWF, protects wildlife species and habitats, (Schneider, 2012).
<b>United Nations Office on Drug and Crime (UNODC)</b>	Preventing organised wildlife crime advancing further and preventing wildlife trafficking (European Union, 2016). Highlighted in considering countries to make this a serious crime to wildlife (TRAFFIC, 2019a).
<b>Convention on Biological Diversity (CBD)</b>	Promotes and contributes to sustainable use of wildlife products to assist in reducing poverty (TRAFFIC, 2019b). and promote sustainable development (Roe, 2008).
<b>Wildlife Conservation Society (WCS)</b>	Attempting to improve and increase understanding of illegal trade (IUCN, 2019c).

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Challender & MacMillan (2014) & Wittemyer *et al.*, (2014) state Illegal Wildlife Trade (IWT) is a global conservation challenge that has dramatically increased in the last decade. Illegal wildlife trade sits as one of the high-listed criminal activity (Haken, 2011) which leads to extinctions in targeted species (Broad *et al.*, 2003), leads to ranger's deaths (Dell'Amore, 2012) and poachers (Poaching Facts, 2018; Brightman, 2011). This makes it increasingly

difficult to enforce trade bans especially with poor governmental control (Biggs *et al.*, 2017; Moyle, 2014) and management structure (Roe, 2008).

*Table 2b: Domestic wildlife laws and functions towards preventing illicit wildlife trade.*

<b>Domestic Laws</b>	<b>Functions</b>
<b>Communal Areas Management Programme for Indigenous Resources (CAMPFIRE)</b>	Local communities participate in conservation purposes while engaging in development programmes, using natural resources sustainability (Bond & Frost, 2005), benefiting from wildlife use (Stiles, 2004). Zimbabwe and Namibian Association of Community-based Resources Management Support Organisations (NACSO) aid these sales (Tavengwa 1997; Shigwedha 2004).
<b>Lacey Act of 1900</b>	In America, protects wildlife and prohibits illegal trading of wildlife by applying penalties. The Lacey act regulates importation of species that are protected by international and domestic law. In 2008 the act was amended to include plants, plant products and illegal logging (USFWS, 2006).
<b>National Norms and Standards for the Management of Elephants in South Africa (NNSMESA)</b>	(NNSMESA) restricts the movement of importation, exportations and any translocations, it also prohibits the hunting of elephants (Law, 2015).
<b>National Parks and Authority of Zimbabwe (NPWAZ)</b>	In Zimbabwe, Rhinoceros have been provided with the highest protection. Shoot to kill anti-poaching policy to discourage poachers (Kagande & Musarurwa, 2014).
<b>The National Environment Management Act of 2004 (NEMBA)</b>	In South Africa, without a permit, (NEMBA) restricts any activity that involves species that are endangered or protected (Law, 2015).

Table 2c: EU laws and their function in preventing European Union illegal wildlife trade.

EU Laws	Functions
<b>EU Action Plan Against Wildlife Trafficking (2016-2020)</b>	This plan implements on reducing organised criminal activity in wildlife trade (European Union, 2016). Reducing demand and corruption linked with wildlife trafficking (IUCN, 2019b), Engaging communities and addressing causes of wildlife trade (European Union, 2016).

This study will take the reader through elements of wildlife trade, especially looking at families of Elephantidae and Rhinocerotidae. reviewing ways of trade and discussing the evolution of trade and other illegal activities, analysing the most popular items of elephant and rhinoceros' goods. Analysing popular importation and exportation routes of illegal wildlife products and hotspots of which country has most activity; in addition to price growth, examining case studies and conservation laws in which all assist to diminish demand of wildlife trade.

## Methodology

Collecting records consisted on gathering Elephant and Rhinoceros data from The CITES Trade Database. This included sorting data files from 1975 to 2017 to establish if any increases or decreases happened during the 42-year period. In total, 75,627 data entries were Elephants, items selected (Ivory = 31,666; Tusks = 11,035). 6,011 data entries were Rhinoceros, items selected (Horn = 736; Carvings = 577). Each data entry of Elephant and Rhinoceros items/products were represented as one entry into the system, however, this become problematic due to each data entries measured in various units (Table 3a & 3b).

*Table 3a: limitations with elephant data collected, problematic to distinguish the true amount of trade being traded, these entries were measured in various units.*

Importer Amount	Exporter Amount	Items	Units
3	-	Horn	Kg
-	1	Horn	Sets
600	-	Horn	g
-	2	Carving	Pairs
22	24	Carving	-
-	12	Carving	-

*Table 3b: limitations with rhinoceros data collected, problematic to distinguish the true amount of trade being traded, these entries were measured in various units.*

Importer Amount	Exporter Amount	Items	Units
-	1	Ivory	Boxes
-	5	Ivory	Pairs
-	31	Ivory	Sets
1	-	Tusk	Shipment
-	500	Tusk	g
-	3125	Tusk	Kg

Once all data was collected and sorted under scientific name, common species name, taxa, appendix, etc. Secondly, identifying which items of trade were most desired; this was done by selecting one item (i.e. Ivory) and calculating all data entries, including where and to they were transported. Thirdly, was sorting the items for hot-spot mapping, importation and

exportation transportation and annual trade amounts, this was an accurate way of sorting the data efficiently.

### ***Annual Elephant and Rhino Trade***

Collecting data from 1975 to 2017 consisted on analysing all CITES entries and calculating the amount of trade on an annual basis. Each year was separated by the total amount of trade (i.e. Elephant Total trade: 1992 → 96,911) and so on until 2017; this method was to analyse if any strong indications of accumulations or depletions happened to elephant and rhinoceros trade over time, calculating annual data aided statistical analyse.









### ***Importations & Exportations***

The importation and exportation sample size was the top 30 countries, out of that, only the top 10 countries were selected to simplify the study. Implementing the same method for hot-spots, the same top two items were chosen, each column categorised as (item, exported from, imported to and amount) were selected. To calculate these entries, the products/items was selected (i.e. Horn) followed by the column labelled (i.e. exporter) these were filtered alphabetically. The amount linked to the country was calculated (i.e. China → South Africa), the same method was used for importer. This would help shape importation and exportation activity levels between which countries had strong desire for elephant and rhinoceros' items/products over the 42-year period. Four maps with arrows illustrating importation (green) and exportation (blue) were created to classify trade routes (Fig 4 & 5).

### ***Logarithms***

To determine the levels of activity of importation and exportation mathematic approach was used ( $\text{Log}_{10}$ ) to determine line thickness (Table 4). These numbers were selected based on the item/product quantity. These lines illustrate the amount/activity of trade entering and exiting countries.

*Table 4: Indicating line thickness by the amounts of trade.*

Line Thickness	Log <sub>10</sub> Equations	Line Thickness by Quantity
	Log <sub>10</sub> <sup>1</sup>	10
	Log <sub>10</sub> <sup>2</sup>	100
	Log <sub>10</sub> <sup>3</sup>	1,000
	Log <sub>10</sub> <sup>4</sup>	10,000
	Log <sub>10</sub> <sup>5</sup>	100,000
	Log <sub>10</sub> <sup>6</sup>	1,000,000
	Log <sub>10</sub> <sup>7</sup>	10,000,000
	Log <sub>10</sub> <sup>8</sup>	100,000,000

### ***Hotspots***

The same two top items of trade were chosen based on popularity, for elephant (Ivory and Tusk) and (Horns and Carvings) for Rhino. To determine sample size, top 30 countries for elephants and top 20 countries for rhinoceros due to lack of data files. In doing so, the countries were randomly selected based on the amount traded. Importation and exportation were separately calculated. The countries of higher activity were then plotted on to a world map, this aided the study to demonstrate where the issue of wildlife trade was. Once all data was collected and distributed individually onto eight maps, four being the number of separate products/items chosen (two for importation hotspots) and (two for exportation hotspots). Next was finding hotspot baselines in order to categorise the numbers into levels of trade (Table 5).



*Table 5: Illustrating trade amounts which determine hotspots.*

Level of Trade	Quantity
High-Level Trade	>100,000
Intermediate-Level Trade	<100,000
Low Intermediate Trade	<10,000
Low-Level Trade	<1,000

### ***MIKE (Monitoring the Illegal Killing in Elephants)***

Data collected from the MIKE database began from 2002 to 2017, this study is to determine is percentages in illegal killings in elephant increased over the 25-year period. Thus, enabling the study to have a strong relationship to understand the decline in elephant populations. To calculate the percentages, the number of illegal carcasses found was divided by the number of carcasses found, then times by 100 to find the percentage of illegal activity during this 15-year period. MIKE data can be found in (Appendix 3).

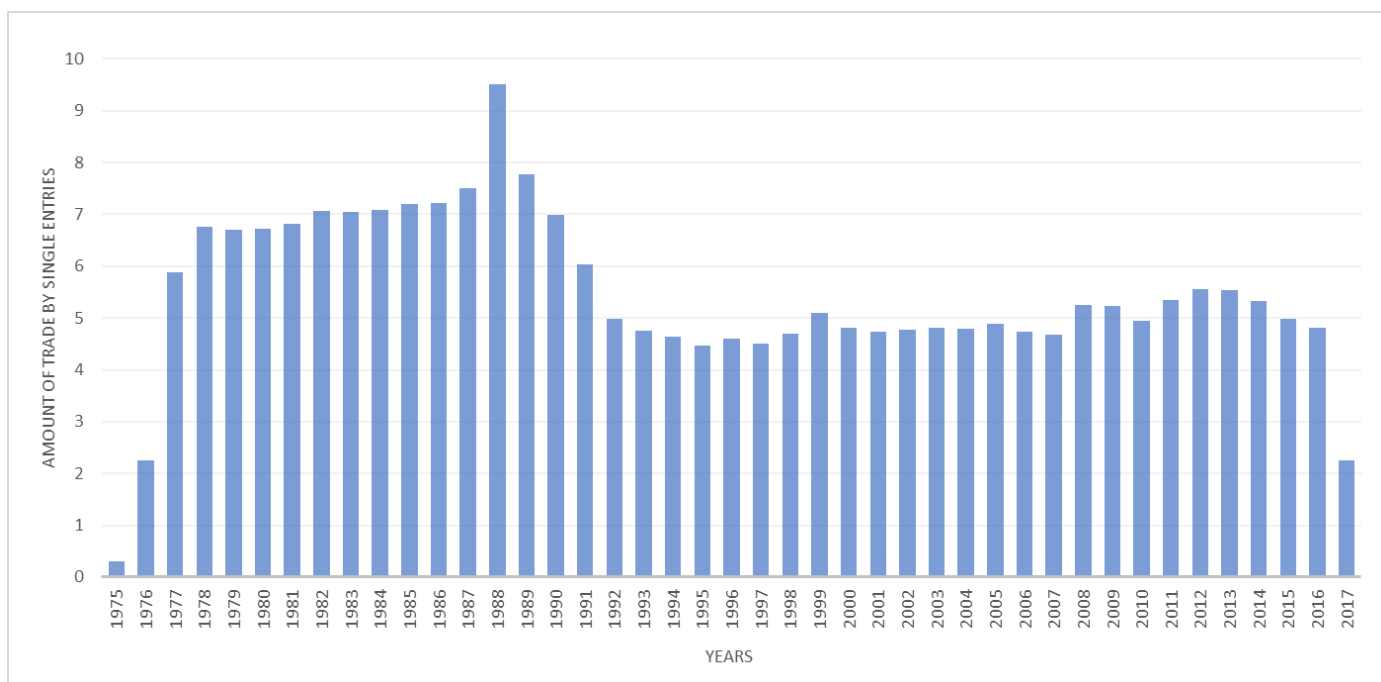
### ***Statistical Analysis***

The statistical methods used were multiple regression analysis of (year vs elephant trade & year vs rhino trade) to see if these two-predictor increased or decreased during the 42-year period. Regression was also used for MIKE data to determine any increase or decrease in percentages from 2002 to 2017.

## Results

### Annual Elephant and Rhinoceros Trade

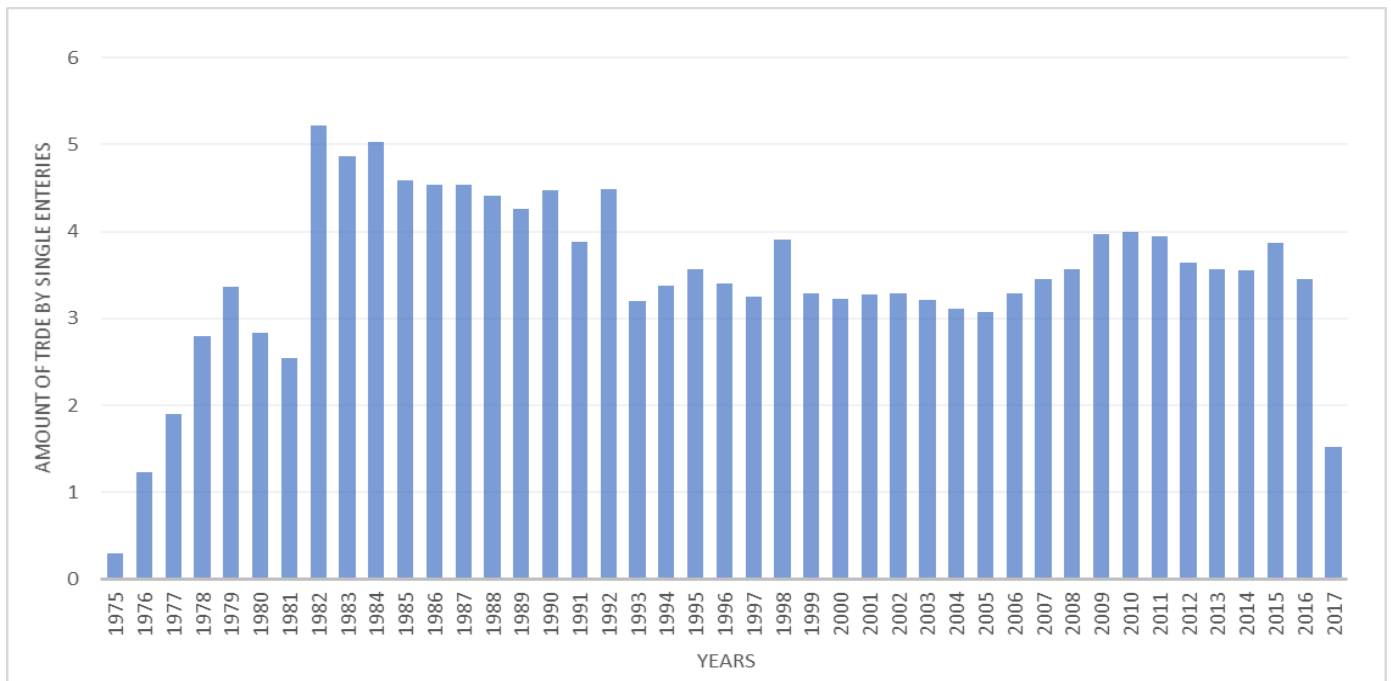
Over the period of 42-years from 1975 to 2017, the Elephantidae and Rhinocerotidae annual trade demonstrated in (Fig 3a & 3b) show quantities of trade reports over the time period. (Fig 3a) demonstrates annual trade by single entries, a statistical regression was used between two variables (Quantity and Year) to indicate any variance over time and quantity. A value of  $p = 0.495$  for elephants suggested there was not a significant difference over time but does display a steady increase during the late 90s into the twentieth century.



*Figure 3a: Showing an annual activity of elephant trade over a 42-year period. y-axis: shows the amount of trade by single entries converted to logarithms against the years of activity, x-axis, displays the 42-years.*

Early 70s and late 80s showed dramatic peaks especially in 1987, 1988 and 1989 when the ivory ban came into place. These years show that trade peaked to unsustainable levels, quantities soaring into the billions. Following the similar statistical analysis was used for elephants, a regression was used for rhinoceros against the same variables. (Fig 3b) displays

annual trade by single entries, interestingly with all rhinoceros products banned in 1977, the results show a rapid increase during the early 80s to 90s where the highest rhinoceros trade reached into the thousands. This suggest that those years were the most prominent years for trade in rhinoceros. Interestingly a value of  $p = 0.032$ , suggests there is an increase and decrease during the early 90s into the twentieth century, rhinoceros trade quantities sored into the thousands.



*Figure 3b: Showing an annual activity of rhinoceros trade over a 42-year period. y-axis: shows the amount of trade by single entries converted to logarithms against the years of activity, x-axis, displays the 42-years.*

## ***Importation & Exportation***

### *Elephants Routes*

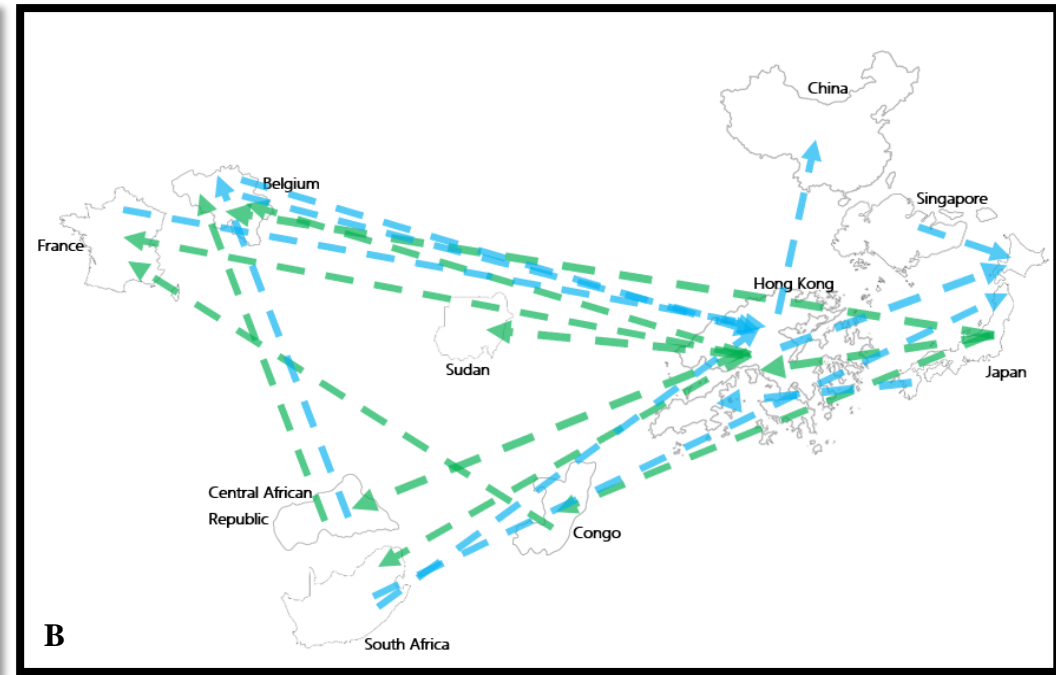
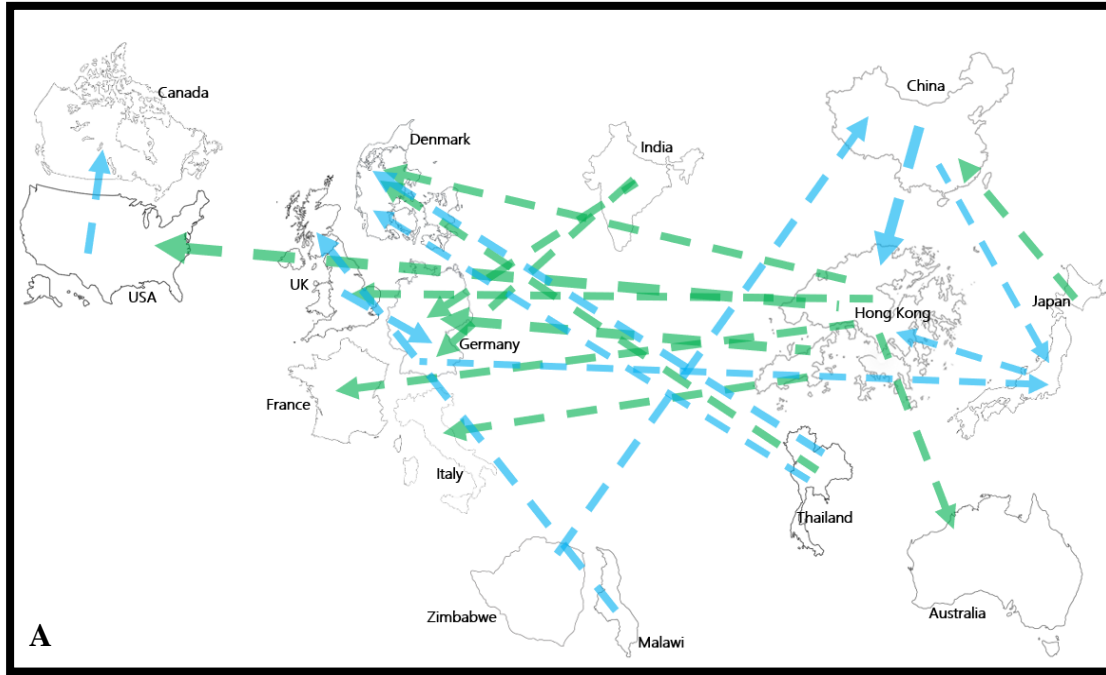
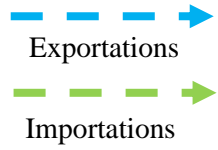
For elephant transportation routes, the two maps indicating importations and exportations display the top 10 countries involved in illegal wildlife trafficking over the 42-year period. Within these maps, the two most desirable and most traded items were elephant ivory and tusks (Fig 4a) displays the most active countries involved in ivory importation were; Countries within Europe; United Kingdom (UK), Germany (DE), France (FR), Denmark (DK). North America; United States of America (US) and Oceania; Australia (AU), line thickness ranged from ( $\text{Log}_{10}^{5,6,7,8}$ ) these are indicated in (Table 4) which represent trade quantities. The results show that trade is being accepted from Hong Kong (HK) into Europe and US (green lines). Subsequently, countries involved in the exportation of ivory showed (Fig 4a) that Thailand (TH) is exporting ivory into Europe, followed by countries within Africa exporting ivory both to Asia and Europe. Interestingly, there is a lot of intra-continental trade within Asia (blue lines), especially between China (CN) - HK and Japan (JP). Yet, other countries such as Zimbabwe (ZW), Malawi (MW) and US are displaying activity levels of ( $\text{Log}_{10}^{4 \& 8}$ ) (See Table 4) in ivory trade.

Following a similar process, (Fig 4b) displays tusk importation and exportation. Countries involved in tusk importation revealed the countries within Africa, Europe and are accepting tusk from Asia, but more profoundly HK showing line thickness of ( $\text{Log}_{10}^{5 \& 6}$ ) displaying quantities of trade ranging into the thousands and millions. Looking closely within Africa, Central African Republic (CF) accepted tusk from HK and exported to Belgium (BE) and BE re-exported back to HK. The exportation results showed intra-continental trade was found between countries in Asia CN - Singapore (SP) - HK - JP, activity of exportation is coming from Europe, specifically BE and within Africa. Nonetheless, the results show that continents most active in tusk exportation were Africa, Europe and Asia.

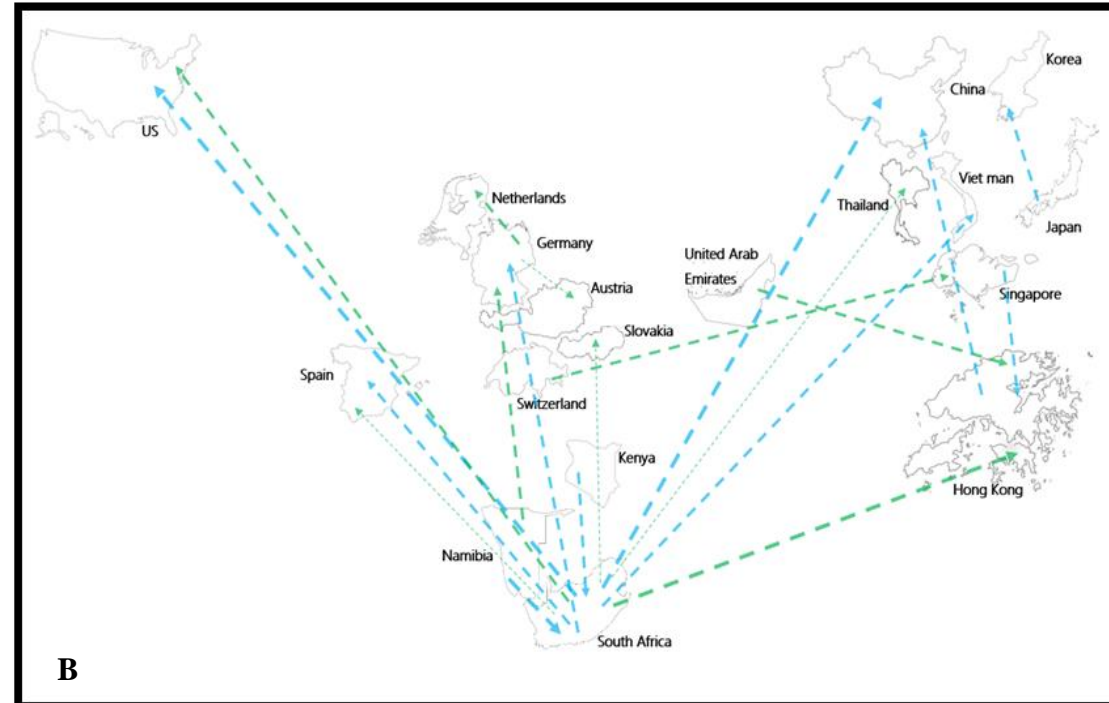
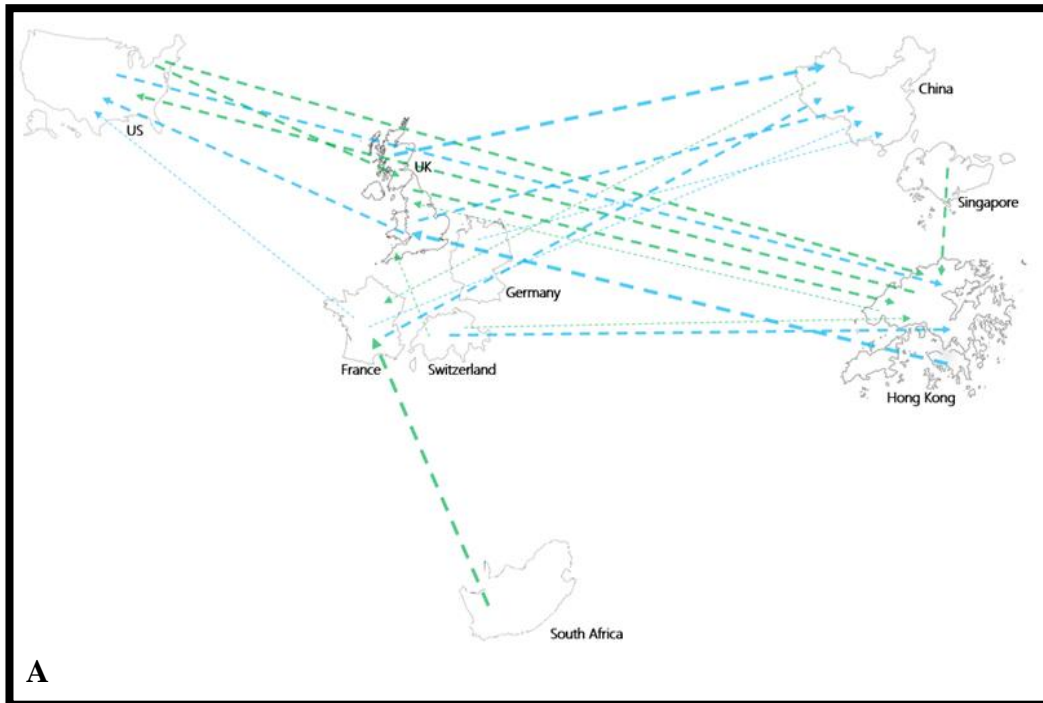
*Rhinoceros Routes*

For rhinoceros transportation routes, the results showed a significant difference in activity levels, these levels range from ( $\text{Log}_{10}^{1, 2, 3, 4}$ ). The two maps demonstrate the top 10 countries involved in wildlife trade. Firstly, the results from carving importations (Fig 5a) show countries within Europe are accepting rhinoceros' carvings from US, South Africa (SZ), HK, the table shows HK is accepting carvings from Europe, US and SP. In relation, Asia and Europe were the highest importation routes. Secondly, carving exportation showed that majority of the trade is coming from Europe: UK, FR, DE, Switzerland (CH) these activity ranges from ( $\text{Log}_{10}^{1, 3, 5}$ ).

For rhinoceros horn importations and exportations showed that the countries with high activity for horn importation (Fig 5b) showed countries within Europe and Asia including US are accepting horn mainly from Africa; this activity ranges from ( $\text{Log}_{10}^{1, 3, 5}$ ). The most prominent countries are within Asia: HK, SP, Europe: Netherlands (NL), DE, Austria (AT), Slovakia (SK) and US. The exportations routes demonstrated activity levels ranging from ( $\text{Log}_{10}^{1,2,3,4}$ ). Again, a lot of intra-continental trade in Asia, but Africa poses as the most common location horn is being exported from. Most of the horn exportations are going to countries within Europe and Asia, there is little activity seen in intra-continental trade between Namibia (NA) - Kenya (KE) - SZ. Resulting in Africa and Asia being the highest exporting continents for horn.



**Figure 4:** Elephant Ivory Importation and Exportation (A), Elephant Tusk Importation and Exportation (B). Green lines represent importation, the arrow tip represents the country in which trade has been imported to (i.e. Hong Kong → United States of America). The blue lines represent exportation, the arrow represents the country it is exiting. The different line thickness indicates the level of activity between each country (See Table 4).



**Figure 5:** Rhinoceros Carvings Importation and Exportation (A), Rhinoceros Horn Importation and Exportation (B). Green lines represent importation, the arrow tip represents the country in which trade has been imported to (i.e. Singapore → Hong Kong). The blue lines represent exportation, the arrow represents the country it is exiting. The different line thickness indicates the level of activity between each country (See Table 4).

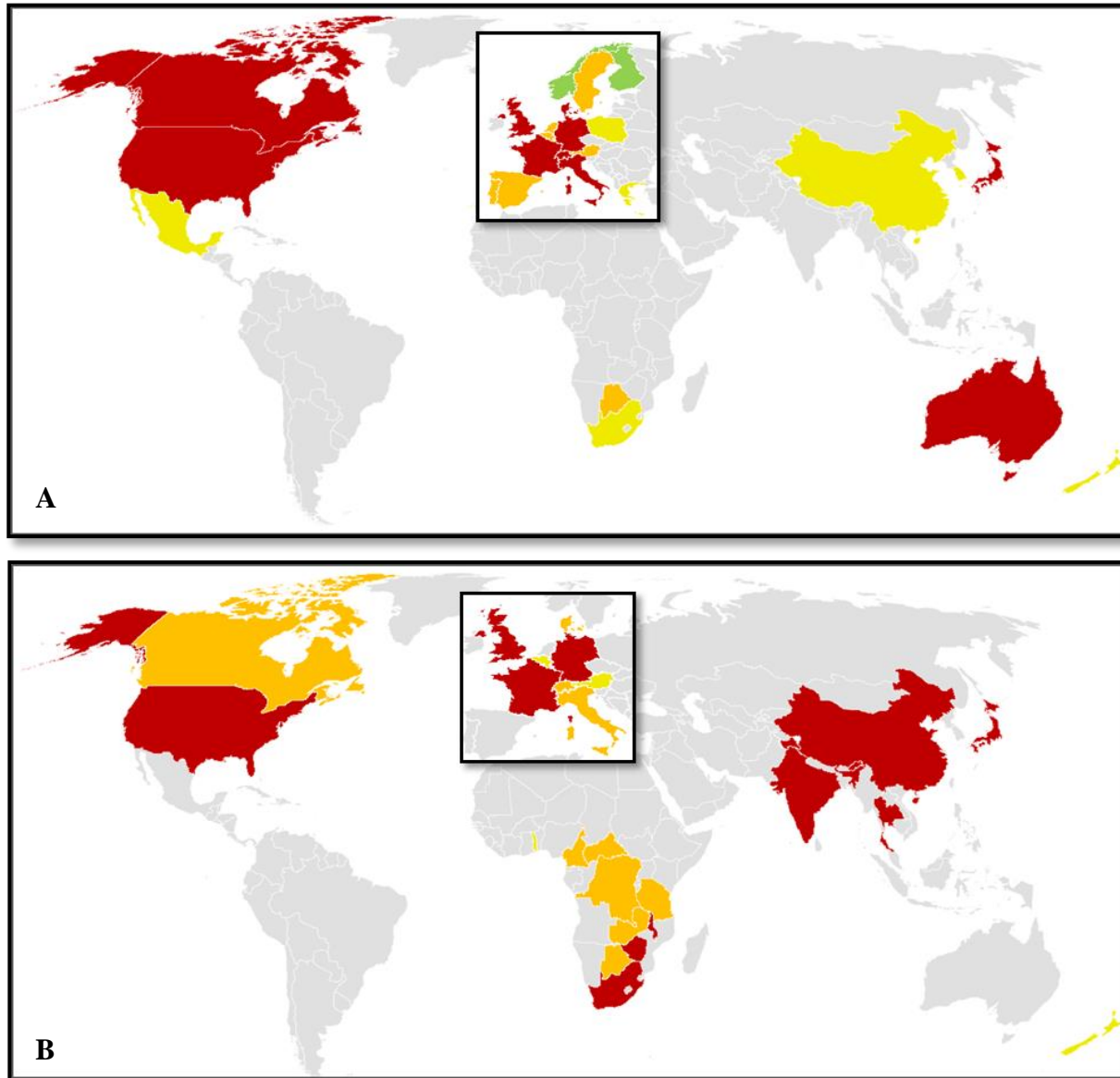
## ***Hotspots***

### *Elephants Products*

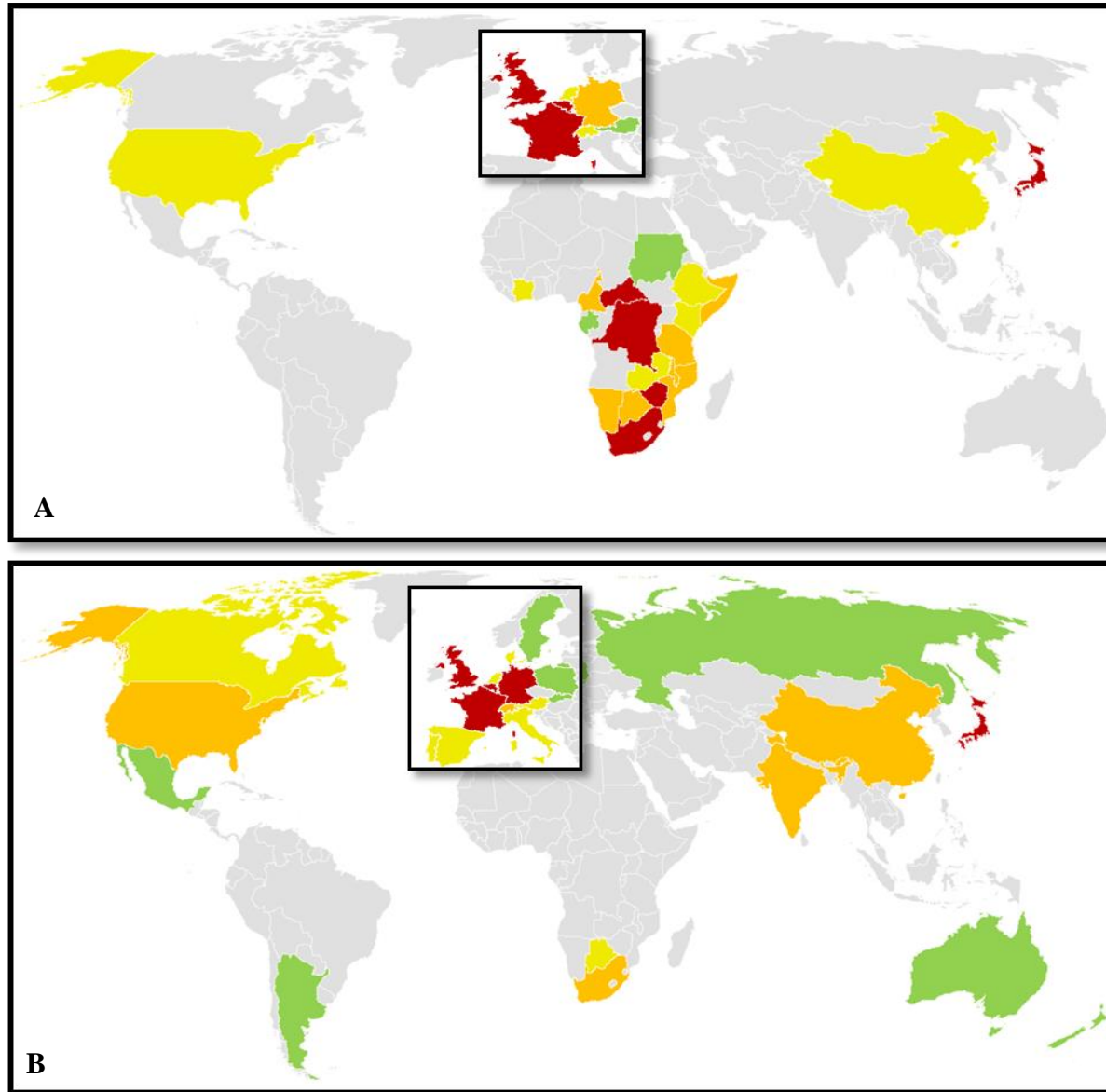
The results for ivory trade hotspots (Fig 6) gave insight to this item of trade using hotspot mapping. (Fig 6a) demonstrates country involved in ivory importations and the same for (Fig 6b). The maps display the top 30 countries participating in illegal wildlife trade. The results show in (Fig 6a) that countries importation hotspots are higher within North America, Asia, Australia and Africa, but more profoundly Europe, majority of the imports are being accepted into UK, FR, SP, Italy IT, CH, DE, DK, including countries; Poland (PL), Sweden (SE), Greece (GR). Results in (Fig 6a) also show North America US, Canada (CA), Mexico (MX), other countries with hotspots of trade are JP, CN, AU, New Zealand (NZ), Botswana (BW) and SZ. For exportation (Fig 6b) demonstrates all the countries involved in the exportation of ivory, the results show that a majority of the exports hotspots are coming from countries throughout Africa; SZ, BW, ZW, MW, Zambia (ZM), Tanzania (TZ) and Congo (CO), countries within Europe; UK, FR, DE, IT, CH were high in ivory trade (See Table 5). Other countries included in high levels of trade were distributed within Asia; JP, CN, TH, India (IN) and countries in North America; US, CA.

For importation and exportation of tusk trade (Fig 7) demonstrates all the countries involved in the illegal trade of elephant tusks. The results showed in (Fig 7a) that countries throughout Africa were highly involved in the exportation of tusks were; SZ, NA, BW, ZW, Mozambique (MZ), MW, TZ, CO, CF, Cameroon (CM), Somalia (SO), followed by countries within Europe: UK, FR, BE and DE, other countries are US, CN and JP. Countries partaking in the importation of tusks is seen in (Fig 7b) a majority of the countries importing tusks are; Europe: UK, GE, NL, FR and Asia: JP are showing as highest importers, yet other countries such as US, CA, CN, IN, BW and SZ are equally involved in receiving tusks.





*Figure 6: Elephant ivory importation hotspots (A) and Elephant ivory exportation (B). Illustrating the top 30 countries. Each country within the map demonstrate different levels of trade, indicating which country has high activity in illegal wildlife trade (See Table 5).*

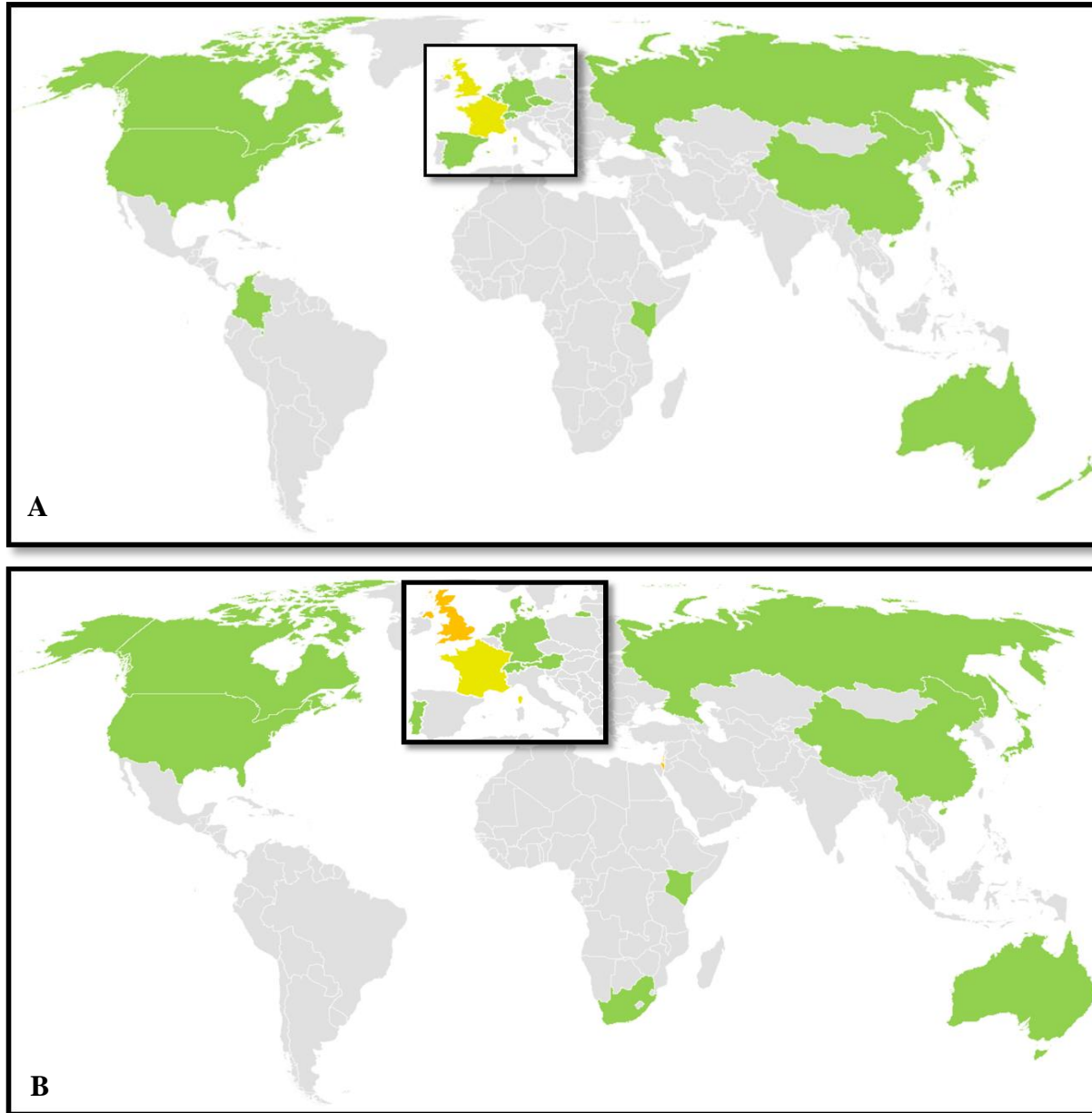


**Figure 7:** Elephant tusk exportation hotspots (A) Elephant tusk importation (B). Illustrating the top 30 countries. Each country within the map demonstrate different levels of trade, indicating which country has high activity in illegal wildlife trade (See Table 5)

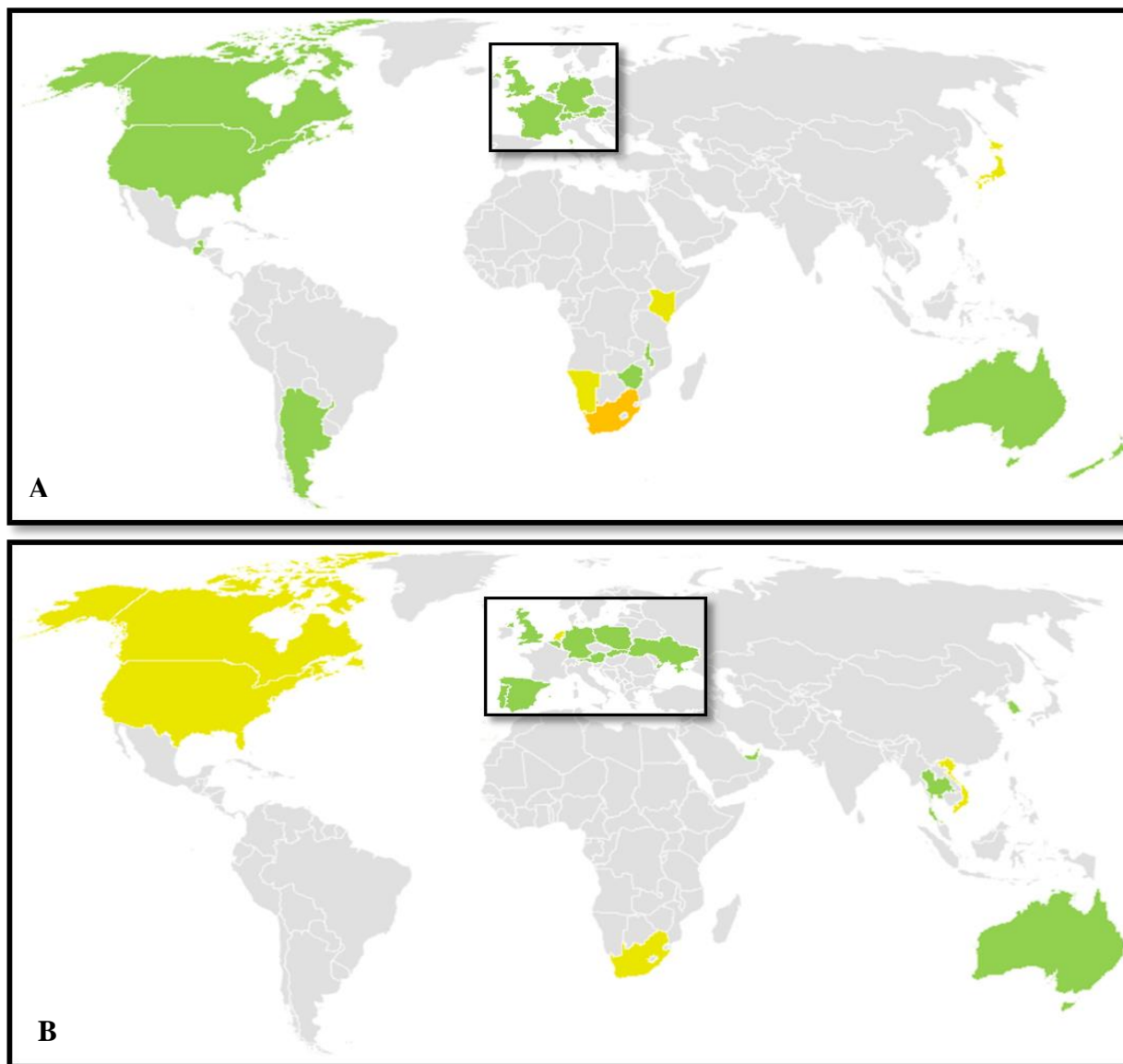
### *Rhinoceros Products*

Following the same method, the results for rhinoceros' hotspots (Fig 7) demonstrates the top 20 countries partaking in illegal wildlife trade of carvings and horns. (Fig 8a) shows a difference in colouration in comparison to elephant trade. Majority of the imports are entering countries throughout Europe: especially in the UK, FR. The remaining 18 countries across the maps involved show low-levels of trading hotspots. For exportation of carvings (Fig 8b) shows that the common troublesome area is within Europe were UK, FR, yet UK had increased in trade levels (See Table 5). The results show that within the Middle East, Israel (IL) is a relatively high exporter hotspot location the remaining 17 countries participating in illegal trade all remained within low-level trade.

The results for importation and exportations for rhinoceros horns displayed locations contributing to illegal trade. (Fig 9b) demonstrated all country imports were primarily located in Europe; NL, North America; US, CA, Africa; SZ and Southern Asia; TH, all other 15 countries located displayed low-level trading hotspots. However, the results for exportation in horns (Fig 9a) showed the highest exporters were primarily disturbed across Africa; SZ, NA and KE, within Asia; JP, all other 16 remaining countries displayed low-level trade.



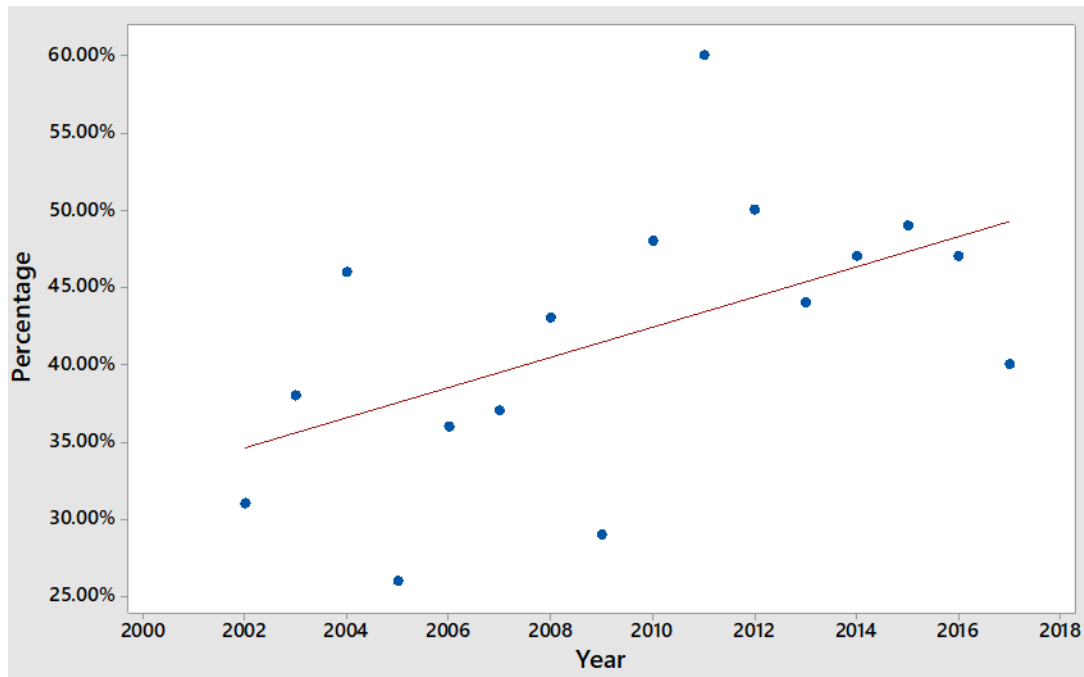
*Figure 8: Rhinoceros carving importation hotspots (A) Rhinoceros carving exportation (B). Illustrating the top 20 countries. Each country within the map demonstrate different levels of trade, indicating which country has high activity in illegal wildlife trade (See Table 5)*



**Figure 9:** Rhinoceros horn exportation hotspots (A) Rhinoceros horn importation (B). Illustrating the top 20 countries. Each country within the map demonstrate different levels of trade, indicating which country has high activity in illegal wildlife trade (See Table 5)

## **MIKE**

Over a 15-year period from 2002-2017, the data collected from MIKE shows a regression line (Fig 10) the graph demonstrates that over the years there was a sharp increase during the mid-twentieth century, percentages had risen into the 40% to 50% range. A  $p = 0.036$  indicates there is a significant increase in illegal killings over the 15-year period.



*Figure 10: This scatter plot illustrates the percentages of elephant carcasses illegally killed against the amount of elephant carcasses found.*

## ***Discussion***

Illegal wildlife trade is the third highest illicit criminal crimes in the world, multiple studies have demonstrated the impact and threats this can have to species population, ecosystems (Dickson, 2008; Brashares et al., 2014). Courchamp et al., (2006) explains that consumers desire species of rarer status and will pay exceeding amounts for them. In many regions of the world, some countries have become more troublesome than others, many sources of literature have agreed. For example, according to (Wylie, 2008) a wave of demand in ivory soared during 1970s and 1980s, these years had similar effect on rhinoceros. Data collected from CITES Trade Database agrees with this statement (Fig 3a & 3b) the data shows peaks in illegal wildlife trade. (Appx. 1b), displaying an unsustainable number of illegal trades in the late 80s. Facts show that trade increased substantially during the early 70s and mid to late 80s. Interestingly, since the ban of rhinoceros horn in 1976 and the international ban of all rhinoceros products in 1977. Crowfoot, (2011) reported >65 thousand rhinoceros were killed since the ban. However, present data until 2017 revealed the total number has increased for more than Crowfoot's assumption, evidence shows >660 thousand (i.e. 659,536). In conjunction to rhinoceros ban, the trade ban for elephant products came into force in 1989, thirteen years after. Samuel et al., (2018) predicted that >40 thousand elephant products were traded for global demand. Again, present data shows amounts exceeding >70 million (i.e. 71,740,442) (Appx. 1a & 1b).

The most concerning year was 1988 in which demonstrated quantity of 3,237,609,102 of illegal trade reports (See Appx. 1b). One-year elephant international ivory ban came into force, gradually after numbers declined massively after the early 90s. This suggests legislations took more control and CITES using Appendix to categorise elephants accordingly to their status (See Table 1a) these categorisations give protection to endangered species suffering from illegal criminal actions. However, in certain countries where these appendices lay, not every country categorise elephants in Appendix I, countries such as; Botswana, Namibia, South

Africa and Zimbabwe list African elephants in Appendix II (See Table 1b) the peak could suggest the “one-off” sale in ivory products. For rhinoceros, the early 80s to the late 90s were some of the most depleting years for species despite protection, with all species categorised as Appendix I, except White rhinoceros which is Appendix II in South Africa and Swaziland (Table 1b). The years 1982 to 1992 displays illegal trade rose to a quantity of 565,592 (Appx. 1a).

Wylie (2008) agrees and states that this increase was due to the demand from China and newly developing Japan and the ever-growing economic growth and the expansion of household and disposable income (Bell, 2016). Moyle (2014) agrees the highest rate of illegal trade happened since the global ban in 1989 which occurred in 2011. (Appx. 1b) shows thousands of elephants were killed for their features. However, CITES (2014) & Wittemyer *et al.*, (2014) states that poaching increased from 2006 and raised to unsustainable levels (See Appx. 1a & 1b) somewhat agrees and disagrees, data shows that unsustainable levels of illegal trade happened during the early and late 70s and 80s (Fig 3a & 3b). However, in 2006 there was a significant decrease in elephants, the amount of trade reported in 2006 was 53,272 entries for elephants and for rhinoceros 1,923 entries but gradually increase throughout the twentieth century (Appx. 1a & 1b). Lusseau & Lee (2016) revealed that since 2008 to 2014, trade within elephant species had increased to high levels of trade. Wittemyer *et al.*, (2014) agrees that the data shows a total number of 1,572,175 entries but decreased below 100,000 entries in the latter years of the twentieth century (Appx. 1b). Multiple sources have mentioned rough estimations of trade that was traded annually to fuel demand. Phys (2018) suggested about 30,000 elephants are killed per year to meet the ever-growing demand in Asia. Knights (2018) claimed that 33,000 elephants were killed, but Bell (2016) suggests otherwise with only 20,000 elephants killed for ivory. Nonetheless, the data collected (Appx. 1a & 1b) reveals that these statements are incorrect and do not give a correct representation; thus, indicating that previous literature displays inaccurate values. However, Milliken, (2014) suggests the lack of data in rhinoceros



is because it is one of the most structured criminal activities. In 2015, Bell (2016) stated that more than 1,200 rhinoceros were killed. The data contradicts Bell's estimation and displays that more than 7,000 were killed during 2015 (Appx. 1a). Bell also mentioned that only 60 rhinoceros were killed in 2006, the results from the data displays that nearly 2,000 rhinoceros were killed and proves this statement to be inaccurate. Moreover, the fuelling of this demand is due to the rapid increase in Chinese Traditional Medicine (TCM), used for an array of treatments for inflammatory, colds and fevers (Rolfes-sas, 2012) (See Fig 1b). Enright (2008) adds it was used to cure snake poisoning, blurred vision, arthritis and haemorrhaging, it is driven by belief and ancestral myths (Rolfes-sas, 2012). Strikingly, Wildlife Conservation Society, (2018) & Wittemyer et al., (2014) claimed that during the years of 2010 to 2012, it was estimated that more than 100,000 elephants were killed by poachers. The collected data which can be found in (Appx. 1b) proves this claim to be true, during 2010 to 2011, over 600,000 elephants were illegally traded. Multiple sources have stated that this could be due to profitable gain from the selling of these items/products (See section on Causes of Trafficking).

### *CITES*

Currently, with 183 countries contracting to CITES (Fig 2a), illegal wildlife trade continuing to the point that it has become one of the most illicit criminal acts in the world, significant loopholes have been developed within the trade industry, says (Weru, 2016). This leads to flaws, resulting in inadequate penalties and mistreating of legislations (DLA Piper, 2015) (See table 2a, b, c). Gossmann (2009) argues that allowing "one-off" stockpile sales of trade products is one of the main forces that intensifies demand, including the smuggling of trade items (Bennett, 2015; EIA, 2014; Gossmann, 2009). This will result in weaker attention to legislation that fails to obstruct and generate activities known to be emboldened (DLA Piper, 2015). Moreto et al., (2015) additionally adds that the lack of educational resources is encouraging rangers to participate in criminal wrongdoings. Now, with sophisticated ways of illegal trading within the dark highly-profitable global market, Wyatt (2013), WWF &

TRAFFIC (2015), Wyatt and Cao (2015), UNDOC (2016) all agreed that corruption is the main factor of illegal wildlife trade. Cressey (2013) argues by stating with international treaties in place to protect species are simply not working. Breuer et al., (2016) further acknowledges this statement and expresses with protection projects, such as; funding anti-poaching & trafficking of illegal trade, awareness campaigns and transporting (See Table 2a, b, c). Still species continue to deplete, looking at the data, it does suggest that there is a lot of missing reports of trade, especially with The CITES trade database, a lot of entries are not single entries but several entries within one (See Table 3a & 3b). Therefore, smugglers take advantage of the amount of cargo entering and exiting locations, causing obscurities in true originalities, import and export amounts (Fig 3a & 3b). Allowing smugglers to conceal the true origin by using many transit countries, more noticeably in the Middle East, South and East Asia, especially locations such as; Hong Kong and Vietnam, where it is known to be controlled by corrupt establishments such as customs, criminal gangs and broader control officers who impose a fee for cargo to enter as under unofficial crossings, (EIA, 2014) agrees. Not only do (HK) and Vietnam (VT), but China and Tanzania accept payoffs for shipments of ivory to pass broader without being inspected. However, countries making public statements to obscure illegal wildlife trade. In 1989 and 1991, Kenya destroyed seized ivory, the president of Kenya burnt 25 thousand ivory tusks (Khanna & Harford, 1996). In 1990, Nepal banned commercial use of elephant ivory (Martin et al., 2013). In 2013, The US released an executive order to prevent illegal trafficking in elephant and rhinoceros' products (The White House, 2013) with potential to enforce anti-poaching awareness (Sonenshire, 2013). In the same year, The US destroyed six tonnes of ivory (Kirchner, 2013). Goldenberg, (2016); Gettleman, (2016); TRAFFIC, (2016); Yu et al., (2016), The US prohibited commercial trade in elephant ivory in 2016, Nikkita et al., (2015). Leading to The US applying sanctions on Taiwan and China to reduce activity in rhinoceros trade products (Rhinoceros Case, 2012). Other countries followed, Gabon destroyed a large stockpile in 2012 (Plumer, 2013), Philippines destroyed five tonnes in 2013

(TRAFFIC, 2014), China destroyed over six tonnes in Guangdong in 2014 (TRAFFIC, 2014). China, being the largest base for ivory have banned legal trade of ivory in 2017. In 2016, The Hong Kong government declared to ban ivory trade before 2021.

### *Elephant Hotspots & Transport Routes*

Globally, some countries demand exceeds others and those are some of the most troublesome, multiple literature have stated concern that certain country demands are damaging Elephant and Rhinoceros populations. Hotspot data shows that the most troublesome locations for ivory trade were North America, Europe, Australia, Asia and Africa. Martin & Stiles, (2000; 2002; 2003) and Stiles and Martin, (2000; 2001; 2002a, b; 2003a, b) all agreed that Africa and Asia are two of the highest countries involved in wildlife trade, especially in ivory trade (See Fig 6). However, following the highest countries for ivory, not a lot of literature mentioned the demand for tusks. (See Fig 7) demonstrates that Europe and Africa are within high-level trade regions. Moyle, (2014) Africa is the main source of ivory and states that most of the poached ivory is imported to Asia (Fig 4a), in fact most of the ivory is being imported to Europe from Asia, very little activity is seen in Africa. (Fig 4b) demonstrates that a lot of the activity is happening within Asia resulting in intra-continental trade. Moreover, key exporter of elephant trade is Kenya and Tanzania (Nikkita et al., 2015; Fiona et al., 2013) and key importers located within Asia; China, Hong Kong, Thailand and Vietnam (Nikkita et al., 2015). Suggestions predict the profit (Warchol, 2014; Challender and Macmillan, 2014), EIA, (2015) indicates the highly desirable commodity investment involved and asset exploitation (Ferreira et al., 2012). Andersson and Gibson, (2018) revealed that Hong Kong is the global hub for illegal wildlife trade, Wong, (2017) confirms Hong Kong is the highest city of illegal wildlife trade in the world, hotspot maps verify their statements (Fig 6 & 7). Multiple sources have declared that China, Japan (Bell, 2016; Huang & Weng, 2014; Underwood et al., 2013; Aryal et al., 2018; Lotter & Clarke, 2014; Wyatt et al., 2018), Thailand (Fiona et al., 2013), Tanzania and Mozambique (CITES, 2016; Wasser et al., 2008; Wasser et al., 2015) are also illegal trade

hotspots. Interestingly, Mozambique one major country within Africa did not appear to be a hotspot for wildlife trade (Fig 6) but appears in (Fig 7) elephant tusk trade. The United States is known as a major location for wildlife products despite prohibiting trade in 2016, including Canada (Reuter & Regan, 2016). Zhang, (2015) admits that it is the second-highest market for illegal ivory, (Fig 6 & 7) revealed The United States and Canada are hotspots and ranged between intermediate to high-levelled trade (See Table 5). Fiona et al., (2013) suggests that Congo and Gabon are major locations for elephant trade. (Fig 6 & 7) demonstrates these countries involved are labelled intermediate to high trade hotspots.

### *Rhinoceros Hotspots & Transport Routes*

Rhinoceros have equally been at the centre of illegal trade, populations suffering during the 70s and 80s due to a demand for horn (Enright, 2008). Wyler & Sheikh, (2008); Nijman et al., (2018) explained that East and Southeast Asia, primarily China and Vietnam (Panjabi, 2014) have said that horn is “the valuable product in the world”. However, the statement does not match with the data collected (Fig 8) nor (Fig 9), it does in fact indicate that Japan, Vietnam and countries of Africa and Europe are involved in rhinoceros product trade have low to intermediate trade levels (See Table 5). Rivalan et al., (2007) opposes and cites rhinoceros horn experienced a sharp increase in Korean markets. (Fig 9b) disagrees with this assumption by displaying Korea as a low-intermediate hotspot location. Interestingly, the transportation routes differ to the hotspots. Looking closely at (Fig 5a) it reveals most of the importation and exportation routes for rhinoceros carving are coming from The United States, Europe and Hong Kong. Majority of the importation and exportation for rhinoceros’ horn is coming from countries within Africa (i.e. South Africa) (Fig 5b). Nikkita et al., (2015) agrees with present data and expresses key exporters for rhinoceros trade is South Africa. Nikkita et al., (2015) also mentioned the key importer were China and Vietnam, in some instances their statements are true. However (Fig 5b) displays some cases of intra-continental activity occurring in Asia. But the data indicates the common importers are Europe and specifically Hong Kong (Fig 5a).

Multiple literature has stated the desire and appeal of rhinoceros products are more of a valuable necessity. Collins et al., (2016) added rhinoceros' horn was used in Traditional Eastern Medicine (TEM), eliminating toxins (But et al., 1990), curing cancer (Truong et al., 2016), ornamental and cultural use (Rolfes-sas, 2012), carving Yemini dagger handles (Esmond & Martin, 1987) and status symbols (Graham-Rowe, 2011; Milliken & Shaw, 2012).

#### *Monitoring the Illegal Killings in Elephants (MIKE)*

A global monitoring database (Bigg et al., 2017) that collects reports of illegally killed elephants across African and Asian regions (Olivia & Porsch, 2015). A statement made by CITES (2002) & Reeve et al., (2003) mentioned that MIKE would not be fully functional until late 2005, however the data illustrates this to be false and was established in 1977 and came into force in 2002. MIKE is the most reliable source of data to monitor illegal poaching across continental regions (Savetheelephants, 2019). Wittemyer (2014) agrees and states that this source of information can be extremely helpful towards to reducing illegal harvest and management projects. However, Stiles (2004) argues that since the establishment of MIKE, there has been a lack of published data in illegal killed elephants made before or after 1990 period; this statement correct as the only data accessible is from 2002 onwards, which suggests a lot of insignificant numbers have been lost since the establishment. Kahindi et al., (2010) A minimum of 389 carcasses were reported during the years 2001 to 2003. This claim is false, as stated above MIKE came into force in 2002, the number of reported carcasses during these years were 371 with a total percentage of 69% (2002 -31% & 2003 - 38%) in illegally killed elephants (Fig 10 & Appx. 4). Three years later, CITES (2013b) stated that their sponsored project MIKE had experienced an increase in poaching levels since 2006, data collected from MIKE displays a significant increase since 2006 (Appx. 4). More so during the years of 2011 and 2012, accumulating into the thousands (2011 = 1014 & 2012 = 1181) (Appx. 4). Burn et al., (2011) gave a rough estimate of 17,000 elephants may have been illegally poached during 2011 within African sites. However, the data available suggests otherwise and disagrees with

this statement, the result of illegal deaths across the African regions showed that only 1,000 thousand were reported. The results do agree that the number of illegal killings were significantly higher in 2011 (Appx. 4). This could suggest an increased demand as elephants are illegally killed for ivory and bushmeat (Lindsey et al., 2013; Maiselset et al., 2013; Wittemyer, Daballen, & Douglas-Hamilton, 2013).

### ***Conclusion***

With countries worldwide implementing bans and demonstrating global statements by burning, seizing and destroying wildlife trade stockpiles may add misconceptions to fully removing all wildlife trade products. There is a need for stronger legislation and regulation to prevent activities such as bribery at borders, weak enforcement and misidentification of species products, stricter documentation of export and import permits. There is a strong need to gain precise evidence of wildlife trafficking to eradicate countries of the highest concern. This study showed clear indication of the most troublesome countries, hotspots and transportation routes; hence requirements are needed to enforce international treaties with harsher laws to prevent trade at seaports, airports and borders. Interestingly, more entries have been made to the CITES trade database, suggests CITES is not embedding a firm statute in protecting endangered species. Improvements in the CITES trade database is required, as majority of the items reported are different units and classified as one entry. This was problematic to differentiate whether one entry meant 3,125 shipments or 3,125 entries made. True originality became troublesome as most entries lack this, by falsifying documentation, re-exportation permits; the country of origin is lost during transportation. This improvement would drive international treaties to push authorisations to prevent illegal trade before populations suffer, discovering the known source allows for better enforcement law within that country. Using MIKE data gave important information in recognising the number of illegal killings found during 2002 to 2017. However, with the early 70s to late 80s there is no data on record, it would be interesting to see if these years coincided with illegal killings. Nonetheless,

species within Elephantidae and Rhinocerotidae are showing population increases according to the IUCN status. Research is needed into why the Asian elephant and Sumatran rhinoceros are still decreasing, especially the Javan rhinoceros which is labelled as unknown.

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## **Science Communication**

### **Wildlife Trade: Analysing 42-years' worth**

#### **Background**

For decades for Elephant and Rhinoceros have been subjected to hunting, poaching, killed for their features for human consumption and investment, used for commodities, sold online for absurd amounts of money, used for personal status, and commonly used in traditional medicines, continuing historical myth that rhinoceros horn causes various diseases, illness, that elephant products are used for ornaments, decoration. It is important to notice that species are suffering which does not only harm the diversity but it also affects ecosystems, both species are classed as umbrella species – these species create environments for other species to thrive and survive within their habitat, resulting in a cascading of species and environments, this will also affect educational values and lack of understanding of why these species are needed This affects various conservation programmes such as WWF, CITES, Save The Elephant, Save The Rhino, International Rhino Foundation, programmes such as these are endlessly working towards informing communities the values of elephants and rhinoceros and primarily working to protect these species from poachers and hunters. Helping protect and prevent these species from decreasing is important to save populations and ecosystems

#### **Project Summary**

Collecting data from CITES Trade Database ranging from 1975 to 2017, analysing all data entries using excel formatting by sectioning off the data by Species, Export and Import and Export and Import amounts and Uses. In doing so, two items/products were chosen from both species (rhinoceros; carvings: 577 and horn: 736) and (elephant; ivory: 31,666 and tusks: 11,035) and working through all the data point individually.

Discovering most common importations and exportations transport routes, discovering country hotspots, as well as establishing baselines for hotspots by trade quantities, these ranged from

low-to-high levels of trade. Importation and exportations were based on level of activity, the quantities were converted into logarithms by using this equation ( $\text{Log}_{10}^{1-8}$ ) this simplify the study and help classify line thickness by activity of trade. All trade was analysed from 1975 to 2017 to witness if any peaks or dips happened in the 42-year period would give an interesting insight to which years were the most devastating for species and finding research to back my hypothesis or dismiss it. Looking at reasons to why trafficking is being performed, including looking in detail at the different laws and legislations put in place to prevent illegal wildlife trade.

### ***Key Findings***

Analysing the data showed that Europe, Asia and Africa where the highest location globally involved in the largest areas for hotspots, which gave an important insight of where laws should be enforced. Upon finding country hotspots, importation and exportation were recognised, firstly the most common location of importations was located within Europe and Asia and exportation were commonly seen within continents of Europe, Asia and Africa, some of which showed a line thickness of 5-8 (estimating to 100,000 – 1000,000,000) for elephants. For rhinoceros it showed that Asia and Europe were the highest importers and Africa and Asia were the highest exporters, resulting in line thickness of 1-5 (estimating to 10 – 100,000). it was discovered that rhino horn is known to be worth more than gold and platinum, that a single horn can be valued at \$150,000 thousand. Elephant ivory has also been valued to be ten times the average income and the price is known to be worth \$100,000.

Two products were chosen from both species to distinguish which out of the products were most desired and figure out which country was commonly seen or involved in the transportation. Out of this, it was found that elephant products/items had more of a high-level trade involvement, whereas rhinoceros products/items had more of a low-level trade involvement, this was suggested that rhinoceros trade is highly sophisticated and reported less, it has also been suggested that smuggler prefer larger quantities of movement rather than

smaller, which allows smuggler to take advantage of the amount of cargo that is getting traded, it also allows smuggler to conceal the true origin by using transits from countries.

The results from the elephant and rhinoceros trade showed that over the 42-year period elephants showed a sharp increase during the 70s and 80s and gradually decreased after the 90s and levelled out into a stable increase during the early and later twentieth century.

For rhinoceros, the results showed that during the late 70s and 80s was the highest amount of trade but reduced rapidly during 90s. During the early twentieth century trade continued to show a decrease but shows little increase after 2009.

Results for MIKE (Monitoring the Illegal Killings in Elephant) showed over a 15-year period (2002 - 2017) that the percentage of illegal killings increased into the twentieth. This suggests a significant difference between elephants that were illegally killed against the time period.

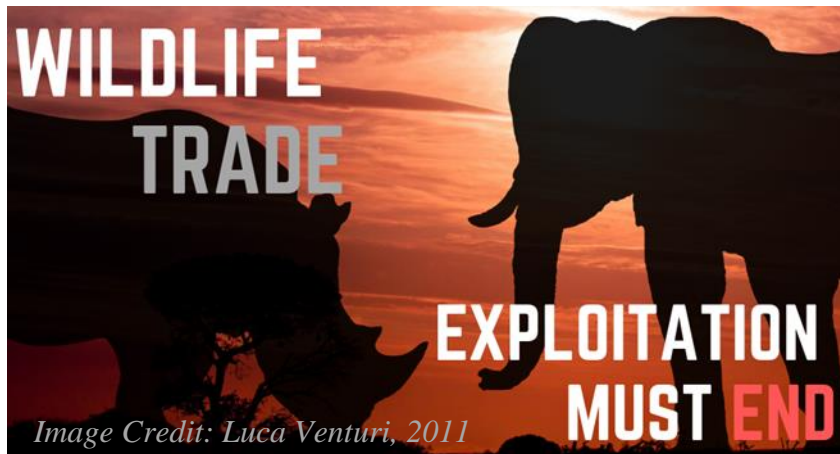
### ***Recommendations***

- Adding stronger legislation and laws prevent bribery, weak enforcement and misidentification.
- Improvements needed towards CITES database, as majority of the entries are misleading.
- Missing data from the early 90s for (MIKE) Monitoring the Illegal Killings in Elephants
- More research is needed on Javan rhinoceros as little is known about this subspecies
- Possible technology to locate transport links (Drones, Tags)
- Harsher penalties for those caught trading



### ***Tweet***

*Wildlife Trade is known as the 3<sup>rd</sup> highest criminal activity in the world. With the continuances of trade, what of species... #SaveTheRhino #TheirTimeIsNotNow #BanIvoryTrade #DontLetThemDisappear*



### ***Reflection***

I have learnt how to capture wide range of people, being able to structure the key elements to get the important information out there, knowing how to connection with different ages of people, giving me a better insight on how to get people interested and what types of topics are news and undiscovered. Finding people who share the same passions as you, enable you to share ideas and suggestions to get business, CEOs to notice your work. I have also learnt where to find the correct resources relevant to my studies and find new discoveries within the areas I am studying. I am have become more confident in front of an audience and being filmed is an exciting way to share information. Because of Science Communication I was able to participate in Planet Parliament, a live stream production on the impact of Climate Change and inspire younger generations to make positive changes to the planet. I have also been campaigning for planting more trees and re-wilding University of Salford Campus, which has enhanced my skills in campaigning and sharing events on social media. These skills will help me in the future, I am applying for a Master's at the University in Wildlife Documentary Production, this will help me use new technologies to display discover new aspects to show the natural world

to screen and connect through imagery, music and inspiring footage of what remains on our planet.

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Science Communication word count = **1,115**

**Appendices**

*Appendix 1a - Yearly data of Rhinoceros poached*

<b>Year</b>	<b>Rhinoceros Trade Quantities</b>	<b>Continued</b>	
1975	2	1997	1,755
1976	17	1998	7,960
1977	79	1999	1,970
1978	628	2000	1,697
1979	2,323	2001	1,909
1980	683	2002	1,943
1981	351	2003	1,636
1982	164,825	2004	1,304
1983	73,796	2005	1,195
1984	106,547	2006	1,923
1985	38,974	2007	2,817
1986	35,023	2008	3,665
1987	34,198	2009	9,466
1988	25,690	2010	9,916
1989	18,109	2011	8,749
1990	29,753	2012	4,356
1991	7,506	2013	3,639
1992	31,171	2014	3,550
1993	1,598	2015	7,344
1994	2,351	2016	2,819
1995	3,722	2017	33
1996	2,556	Since Ban (1976) Total:	659,536

*Appendix 1b - Yearly data of Elephants poached*

<b>Year</b>	<b>Elephant Trade Quantities</b>	<b>Continued</b>	
<b>1975</b>	2	1997	32,541
<b>1976</b>	176	1998	49,454
<b>1977</b>	745,616	1999	124,319
<b>1978</b>	5,689,214	2000	65,051
<b>1979</b>	5,070,036	2001	53,213
<b>1980</b>	5,291,947	2002	58,572
<b>1981</b>	6,456,095	2003	64,003
<b>1982</b>	11,466,474	2004	61,170
<b>1983</b>	11,109,702	2005	75,760
<b>1984</b>	12,399,171	2006	53,272
<b>1985</b>	15,595,272	2007	48,346
<b>1986</b>	16,514,494	2008	181,771
<b>1987</b>	32,528,102	2009	167,946
<b>1988</b>	3,237,609,102	2010	87,432
<b>1989</b>	58,368,060	2011	218,049
<b>1990</b>	9,601,191	2012	356,780
<b>1991</b>	1,084,283	2013	349,623
<b>1992</b>	96,911	2014	210,574
<b>1993</b>	57,572	2015	97,300
<b>1994</b>	42,900	2016	64,283
<b>1995</b>	29,708	2017	175
<b>1996</b>	40,172	Since Ban (1989) Total:	71,740,442

*Appendix 2 - Various case studies and their outcomes to illegal wildlife trade.*

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**Case Studies**

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~ In 2017, during Interpol operations; two people were convicted for illegally trading rhinoceros' horn, an additional two people were caught actively buying rhinoceros horn including money laundering. A further thirteen people were arrested during Interpol's Operation Thunderstorm in 2018. Locations of high activity were ports and airport between South Africa, Europe, Botswana and Zimbabwe (The Citizen, 2018)

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~ As of the Zambia Wildlife Act of 2015, it is prohibited those who are in possession of elephant ivory and rhinoceros' horn will be convicted of imprisonment for 5 to 10 years. In 2018, three non-native and two natives were imprisoned for possession of 25 pieces of rhino horn (GOVE, 2018)

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~ A resident of Chitwan was convicted by Interpol for poaching 20 rhinoceros over a six-year span, including wounding five rhinoceros and involved in case of illegal trade of two rhinoceros' horns. (Roberts, 2015).

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~ Three people were convicted for being involved in illegal shipment of three tones of ivory exported from Mombasa to Laos. Customs in Thailand confiscated three tones of ivory labelled as tea leaves leaving Mombasa to Laos, an additional four tones of ivory from Democratic Republic of Congo to Laos. In Singapore, \$6 million worth of ivory labelled as tea leaves were confiscated (African Wildlife Foundation, 2015).

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~ In 2018, eight people including three government officials were arrested for illegal trafficking in elephant tusks, the same people were linked to the smuggling of elephant tusks found in Thailand in 2017 (Mongabay, 2018).

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~ Six Zimbabwean men were arrested for being involved in wildlife trade crimes (Herald News, 2018)

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~ European Union Action to Fight Environmental Crime (EFFACE) stated Heathrow was a main import and export location for trade (Sollund & Maher, 2015). Chaber *et*

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*al.*, (2010) states the importance of Paris Charles de Gaulle Airport being linked to bushmeat coming from Africa.

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~ In the UK, a person was imprisoned for illegally selling a worth of \$2,710,760 in rhino horn, elephant tusks on Instagram (BBC, 2017). An additional person was fined \$1,390 for illegally selling ivory on eBay (Cooper, 2018).

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*Appendix 3 - Calculated data of all percentages of illegally killed elephants from 2002 to 2017. Taken from MIKE Database*

<b>Year</b>	<b>Percentage of Illegal Elephant Kills</b>
2002	31%
2003	38%
2004	46%
2005	26%
2006	36%
2007	37%
2008	43%
2009	29%
2010	48%
2011	60%
2012	50%
2013	44%
2014	47%
2015	49%
2016	47%
2017	40%

*Appendix 4 – Yearly number of carcasses against the number of illegal carcasses from 2002 – 2017, within sites of Africa and Asia. Taken from MIKE database*

<b>Year</b>	<b>Number of Carcasses</b>	<b>Number of Illegal Carcasses</b>
2002	238	75
2003	769	296
2004	890	411
2005	806	212
2006	771	281
2007	1037	383
2008	1225	528
2009	1565	457
2010	1303	637
2011	1688	1014
2012	2357	1181
2013	1832	808
2014	1730	818
2015	1702	843
2016	1413	674
2017	1602	648