The rhino horn and ivory trade: 1980–2020

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This thesis is submitted to Oxford Brookes University for the degree of Doctor of Philosophy based on published work.

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This PhD is dedicated to

Esmond Bradley Martin

who inspired me with his commitment to this field and with whom I worked on ivory and rhino horn market surveys and field research for 35 years, until his tragic murder at his home in Nairobi in early 2018.

Fig. 1. Ivory carving in Guangzhou, China, 2011

This thesis is the result of my own work, with no work done in collaboration, except where indicated and acknowledged in the text. No part has been submitted for any other degree at any other university.

Cover photograph: Jambiyas of Yemen

All photographs by Lucy Vigne

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Abstract

In much of tropical Africa a breakdown in law and order, corruption and an influx of firearms led to heavy rhino and elephant poaching, especially in the 1970s and 1980s. I collected and analysed data to reveal the collapsing numbers of rhinos in Africa. Although we had general trade information, we needed more understanding of the soaring smuggling and consumption in order to combat it. I carried out extensive fieldwork in the main market at the time: North Yemen (Yemen from 1990). From the 1980s I regularly monitored the trade in rhino horn used for prestigious curved dagger (jambiya) handles, updating information on smuggling routes, prices, and demand. I worked with Yemenis on education campaigns, encouraged substitutes, and assisted policy makers, with Esmond Martin, who was to become my long-term research colleague. In the Indian subcontinent, home to most Asian rhinos, we also worked with officials and local people on strategies to fight rhino poaching and smuggling. And in eastern Asia we surveyed consumer markets for rhino horn used in traditional Oriental medicine to close down illegal trade. Around 2010 demand escalated once again causing serious rhino poaching, this time mainly in South Africa for customers in China and Vietnam, but again information was lacking. I surveyed illegal markets and collected prices of rhino horn, in order to strengthen legislation and enforcement. Demand for elephant ivory also rocketed from about 2010 onwards and we learned newly moneyed undiscerning Chinese consumers were eager to acquire mass-produced ivory items. We carried out market surveys in key illegal African and Asian markets to alert decision makers to control the surge in trafficking and unregulated retail sales, mostly for mainland Chinese. A new Chinese diaspora and the internet encouraged this lucrative trade, fuelled by corruption, mismanagement and apathy in many regions. Human population pressure on valuable natural resources is rising, resulting in climate change and wildlife crime increasing, and biodiversity in wild habitats more threatened, plus spreading zoonotic diseases. Compared with the 1980s there is at last growing attention to these challenges, including wildlife crime, in search of securing nature for a healthier, safer planet.

Acknowledgements

First and foremost I acknowledge Esmond Bradley Martin whom I met in 1981 and with whom I worked from the 1980s for many years. I thank David Western, former Chair of the International Union for Conservation of Nature Species Survival Commission (IUCN SSC) African Elephant and Rhino Specialist Group (AERSG) working from 1983 to 1985 as the Group's first executive officer and as first editor of *Pachyderm.* I thank Iain Douglas-Hamilton when in the early 1980s we collated his aerial survey data of elephant carcasses, and more recently, through Save the Elephants (STE) for publishing my six monographs with Esmond on the ivory trade, and for his continued valued support. From 1985 to 1992 Esmond and I worked on a WWF International rhino project for John Hanks to whom I extend my gratitude for his support in our work to close down the international trade in rhino products when rhino populations were being devastated. I also thank the United Nations Environment Programme (UNEP) for an important period in 1992/1993 when I helped Esmond as the first UN special envoy for rhinos. I acknowledge Daniel Stiles for work done together with Esmond on five earlier ivory trade monographs for STE, and for lengthy and interesting discussions on illegal wildlife trade and help over the years.

I thank all current fellow members of the IUCN African Rhino Specialist Group (AfRSG) and the IUCN African Elephant Specialist Group (AfESG) for sharing knowledge and friendship. Thanks go especially to Holly Dublin, Richard Emslie, Mike Knight, Benson Okita Ouma, Rob Slotow, Bibhab Talukdar and Michael 't Sas-Rolfes; and I thank also Rob Brett and Chris Thouless for many rhino and elephant deliberations and close friendship since our undergraduate days at Oxford University. I thank Karl Ammann for much advice, and also Crawford Allan, Tom Milliken and many working for TRAFFIC, the wildlife trade monitoring network, as well as the Environmental Investigation Agency (EIA) and other non governmental organizations (NGOs) for interesting meetings and collaboration. Thanks also go to Njoki Kibanya at the Save the Elephants office for her extra help on many publications. I acknowledge translators, guides and interpreters who remain anonymous and with whom I have carried out fieldwork in many countries and often in testing circumstances.

I thank Oxford Brookes University and especially Vincent Nijman for encouraging me to carry out this PhD and for his assistance throughout. Thanks go also to my fellow students and researchers for times spent together before COVID-19. Vincent Nijman's memorable morning MSc class in December 2019 entitled, 'International Conservation – disease transmission', was only shortly before COVID-19 changed the world.

List of Annexes

My selected published reports (Annexes 1 to 27) are listed below (Box 1), all based on my field research. **These Annexes are referenced in bold in the text**. My publications were often illustrated to help inform people about rhino horn and ivory items seen for sale, as in this thesis (Cover photograph, Figs. 1 to 10).

Box 1. Selected publications for the PhD by Published Work in four sections

Part 1: The rhino horn trade from Africa to Yemen (six publications)

ANNEX 1. Western D, **Vigne L**. 1985. The deteriorating status of African rhinos. *Oryx* 19(4):215–220.

ANNEX 2. **Vigne L**, Martin E. 1993. Yemen's rhino horn trade increases. *Oryx* 27(2):91–96.

ANNEX 3. Martin E, **Vigne L**, Allan C. 1997. *On a knife's edge: the rhinoceros horn trade in Yemen*. TRAFFIC International, Cambridge, UK. 45 pages.

ANNEX 4. **Vigne L**, Martin E. 2006. The Garamba–Yemen link and the near extinction of the northern white rhino. *Oryx* 40(1):13–14.

ANNEX 5. **Vigne L**, Martin E, Okita–Ouma B. 2007. Increased demand for rhino horn in Yemen threatens eastern Africa's rhinos. *Pachyderm* 43:73–86.

ANNEX 6. **Vigne L**, Martin E. 2013. Increasing rhino awareness in Yemen and a decline in the rhino horn trade. *Pachyderm* 53:51–58.

Part 2: The rhino horn trade to eastern Asia (five publications)

ANNEX 7. Martin E, Martin C, **Vigne L.** 1987. Conservation crisis – the rhinoceros in India. *Oryx* 21(4): 212–218.

ANNEX 8. Martin E, **Vigne L**. 1987. Recent developments in the rhino horn trade. *TRAFFIC Bulletin* 9(2/3):49–53.

ANNEX 9. **Vigne L**, Martin E. 1991. Assam's rhinos face new poaching threats. *Oryx* 25(4): 215–221.

ANNEX 10. **Vigne L**, Martin E. 1991. African and Asian rhino products for sale in Bangkok. *Pachyderm* 14:39–41.

ANNEX 11. **Vigne L,** Martin E. 2018. *Illegal rhino horn trade in eastern Asia still threatens Kruger's rhinos*. The Aspinall Foundation, UK. 120 pages.

Part 3: Ivory markets on the African continent (five publications)

ANNEX 12. Martin E, **Vigne L.** 2010. The status of the retail ivory trade in Addis Ababa in 2009. *TRAFFIC Bulletin* 22(3):141–146.

ANNEX 13. Martin E, **Vigne L.** 2011. Illegal ivory sales in Egypt. *TRAFFIC Bulletin* 23(3):117–122.

ANNEX 14. Martin E, **Vigne L.** 2013. Lagos, Nigeria: one of the largest retail centres for illegal ivory surveyed to date. *TRAFFIC Bulletin* 25(1):35–40.

ANNEX 15. **Vigne L**, Martin E. 2014. Findings on the flourishing ivory trade in Angola's capital, Luanda. *TRAFFIC Bulletin* 26(2):44–46.

ANNEX 16. **Vigne L.** 2016/2017. A tale of two African cities – ivory trade comparisons in Khartoum/Omdurman and Addis Ababa. *Pachyderm* 58:88–96.

Part 4: The ivory trade in eastern Asia, eleven publications (11 publications)

ANNEX 17. **Vigne L**, Martin E. 2010. Consumer demand for ivory in Japan declines. *Pachyderm* 47:45–54.

ANNEX 18. **Vigne L**. 2013. Recent findings on the ivory and rhino-horn trade in Lao People's Democratic Republic. *Pachyderm* 54:36–44.

ANNEX 19. **Vigne L**. 2016. Ivory and religious statues in the Philippines today. *Pachyderm* 57:48–56.

ANNEX 20. **Vigne L**, Martin E. 2016. Vietnam's illegal ivory trade threatens Africa's elephants. Save the Elephants, Nairobi, Kenya. 84 pages.

ANNEX 21. **Vigne L**, Martin E. 2017. *The ivory trade of Laos: now the fastest growing in the world.* Save the Elephants, Nairobi, Kenya. 88 pages.

ANNEX 22. **Vigne L,** Martin E. 2018. *Myanmar's growing illegal ivory trade with China*. Save the Elephants, Nairobi, Kenya. 88 pages.

ANNEX 23. Martin E, **Vigne L.** 2011. *The ivory dynasty: a report on the soaring demand for elephant and mammoth ivory in southern China.* Elephant Family, The Aspinall Foundation and Columbus Zoo and Aquarium, UK. 22 pages.

ANNEX 24. **Vigne L,** Martin E. 2014. *China faces a conservation challenge: the expanding elephant and mammoth ivory trade in Beijing and Shanghai*. Save the Elephants and The Aspinall Foundation, UK. 88 pages.

ANNEX 25. Martin E, **Vigne L**. 2015. *Hong Kong's ivory: more items for sale than in any other city in the world.* Save the Elephants, Nairobi, Kenya. 66 pages.

ANNEX 26. Martin E, **Vigne L**. 2016. Macau's elephant and mammoth ivory trade today. *Pachyderm* 57:78–85.

ANNEX 27. **Vigne L,** Martin E. 2017. *Decline in the legal ivory trade in China in anticipation of a ban.* Save the Elephants, Nairobi, Kenya, 84 pages.

NB. Most of my fieldwork was conducted with Esmond Martin in order for two people to gather more accurate data and for safety in sometimes dangerous places. I increasingly took the lead role collecting field data, analysing it and writing it up for publication. In my publications and in my thesis, prices are reported in USD for consistency in the exchange rate at the time of data collection, not corrected for inflation. I use the word 'ivory' for elephant ivory. The word 'markets' broadly refer to all retail outlets. I use tonnes (not tons) referring to 1,000 kg.

Fig. 2. Traditional Oriental medicines with rhino horn, for sale in the early 1980s in eastern Asia

Tables

Boxes

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Abbreviations

ACET	Analytical Center of Excellence on Trafficking
ADMCF	ADM Capital Foundation
AERSG	African and Elephant Rhino Specialist Group
AfRSG	African Rhino Specialist Group
AfESG	African Elephant Specialist Group
AsRSG	Asian Rhino Specialist Group
ASEAN-WEN	Association for Southeast Asian countries Wildlife Enforcement Network
CITES and Flora	Convention on International Trade in Endangered Species of Wild Fauna
CoP	Conference of the Parties to CITES
EIA	Environmental Investigation Agency
ETIS	Elephant Trade Information System
FATF	Financial Action Task Force
FFI	Fauna and Flora International
IUCN/SSC Commission	International Union for Conservation of Nature / Species Survival
MIKE	Monitoring of Illegal Killing of Elephants
NGO	Non-Governmental Organization
NIAP	National Ivory Action Plan
STE	Save the Elephants
TCM/TVM	Traditional Chinese/Vietnamese medicine
TRAFFIC	Trade Records Analysis of Flora and Fauna in Commerce
UNEP	United Nations Environment Programme
UNODC	United Nations Office on Drugs and Crime
USAID	US Agency for International Development
USFWS	US Fish and Wildlife Service
USD	US dollar
WWF	World Wildlife Fund / World Wide Fund for Nature
WJC	Wildlife Justice Commission

Fig. 3. Endangered wildlife products often sell together for the Chinese market: rhino horn pieces at the back, a helmeted hornbill skull with casque, two bear gall bladders and ivory jewellery.

CHAPTER 1: INTRODUCTION

1.1 Background

Demand for wildlife products. China's new wealth and consumption by its rising human population, and inadequate law enforcement in the region, has led to a rocketing demand for illegal wildlife species which is often combined with other global crime (ACET 2019). Wildlife crime has become one of the largest international organized crimes because it was previously downplayed, but now more awareness and changing attitudes are emerging to encourage stronger law enforcement (ACET 2019) to support species protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora or CITES (Table 1). In China especially, from the 2000s, trade in endangered wildlife products shot up, with many able to afford luxury commodities (Fig.1) (Zhao et al. 2017). This demand, notably for food, 'pets', ornaments, traditional medicine, and superstitious use, threatens many animals, including rhinos and elephants.

Table 1. Details of species named in this thesis with their CITES Appendix listing dates

Common name	Latin name	CITES Appendix listing date
Black rhino	*Diceros bicornis*	Appendix I 1977
White rhino	*Ceratotherium simum*	Appendix I 1976
	South Africa: live trade, trophies	Appendix II 1994
	Eswatini: live trade, trophies	Appendix II 2004
Greater one-horned rhino	*Rhinoceros unicornis*	Appendix I 1975
Sumatran rhino	*Dicerorhinus sumatrensis*	Appendix I 1975
Javan rhino	*Rhinoceros sondaicus*	Appendix I 1975
Asian elephant	*Elephas maximus*	Appendix I 1975
African elephant	*Loxodonta africana* and *cyclotis*	Appendix I 1989
Pangolin (8 species)	Manidae	Appendix I 2016
Helmeted hornbill	*Rhinoplaxis vigil*	Appendix I 1975
Saiga antelope	*Saiga tatarica*	Appendix II 2008

Sources: CITES.org; savetherhino.org

Poaching and wildlife trafficking in countries near China increased from the 2000s for many endangered mammal species, including tigers, *Panthera tigris* (Nijman and Shepherd 2015) and the elusive serow, *Capricornis sumatraensis* (Leupen et al. 2017), as well as birds, reptiles and amphibians. Timber from endangered hardwoods is trafficked in huge quantities to China, despite legislation (UNODC and Freeland 2015; ACET 2019). Cross-border illegal wildlife trade has long occurred from poorer to richer countries in the region (Srikosamatara et al. 1992; UNODC 2020). The smuggling of pangolins into China has become rife (Nijman

et al. 2016; Shepherd et al. 2018), and as numbers have dwindled in Southeast Asia, a new demand for them has grown from Africa. (Challender and MacMillan 2014; Challender et al. 2014; Svensson et al. 2014a; Shepherd et al. 2017), with tonnes of pangolin scales smuggled in large shipments (often with ivory) to Asia for traditional Chinese medicine (ADMCF 2019; UNODC 2020). A similar smuggling pattern occurred with rhino horn and ivory. As rhino and elephant populations collapsed in most of Asia, Africa became the main source (Walker 2009; Vigne and Martin 2018b).

Threats to wild fauna and flora are growing. Major development projects, such as China's Belt and Road Initiative and Africa's economic growth strategies may bring prosperity, but also biodiversity loss (Esmail et al. 2020) with increasing access to wildlife for trafficking. In 2020 COVID-19 brought to the attention of the world that considerable funds are needed to prevent future pandemics caused by habitat fragmentation and illegal wildlife trade that are major threats to nature as well as climate change (Dobson et al. 2020; Walzer 2020). We have to re-think nature-based tourism and encourage conservation easements to secure ecosystem diversity and landscape connectivity (Graves et al. 2019) safeguarding elephants and rhinos in their wild habitats. Not only are non-protected areas and species within them being destroyed, but there is also an urgent need for adequate financing to safeguard the world's protected areas (Pacifici et al. 2020). There is now recognition that if rhino, elephant, and all wildlife conservation projects are going to work in general they require active involvement with knowledgeable local communities as stakeholders and guardians of wildlife, especially valuable species —or they will fail (Remis and Robinson 2020).

Rhinos and elephants. Rhinos in Africa and particularly Asia have been threatened for centuries by human population growth and human impact, with alarming forecasts (Andermann et al. 2020). In Asia the main problems in the last 40 years facing the conservation of greater one-horned, Javan and Sumatran rhinos and Asian elephants have been their shrinking habitat, human–wildlife conflict and poaching for the illegal trade in rhino horn, ivory and skin (Khan1989; Dawson and Blackburn 1992; Tilman et al. 1994; Blake and Hedges 2004; Leimgruber et al. 2011; Gosling 2018; Sampson et al. 2018). In Africa over this period poaching for the rhino horn trade has been by far the major threat to both Africa's rhino species (**Vigne and Martin 2018b**; CITES 2019c).

The international trade in all Africa's rhinos was banned in 1977 amongst CITES member states (Table 1), but rhino poaching in Africa for the international trade in rhino horn spiralled in the late 1970s and 1980s wiping out most populations (**Western and Vigne**

1985; Tudge 1991), for markets in Yemen and eastern Asia (Cover photograph and Fig 2). Very slowly, however, with legislation and improved law enforcement, as well as greater protection for those left, numbers increased on the continent. In India and Nepal in parallel, greater one-horned rhino numbers slowly recovered due to political commitment and successful management, despite setbacks during times of civil unrest (Martin and Vigne 1995a; Martin and Vigne 1996; Martin and Vigne 2012a). In contrast the Javan rhino species has long been on the brink of extinction with fewer than a 100 for decades, and the Sumatran rhino species has dropped in number from several hundred in the 1980s to a few tens – essentially due to a lack of political will (Khan 1989; CITES 2019c). South Africa, recognized for the greatest rhino conservation success story since the 1970s, witnessed from 2008 a worrying increase in rhino poaching that contributed to a significant reduction in numbers notably in the largest stronghold: Kruger National Park (Haas and Ferreira 2016; CITES 2019c, Ferreira and Pienaar 2019-2020). This has emphasized the importance of also keeping rhinos on private land (Ferreira 2016; Clements et al. 2020).

Illegal killing of elephants in Africa for ivory has caused considerable population declines especially since the 1970s (Wasser et al. 2010; Wittemyer et al. 2014; Cerling et al. 2016; Poulsen et al. 2017) due to corruption, local poverty, and high global ivory prices (Hauenstein et al. 2019; Schlossberg et al. 2020). Indeed in 1981 when there were over a million elephants on the continent, at an IUCN African Elephant and Rhino Specialist Group (AERSG) meeting it was predicted that some elephants in Africa may not be conservable (Cumming and Jackson 1984). While in the 1980s it was elephant habitat loss that was the main threat to Asian elephants (Phanthavong and Santiapillai 1992), in tropical Africa the main threat was poaching, with tusks feeding into illegal and sometimes legal trade. The legal ivory trade from certain southern African countries with well managed elephant populations witnessed elephant numbers grow rapidly, requiring culling programmes in South Africa and Zimbabwe at that time—all parts of the elephants were utilized and this funded successful park management and benefited local people living with the dangers of megafauna (Cumming and Jackson 1984). A regulated, sustainable trade requires effective management in range states and consumer countries (Stiles 2004a), but more recently, with the uncontrolled surge in Chinese demand, this could not be managed appropriately (**Vigne and Martin 2014b, Vigne and Martin 2017b**).

Another increasing challenge in many areas of Africa is the rising population of both elephants and humans competing directly for habitat. Land clearance for agriculture and

settlement have been of great concern for elephant conservation (Parker and Amin 1983; Tilman et al. 1994; Myers et al. 2000) – compounded by illegal ivory trade (Pagel and Mace 1991). The last update from the African Elephant Database in 2016 of 415,428 ± 20,111 in surveyed areas, with perhaps an additional 117,127 to 135,384 other elephants in Africa (Thouless et al. 2016), denotes major losses in some regions (CITES 2017). While the legal and illegal ivory and rhino horn trades have been hotly debated for 40 years at CITES conferences, with trade proponents increasingly disappointed, poor law enforcement remains in many range and consumer states, whether or not there are forms of legal trade, and both pachyderms are still threatened (UNODC 2020). This is echoed by other species endangered from commercial wildlife trafficking (Fig. 3), with China today the main driver (ACET 2019; ADMCF 2018).

1.2 Different research approaches relating to rhino horn and ivory trade

Data and information provided for law enforcement against illegal wildlife trade (IWT) are shared at conferences and workshops, notably on ivory and rhino horn in order to combat poaching and illegal markets. Increased funding for multidisciplinary research in recent years has been commendable.

Genetics. In South Africa genome scientists have created a DNA-based individual identification protocol to link confiscated rhino horns to specific poaching incidents, in support of criminal investigations. This is called the Rhinoceros DNA Index System (RhODIS) and has proved highly effective for rhino horn identification (Harper et al. 2018). Also involving DNA, the work of Samuel Wasser and colleagues has provided important information about criminal networks operating from Africa (Wasser et al. 2007). They use molecular biology to study seized tusk DNA to link the site of poaching with the smuggling routes from African to Asian markets. They have shown poaching sources and the massing of tusks from different regions to specific East, southern and West African ports for smuggling, explaining that big illegal traders in recent years are interlinked in a network across Africa. The level of power and sophistication criminal syndicates have in moving large quantities of tusks off the continent is considerable, including those from the recent poaching onslaught in Tanzania and Mozambique (Wasser et al. 2010; EIA 2014; Wasser et al. 2018).

Statistical modelling. Statistical modelling of ivory and rhino horn trade also is important for research. Milner-Gulland and Mace (1991) reviewed the quantity of tusks in trade being 12–13% of elephants with tusks, each year in the late 1980s. The relationship between financial

gains, detection and penalties in Zambia was modelled to understand the incentives of poaching, and law enforcement needs (Milner-Gulland and Leader-Williams 1992). An econometric model was used to describe Japan's consumer demand for rhino horn and ivory, showing that it was primarily income-led (Milner-Gulland 1993) during a period of ample disposable income in Japan. Her academic work at the Oxford Martin Programme on the Illegal Wildlife Trade examines wildlife consumption, and she has explained that illegal wildlife trade is not a new problem and it is important to look back at attempts to address such trade, for insights into current policy and practice (Milner-Gulland 2018). Growing human population pressure and over-consumption, as well as corruption and mismanagement, remain the unresolved challenges (Parker and Amin1983; UNODC 2020).

Seizure data. Statistical analysis helps interpret official ivory seizure data by examining where seizures have occurred, recording origin, transit and intended destination countries/territories, and quantities of ivory. Fiona Underwood and colleagues have analysed figures from the Elephant Trade Information System (ETIS) database for CITES (Box 3) (Underwood et al. 2013). Compiled by Tom Milliken with TRAFFIC (a leading NGO monitoring wildlife trade), this shows the growing complexity of smuggling and trade routes (Milliken et al. 2012; 2016; 2019).Their work has helped to identify countries that need to be 'watched' and to modernize their law enforcement under the National Ivory Action Plan (NIAP). This started in 2013 at CITES CoP16 in Bangkok (Milliken 2013) and is updated at each Conference of the Parties (CoP), the last being CITES CoP18 in 2019 in Geneva that included in Category A for the first time Mozambique and Nigeria as countries most affected by illegal ivory trade, as we found in Lagos (**Martin and Vigne 2013b**), with China and Hong Kong still ranking second in prominence, and Vietnam having worsened considerably (CITES 2019b; Milliken et al. 2019). These countries/territories are then required by CITES through the NIAP process to implement CITES regulations (CITES 2019c). Tom Milliken with TRAFFIC has compiled data on ivory and rhino horn seizures since 1997, helping CITES and other agencies understand the scale of the problem (Milliken 2014).

Market surveys. Researchers from Oxford Brookes University's Oxford Wildlife Trade Research Group, and NGOs such as Monitor as well as TRAFFIC, collect comparable data on trade in wild animals and plants. For ivory and rhino horn, from early fieldwork in Lao PDR and Vietnam (Nash 1997) to ivory surveys, such as in Angola and Mozambique (Milliken et al. 2006), West Africa (Courable et al. 2003), Cambodia (Nguyen and Frechette

2017) and mainland China (Zhao et al. 2017), these add to our overall understanding of trends to tackle illicit consumer markets.

Online monitoring. Since 2012 in China, monthly online e-commerce surveys collect and send information to law enforcement agencies for punitive action (Zhao et al. 2017). In March 2014 TRAFFIC began monitoring illegal ivory trade on social media platforms, recording advertisements, pictures and videos per user to assess trade trends and to compare ivory prices in legal and illegal markets (Zhao et al. 2017). Studying the growing social media trade has become increasingly time-consuming (Krishnasamy and Stoner 2016).

Demand. Statisticians analyse questionnaires to ascertain what is driving illegal consumer demand notably in certain cities in China, drawing demand curves and collecting consumer profiles of potential users. This statistical analysis, such as for rhino horn, helps provide information for demand reduction strategies, using a random sampling methodology (Kennaugh 2016). USAID-funded surveys (usaidwildlifeasia.org) have increased greatly.

Economics of trade. Economists study legal and illegal markets, examining effects of prices on supply and demand and the complexity of rhino horn and ivory issues, such as stockpile management and speculation for investment ('t Sas-Rolfes et al. 2014; Stiles et al. 2015). They appraised ivory price data by using empirical methodology to indicate the extent of elasticity (Do et al. 2018) showing that demand for such items, embedded in Chinese culture whether legal or illegal, continues often irrespective of price. Economists and stakeholders also look at methodologies regarding the best options for rhino horn in conservation (Economists at Large 2013; Clements et al. 2020) investigating whether certain forms of trade in rhino horn and/or ivory may or may not be appropriate under certain conditions.

Undercover investigations. In recent years undercover investigations have expanded. This sometimes dangerous approach includes studies by the Environmental Investigation Agency (EIA 2014; 2015; 2017; 2018), the Elephant Action League (Crosta et al. 2015; 2017), and the Wildlife Justice Commission (Stoner et al. 2017; WJC 2020a). Wayne Lotter was murdered in 2017 in Tanzania carrying out investigations for PAMS Foundation on ivory trade (**Vigne and Martin 2018b**), distressingly highlighting the risk in such work against powerful criminals. This data, collected from producing and consuming countries via poachers, brokers, suppliers, vendors and carving facilities, is essential to expose the main players who profit from the illegal ivory and rhino horn trade. Investigative journalists also use methodologies, interviewing criminals sometimes in jail to collect valuable information (Rademeyer 2012; 2016a; 2016b). Of note in 2019, collaborative intelligence work

dismantled two big ivory transnational networks operating from Africa: the Kromah cartel (Marsh 2019; Anon. 2019/2020) coordinated by the United Fish and Wildlife Service (USFWS), and the Shuidong network (EIA 2017; Anon. 2019/2020) with China government support. These show that internationally coordinated and trust-based intelligence can expose transnational organized wildlife crime, dealing with it as a serious crime, as for the drugs trade (Marsh 2019), thus helping to remove wildlife criminals' feeling of impunity.

Interviews. Other methodologies focus on field interviews and direct observations on wildlife trade patterns in different seasons at specific locations including border towns, such as in Myanmar (Min 2012). Questionnaires may be used for quantitative data collection on species hunted, trade routes and sources to help in interviewing villagers, hunters, small-scale dealers, middlemen and other traders, with the aid of pictures of wildlife (Min 2012). Local communities need disincentives to poach, and incentives to steward wildlife by reducing their costs of living with wild animals, in the process improving local livelihoods and fair governance (Martin and Vigne 2012a; Biggs et al. 2016).

Law. There has been increased research in how to address the criminal market by examining the convergence between licit and illicit markets (Dininio 2020). Coordinated efforts among governments and agencies have helped in producing Vietnam's National Ivory and Rhino Horn Action Plan (Vietnam government 2018). Legal experts collaborate with financial investigations to break wildlife crime networks, for which follow up methodology on enforcement is important (Reid and Keatinge 2020). A growing number of agencies are collaborating with similar methodologies to break criminal syndicates and transnational organized crime in ivory, rhino horn and other illegal wildlife products (FATF 2020; UNODC 2020). This includes the Association for Southeast Asian countries Wildlife Enforcement Network (ASEAN-WEN) and Interpol engaging more with China for collaboration to counter wildlife trafficking (ACET 2019).

Court cases. Some NGOs undertake in-depth studies for various species and their products to assist with court cases, such as studying media information and seizure data. In Zimbabwe this helped to establish penalties publicized against the pangolin trade (Shepherd et al. 2017). Researchers also assess court cases in Hong Kong, aiming at the higher end criminals involved in smuggling (ADMCF 2018).

Capacity building. Government offices (USFWS, for example) and NGOs carry out research and training workshops for capacity building. These include ivory and rhino horn identification and trade dynamics (TRAFFIC 2008). To improve the judiciary in Africa and

strengthen wildlife prosecution and sentencing, training initiated by Space for Giants, has provided a clear road map for criminal justice solutions (Fletcher 2016).

1.3 Aims and objectives of this work

Rhino horn and ivory have long been among the most lucrative and significant wildlife commodities in wildlife trade (Parker and Martin 1979; 1982; 1983) and continue to be so (Milliken 2014; **Vigne and Martin 2018b**). Ivory and rhino horn are famed for their value, and due to weak law enforcement and corruption along the supply chain, illegal trade involves sophisticated international criminal networks (Milliken and Shaw 2012) with increasing security implications linked to global organized crime (Milliken et al. 2016; Biggs et al. 2016). From the early 1980s onwards we have been seeking to understand the drivers of poaching and illegal trade in order to combat them. The specific aim of my research as presented in this thesis has been to study the sources of rhino horn and tusks, the demand for rhino horn and ivory, and to help combat the illegal markets that threaten rhino and elephant populations. My objectives have been to uncover and survey key markets in the field, collecting original data using a consistent methodology to gather fact-based evidence on rhino horn and ivory markets, and to disseminate this information widely to support action by stakeholders and decision makers in protecting rhino and elephant populations in the wild.

My many photographs taken for research and for publication clearly show the uses of ivory and rhino horn in the markets. Vietnamese officials, for example, admitted to Tom Milliken of TRAFFIC a few weeks before the 2016 CITES conference that it was photographs I had taken for our monograph (**Vigne and Martin 2016a**) that convinced them of a problem regarding the quantity of new illegal items being made for retail sale and the need for greater law enforcement (Figs. 7 and 8).

In this thesis I present a selection of my main published work **(in bold in the text):** a total of 27 Annexes (within the hard copy Appendix). My research questions focus on four topics: What is the extent of unregulated trade in rhino horn in 1) Yemen and 2) eastern Asia? And what is the extent of unregulated trade in ivory in 3) Africa and 4) eastern Asia? (Box 2). I then look at certain themes: 1) Why has demand shifted from one country to another over the period of 1980 to 2020? 2) How has demand spread so much in recent years? 3) What has caused changes in trade and marketing? 4) In which direction is demand going?

Box 2. Outline: Fieldwork in four sections

The rhino horn trade from Africa to Yemen

My research in Yemen concentrated on smuggling routes and the rhino horn trade mainly to the capital, Sanaa. I collected baseline data and followed up on trade trends on subsequent surveys. Due to the civil war from 2014, I had to investigate through WhatsApp with a contact in Yemen in 2017 and again in 2020. Our work brought much needed attention to the significance of Sanaa regarding the illegal trade in rhino horn to curb this trade (Annexes 1-6).

The rhino horn trade to eastern Asia

I researched rhino poaching and smuggling of rhino horn, and efforts to combat it in India and Nepal collating unpublished official data and interviewing officials, forest guards and local people for their opinions on anti-poaching strategies that work. I analysed our findings and wrote extensively for international support. I surveyed rhino products in India, Thailand and later in China, Vietnam, Lao PDR and Myanmar to learn about the developing markets in Indochina. My recent market survey studies revealed interesting changes in consumer demand and have been published to assist in finding workable solutions to the problem (Annexes 7-11).

Ivory markets on the African continent

In Africa I surveyed key illegal ivory markets: in Ethiopia, Egypt, Nigeria, Angola, and Sudan (Fig.4), sometimes with follow up visits to ascertain trends, providing reports with data on numbers, types and prices of ivory items, as used by various stakeholders aiming to stop the open, unregulated outlets selling new ivory items (Annexes 12-16).

Ivory markets in eastern Asia, a) Eastern Asia, b) China

In alphabetical order I carried out fieldwork in China, Hong Kong, Japan, Lao PDR, Macau, Myanmar the Philippines, Thailand, and Vietnam (Annexes 17-27) again often on repeated visits to update findings and to help pinpoint areas of grave concern where efforts were/are needed to close down illegal markets, cited in various reports, such as that of UNODC (2020).

Fig. 4. Small tusks, ivory animal figurines and ivory brush pots for sale in Khartoum, Sudan, 2017

My research was guided by the needs of CITES (Box 3). CITES prohibited the international trade in all five endangered rhino species by 1977. The international ivory trade was prohibited by CITES Parties in 1989 and came into effect in January 1990.

Box 3. CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) entered into force in July 1975 as a multilateral treaty to protect endangered animals and plants. Countries gradually became signatories to the so-called Washington Convention (Table 2).

CITES today has at least 183 member 'Parties' with trade regulated for more than 35,000 species. Its main role has been placing certain wildlife species on listings (Appendices) that need protecting in trade, with Appendix I prohibiting the international trade amongst Parties or member states. Every three years documents on ivory and rhino horn trade are updated for the Party Conventions (Conference of the Parties or CoP) with a wealth of material (CITES 2019a,b,d,c,e) to help prepare policy makers with factual information. Specialist researchers, many volunteering their time for the IUCN/SSC groups, compile data on species in trade to be discussed (iucn.org/sscgroups).

My field data and others have been used every three years for reports produced by the IUCN African Elephant and African Rhino Specialist Groups (AfESG and AfRSG) to submit to CITES, in order to give objective empirical evidence on ivory and rhino horn markets, as well as other facts about poaching, smuggling and consumer demand (CITES 2017; Emslie et al. 2019). Reports for CITES are becoming increasingly numerous and detailed, with more NGOs collecting information on the wildlife trade and helping us to understand more about important markets, such as ivory in China (Chou 2018; Xiao 2018). It is important that neutral academic research is used to guide decision makers at CITES conferences and in general.

Receiving annual ivory seizure data from member states, ETIS was set up by CITES in 1997 together with MIKE (Monitoring of Illegal Killing of Elephants) in order to track illegal ivory trade (Hunter et al. 2004; CITES 2019a,b). These are processes reported to CITES at each CoP, for member states to use in checking where elephant poaching and smuggling may be occurring so that it can be confronted. Any changes in our survey data indicators can be compared with MIKE and ETIS for correlations to assist CITES.

Table 2. Countries/territories with CITES dates of accession and dates entered into force, relevant to my fieldwork research publications in Box 1

Africa/Middle East	Date	Asia	Date
Nigeria	May/July 1975	India	July/Oct 1976
South Africa	July/October 1975	Hong Kong (UK till '97)	Aug/Oct 1976
Egypt	Jan/Apr 1978	Japan	Aug/Nov 1980
Sudan	Oct 1982/Jan 1983	Macau (Portugal till '99)	Dec 1980/Mar 1981
Ethiopia	Apr/Jul 1989	China	January/April 1981
Yemen	Apr/Aug 1997	Philippines	Aug/Nov 1981
Angola	Oct/Dec 2013	Thailand	Jan/Apr 1983
		Vietnam	Jan/Apr 1994
		Myanmar	Jun/Sept 1997
		Lao PDR	Mar/May 2004

Source: CITES.org

CHAPTER 2: METHODOLOGY

2.1 My research and chosen market survey techniques

I initially collected data with questionnaires from members of the IUCN SSC African Elephant and Rhino Specialist Group (AESRG) compiling numbers and distribution of African rhinos in 1983/1984. Poaching had been heavy and we needed to update our 1980/1981 figures for IUCN. I published my findings with the then Chairman, David Western (**Western and Vigne** 1984, **1985)** and carried out research work on elephant carcass counts from aerial survey data with Anne Burrill for Iain Douglas-Hamilton (Douglas-Hamilton and Burrill 1991).

From 1985 I worked on a WWF International project with the Vice Chair of the AERSG, Esmond Martin, to research and close down the international trade in rhino products. I focused on investigating North Yemen's jambiyas (traditional daggers: Cover photograph; Fig. 5), the 'best' with rhino horn handles, writing many articles (**Vigne and Martin 1993a;** Vigne and Martin 1993c; **Martin et al. 1997; Vigne and Martin 2006; Vigne et al. 2007)**. My fieldwork in Yemen from 1986 to 2012 involved market surveys every two or three years in Sanaa's old souk: I was heavily scarved in keeping with Yemeni culture and to help disguise me so as not to be recognized by the craftsmen making jambiya handles, in case they would hide their horn. I would walk alone to the workshop area deep in the souk through the narrow alleyways, looking for rhino horn and rhino horn handles being made. After my count and noting the rhino horn workshops, I would then hastily retreat to the safety of the hotel. Later Esmond Martin and I separately would count artisans and workshops, to compare for accuracy and recount if necessary. We would also survey the retail jambiya market close by with a translator to help with pricing as nothing was labelled. We would collect retail price data for jambiyas with differing handles, noting new trends on each visit, and have tea and talk with rhino horn dealers to update our findings on their trade and to gather general information. Some members of the senior family had lived in Mombasa and spoke English, giving me information more freely when I began this research.

Our interpreter, under our direction, would help us collect information on wholesale prices of rhino horn, quantities and origin of the horn coming in, current smuggling routes and techniques, and the price of left-over chips and shavings that were sold for export to eastern Asia, mainly China. On short visits we concentrated our monitoring in Sanaa and on longer visits we surveyed the souks in other towns to check jambiya production and sales. Recently,

unable to go to the country due to civil war, I collected data through a contact in Yemen on WhatsApp (Vigne and Martin 2018c), and I have updated 2020 information (unpublished).

I also worked with Esmond Martin on his ivory market data, mainly for southern Africa in the early 1980s (Martin 1984a,b; 1985a,b; 1986); and after the CITES ban in Zimbabwe (Martin 1991), Sudan (Martin 1998) and Egypt (Martin 2000). I did not carry out extensive ivory fieldwork in the 1990s or early 2000s, but worked on Esmond Martin's data, and also with Daniel Stiles producing five initial monographs for Save the Elephants including on Africa, Southeast Asia, and East Asia (Martin and Stiles 2000; 2002; 2003).

From about 2009 in Asia and Africa I collected field data on ivory and rhino horn (Box 1), sometimes with Esmond Martin for added security as investigations became less safe, but sometimes alone, in the same systematic way we had developed for useful comparison, updating techniques where appropriate. We could sometimes gather more data when there were two of us, one distracting the vendor by asking questions and pricing items, while the other counted or took photographs, for example. We recorded the number and types of ivory items (in certain locations rhino horn as well) on display for sale, noting also the numbers and variety of outlets. I photographed the objects where possible to verify counts. I observed items for age and origin of carving. If some were hidden in drawers or back rooms these were noted as extras. Starting/ labelled retail prices were recorded as well as the discount vendors were prepared to give. If stated in the local currency, we reported prices converted into USD at the exchange rate at the time, not corrected for inflation. We also learnt about current wages, to put prices of items for sale into context. Often in tourist areas US dollars were quoted, especially for expensive items. Where possible we would check the source of the ivory (or horn), both raw and worked, obtain wholesale prices for the raw material according to size and quality/type of the tusk (or horn), and visit craftsmen in workshops to establish trends in the numbers of workshops and artisan numbers (and if they worked full-time or part-time and how they were paid). We would note any changes in production and see what and how items were produced—by hand or with electric drills, for instance. In the retail outlets I recorded the nationality of the traders and customers and, usually through our interpreter, asked their views on the trade, documenting substitutes/alternatives as well. Unobserved, I would briefly write the data in a small notepad. Vendors in most countries became increasingly nervous of possible investigators, so to avoid causing alarm I also recorded items secretly taking close up photos with a small camera, and later by iPhone. In

the evenings I typed detailed data from my brief notes and photos of that day. And our interpreter explained what he had gleaned from conversations with the vendors and buyers.

We would select a country in Africa or Asia that we understood from friends and colleagues had an unregulated market and needed in-depth investigation. Some well-known markets required regular updating, such as in Ethiopia (Vigne and Martin 1993d; Vigne and Martin and Vigne 2008b,c,d; **Martin and Vigne 2010;** Vigne 2016/2017). Egypt is known for selling mainly older souvenir ivory items (Martin 2000; Martin and Milliken 2005) but we found new name seals and beads also being crafted, with similar new items for sale in large markets in Nigeria (**Martin and Vigne 2013b**) and Angola (Svensson et al. 2014b; **Vigne and Martin 2014a**). I maintained a standardized recording system for data comparisons in time and space (**Vigne 2016/2017**).

Price data and statistical analysis need careful interpretation for worked ivory, for instance with antique items or those of artistic merit bringing average prices high. A further limiting factor is establishing accurate turnover. Descriptions and photographs taken in different years of the same items in the same shops, and interviewing vendors, help, but this remains a pursuit to be better clarified for many markets.

2.2 Literature review

Particularly useful over the years for research have been *Oryx, Pachyderm, TRAFFIC Bulletin* and TRAFFIC reports. With the internet, many papers have been made available, revolutionizing this work for both learning about areas to visit for fieldwork and for wildlife trafficking information. Academia.edu, Google Scholar, Researchgate, Sci Hub, as well as African-elephant-request@elephantnews.org and rhinoresoourcecenter.com are vital sources for information using a snowball method for further citations, along with papers and links shared from colleagues by email and WhatsApp.

2.3 Timeline

I have researched a 40-year period on rhino horn and ivory markets from 1980 to 2020 and with decades of experience I have a broad understanding of the consistencies and changes in consumer demand and the challenges faced. In numerous countries I carried out fieldwork on rhino horn and ivory, with my timeline shown in Table 3. Fieldwork lasted a minimum of a week when one location was surveyed (such as Sanaa) to maximum 6 weeks for larger areas, such as India. Usually I spent 2–4 weeks collecting data in most of my surveys.

Table 3. Timeline showing my main fieldwork

Date	Country	Research (italics = reports in References)	Annexes
1983/84	Kenya	*Rhino population data collection*	Annex 1
1986	India	*Rhinos, survey on rhino horn uses*	Annex 7
1986	North Yemen	*Studying and curtailing the rhino horn trade*	Annex 8
1988	Nepal	Chitwan rhinos, rhino product investigations	
1988	Bangladesh	Rhino product investigations	
1988	India	*Rhino product investigations*	
1989	India	*A 6-week survey of the legal ivory trade (pre CITES ban)*	
1990	India	*Ivory trade follow up; rhino poaching study in Assam*	Annex 9
1990	Thailand	*Rhino product trade survey in Bangkok*	Annex 10
1990	China	Survey of wildlife products for sale in Guangzhou	
1990	Yemen	*Rhino horn trade study, WWF International*	
1992	Yemen	*Rhino horn trade survey and law enforcement*	
1993	Ethiopia	*Ivory trade study in Addis Ababa*	
1993	Yemen	*Closing down the trade in illegal rhino horn*	Annex 2
1993	India	*Assam's rhino protection*	
1995	Yemen	*Closing down the illegal trade in rhino horn*	
1995	India	*Assam's rhino anti-poaching study*	
1996	Yemen	*Arranging the joining of CITES*	Annex 3
1997	Tanzania	Study of the Kidai rhino population, Selous Game Reserve	
1998	India	*Assam's rhino conservation*	
1999	Ethiopia	*Ivory trade survey in Addis Ababa*	
1999	Yemen	*Survey of the rhino horn trade*	
2001	Yemen	*Rhino horn study, including Saada and Sokotra*	
2003	Yemen	*Rhino horn trade monitoring, legislation, education*	Annex 4
2005	Thailand, Vietnam	Retail Ivory investigation	
2005	Java	Rhino conservation in Ujung Kulon National Park	
2007	Yemen	*Monitoring rhino horn from eastern Africa to Yemen*	Annex 5
2008	Hong Kong	Elephant and mammoth retail ivory items investigation	
2008	Ethiopia	*Ivory market survey in Addis Ababa*	
2008	Yemen	*Jambiyas in Yemen and a rhino horn awareness campaign*	
2009	Ethiopia	*Ivory trade study in Addis Ababa*	Annex 12
2009	Japan	*The ivory markets of Osaka and Tokyo*	Annex 17
2011	Southern China	*A survey of the ivory and mammoth ivory trade*	Annex 23
2011	Egypt	*Ivory carving and retail ivory survey in Cairo and Luxor*	Annex 13
2012	India:	*Studying rhino conservation strategies in West Bengal*	
2012	Nepal	Bardia and Suklaphanta rhino study	
2012	Nigeria	*Ivory trade survey in Lagos*	Annex 14
2012	Yemen	*Rhino horn trade study in Yemen and public awareness*	Annex 6
2013	Lao PDR	*Rhino horn and ivory trade and wildlife markets studied*	Annex 18
2014	Angola	*Survey of Luanda's retail ivory markets*	Annex 15
2014	China	*Ivories and rhino horn in Beijing and Shanghai*	Annex 24
2015	Hong Kong	*Elephant and mammoth ivory trade survey*	Annex 25
2015	Macau	*Elephant and mammoth ivory trade survey*	Annex 26
2015	Philippines	*Ivory trade survey*	Annex 19
2015	China	*Ivory and rhino horn study in eight cities*	Annex 27
2015	Vietnam	*Ivory and rhino horn survey*	Annex 20
2015	Lao PDR	Ivory research	
2016	South Africa	*Rhino horn in South Africa, especially from Kruger*	Annex 11
2016	Lao PDR	*Ivory and rhino horn trade survey*	Annex 21
2017	Sudan	*Ivory and rhino horn trade in Khartoum/Omdurman*	Annex 16
2017	Ethiopia	*Addis Ababa ivory survey and study*	Annex 16
2017	Thailand	Ivory in Chatuchak market, Bangkok	
2017	Myanmar	*Ivory and rhino horn trade study*	Annex 22
2018	Japan and China	Ivory and mammoth ivory trade studies	
2020	East Myanmar	Retail ivory and rhino horn survey	

2.4 Study areas

My study areas presented in this thesis took place in markets of major concern regarding production and sales of worked rhino horn and ivory (Table 3). In North Yemen (Yemen from 1990) I regularly examined Sanaa's oldest souk (bazaar) buried deep in the ancient walled Old City inside the capital. I also surveyed Taiz and Dhamar, both known for jambiya making, and various towns as far north as Saada, as far west as the port of Hodeidah and into the southern region, notably Aden, Mukalla, Wadi Hadhramaut and Marib. In India and Nepal I went to all national parks and reserves with rhinos, especially Assam in northeast India with the most rhino protected areas.

In countries surveyed for their markets, I explored the main cities, tourist sites and resorts looking for workshops and retail outlets selling ivory and rhino horn. I concentrated on souvenir shops, luxury hotels with gift shops, expensive jewellery or jade shops, arts and crafts galleries, antique shops, exhibitions, shopping malls with specialist shops, religious outlets, wood shops, dagger/knife shops, Chinese markets, wildlife outlets, pharmacists or stalls selling traditional Oriental medicines (Fig. 2), and herbal tea outlets. Surveys were generally conducted in the main downtown areas of a city. I returned on later surveys to inspect previously visited shops and looked for new outlets. This involved taxis and a lot of walking. Taxi drivers sometimes found us new locations when we asked for help to find, for example, places carving or selling arts and crafts or traditional medicines (so as not to draw attention to our interest in ivory and rhino horn). Generally we had guides who helped us locate new workshop and shopping areas as well.

2.5 Identifying ivory and rhino horn

I have learned from experience to identify most ivory even in dim light, able to recognize styles and origins of a carving and usually whether an item is a genuine antique (pre 1947), old (pre 1990), carved recently in the 1990s and early 2000s or more newly carved in the previous five years. Ivory is recognizable in cross-section by its cross-hatchings or Schreger lines that are obtuse in angle and looser in appearance than mammoth ivory (Espinoza and Mann 1999; Baker et al. 2020). It helps to take a photograph and then blow up the image on an iPhone or computer to be sure of the Schreger lines. Small ivory items can be confused with mammoth ivory unless the outer 'peel' of a mammoth tusk (cementum) is present. Other ivories do not have Schreger lines. Bone has dots called pits that may collect dust grains due to the Havesian canal system in bone (Espinoza and Mann 1999; Baker et al. 2020). Large

items cannot be made out of a single bone, as for ivory. Synthetic/resin ivory generally has wavy lines. For extremely small beads in an item of jewellery, it is possible to confuse ivory with synthetic ivory, generally requiring careful examination and feeling the texture as well as using magnifying reading glasses, for example.

In Yemen it was straightforward to identify a full rhino horn by its distinctive fibrous base area, or for an oblong piece of horn by the texture and creamy colouring and the thin strands within it. Pieces of horn were sometimes smuggled in foodstuffs, cut into cigarette packet-sized oblongs for easier disguise. While Yemeni artisans were carving rhino horns I saw that they kept a sheet of plastic under the handle being filed, gathering the rhino horn shavings to sell. This would not happen with domestic water buffalo horn, *Bubalus bubalis*, (imported cheaply from India) of which the shavings merely fell to the ground. A finished rhino horn handle was recognizable by its lizard skin-like appearance that is unique, beiger for a new one and darker for an old one. It was important to have a close up view to make certain. Another technique was to look at the top edges of the handle for an amber-like translucency if held up to a light.

It was rare to see genuine old rhino horns or rhino horn items in eastern Asia. They were nearly all fakes, such as with curious knobbles around their base, and large dark 'antique' libation cups that were resin-like. Rhino horn is wider towards its base and solid and can be distinguished from cow or buffalo horns that are narrower and more hollow (Sims and Yates 2010). Tips of buffalo horn are difficult to distinguish from rhino horn tips (Tallant et al. 2010) and can confuse customers, especially common in traditional medicine shops in Vietnam (Ammann 2011). New, large rhino horn items, generally produced from horns of the white rhino, are nowadays made into standard-looking thick bangles and big plain pendants/large slices, beaded items, small Chinese drinking cups etc. These have thin filaments and sometimes melanin central patches perhaps with distinctive mottled edges. As for left-over chips and shavings used for medicine, these were often in trays of oil or neatly kept in small plastic bags or glass bottles with the familiar fibrous texture sometimes with part of a hole from bead cutting. Shavings are surprisingly white and can be in thin peels from a machine. It was not the cheaper shops, but Chinese shops selling herbal teas, jade or other expensive items where you might see rhino horn objects, often behind glass with ivory items. Thus knowing where they are likely to be found and their packaging/display techniques help to distinguish the genuine items.

2.6 Ethics

Over the decades market survey ethical requirements have changed. In our earlier studies, such as in Bangkok's Chinatown in 1990 (**Vigne and Martin 1991d**) salesmen were happy to answer questions. We could openly interview and record our findings in notebooks, spending time with artisans, pharmacists and traders at their desks. Dealers and shop owners often said they had never before been interviewed by a foreigner and were flattered by our attention. Being two of us helped them think we were simply interested tourists, especially important in later years. Even as late as 2015 in China, master ivory carvers liked to talk to us openly and at length, allowing us to write down their information, wanting to explain about their work in which they had great pride as well as confidence about their legal status (**Vigne and Martin 2017b**). Most vendors were glad of our notice in their items for sale. Some assumed that we wanted to learn about local handicrafts as writers for a book perhaps, or that we were carrying out a market survey with the aim of opening our own jewellery or souvenir outlet, for example, and we accepted graciously their usual unwillingness not to disclose details of their turnover (Hunt et al. 1984). We played a partially covert role in these instances, avoiding too many questions about ourselves, while encouraging an easy rapport with dealers and vendors for sometimes lengthy discussions (Li 2008). Only in later years did ethical challenges steadily increase requiring more covert investigations (Li 2008). Vendors could become overly suspicious and we had to adapt accordingly, keeping notebooks out of sight. But undisclosed research has to be accepted as a normal part of academic inquiry (Spicker 2011). We were tactful in the way we recorded our findings out of view to avoid annoying shop owners and being labelled as 'wildlife protectionists' which could result in our being told to leave the premises, outlets closing up, and worse. We adjusted, with speedier surveying thanks to photographs (asking permission to photograph if appropriate, or taking photos covertly if not). Photographs also improved accuracy as a reminder of shops and items. In published photographs we generally blurred or blackened faces for people's privacy. We never published names and addresses of those we interviewed, in respect of the right to confidentiality. We were of course always polite and generally vendors were polite and tolerated us, although we disappointed them by never buying an item of ivory or rhino horn, so as not to encourage the market or break the law.

CHAPTER 3: DISCUSSION

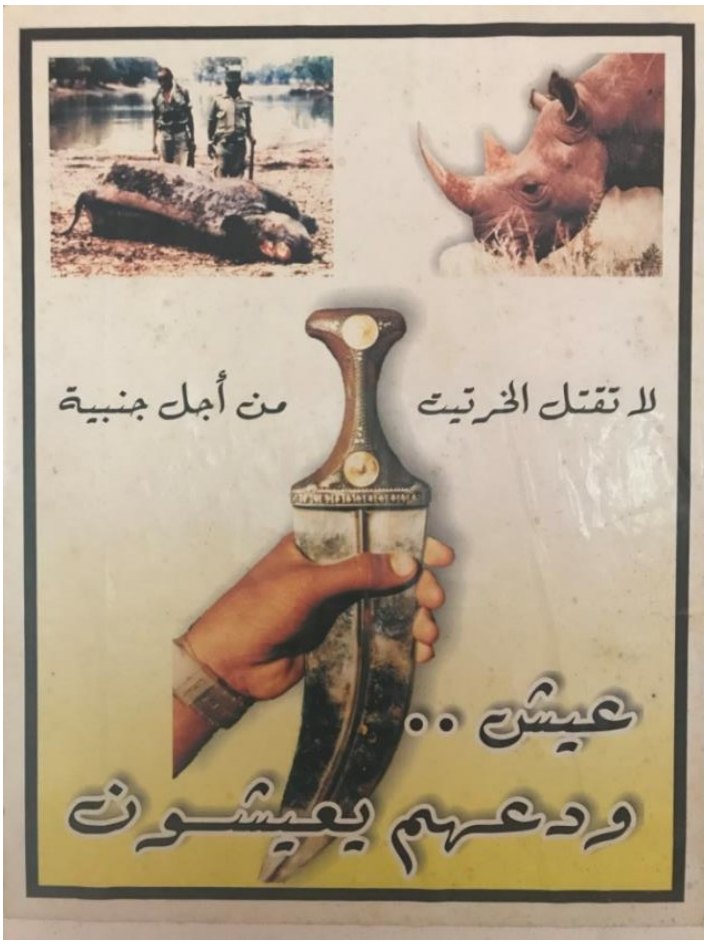

Fig. 5. Our 2007 poster in Yemen: ‘Don’t kill the rhino for a jambiya: Live and let them live too’

3.1 The rhino horn trade from Africa to Yemen

In Africa in the 1970s civil wars, an influx of firearms, a breakdown in law and order, weak governance, corruption and mismanagement afflicted much of tropical Africa and led to increasingly threatening rhino poaching. In the late 1970s rhino populations were declining rapidly (Parker and Martin 1979; Hillman and Martin 1979). It was the fast falling number of black rhinos in Africa from an estimated 65,000 in 1970 to an estimate of 14,000–15,000 in 1980, dropping to 8,800 in 1984, from data I compiled for IUCN/SSC AERSG (**Western and Vigne** 1984; **1985**) that alarmed conservationists and prompted my research into trade and demand, particularly in North Yemen (Box 4).

Box 4. Background to Yemen's rhino horn trade

Most Yemeni men in the 1980s wore daily a traditional curved dagger / jambiya. Those with a rhino horn handle were (and still are) considered the best, and the oldest, most precious daggers are known as *sayfani.* North Yemenis had become rich due to oil in the Gulf and from 1976 to 1980 Yemen was the major importer of rhino horn, officially importing 3 tonnes a year, 40% of the world market. The legal import price over that period rose from USD 100/kg to USD 766/kg (**Martin et al. 1997**). The wholesale price in the main market in Sanaa was USD 675/kg in late 1978 (Parker and Martin 1979). Although North Yemen banned rhino horn imports in 1982, smuggling continued and as rhino populations were being annihilated in tropical Africa, poaching spread southwards into Zambia where salesmen mixed real and fake rhino horns to try to fool traders (Martin and Vigne 1986). Rhinos were wiped out in Zambia for rhino horn due to inadequate anti-poaching patrols (Leader-Williams et al. 1990; **Vigne and Martin 2018b**).

We investigated poaching and smuggling of horn from Africa into the Arabian peninsula in the 1980s and early 1990s that involved a number of routes and techniques: from Khartoum and Addis Ababa on flights, from Djibouti by sea, or across the desert (**Vigne and Martin 1993a; Martin et al. 1997; Vigne and Martin 2006); Vigne et al. 2007; Vigne and Martin 2013a**). Our Sanaa visits from 1986 onwards involved a three-pronged approach. I would survey the souks and talk to the main trader who bought 70–80% of the total: an average of 1,226 kg/year from Tanzania, Kenya, Ethiopia, Sudan and Somalia from 1980 through 1984, and then declining. About 60–70% of the raw horn was 'discarded' as chips and shavings for export mostly to China, earning the Yemeni traders more to compensate for the rising price of the horn. We learned prices for shavings rose from between USD 219–340/kg from 1983 to 1990 to USD 500/kg in 1993 (**Martin et al. 1997**) and up to USD 940/kg in 2012.

Secondly, we would talk to high level officials, notably our friend Dr Abdul Karim al-Iryani who was Foreign Minister or Prime Minister or later Adviser to the President. On nearly every visit we saw him to discuss our findings, legislation and law enforcement as needed. He was always able to make immediate decisions with a phone call to various ministries to put into place the legislation we devised together, such as banning re-exports of left-over rhino horn, and finally Yemen joining CITES. Meetings with the top decision makers could be the fastest way to a solution. For example, as UN Special Envoy to rhinos in 1992 Esmond Martin met the ruler of Sharjah, Sultan bin Muhammad Al-Qasimi, who agreed to funding support and to prevent any more endangered wild animals from coming into his Emirate (Vigne and Martin 1993b), although funds were often lacking for follow-up work on such initiatives.

Thirdly, we encouraged wildlife education, describing in newspapers and on the Yemeni television the plight of the rhino. I arranged the design and distribution of posters (Fig. 5) and stickers that were handed out liberally to the public. We made billboards and other notices for the Sanaa and Taiz zoos, choosing the most useful positions and helping put them up strategically for the many visitors, so as to publicize the importance of wildlife and the perils of rhino survival (**Vigne et al. 2007; Vigne and Martin 2013a**). We spoke to students through contacts at the Sanaa University and other training institutes, lecturing and providing written information. We held regular meetings with traders to discuss the use of substitutes. We discovered that if the senior trading family approved of a material it would sell. They initially sold plastic handles for the same price as rhino horn and this was a success until it cracked when dropped or melted with cigarette ash. We encouraged new expensive agate handles, as did the President and Foreign Minister (Vigne and Martin 2000), but the senior trading family did not promote these as a prestigious substitute for local use because stone was not a material they wanted to craft. New look-alike resin Chinese-style handles made in more recent years have not been accepted by this family either, but have become popular, as well as domestic water buffalo horn, with the many who cannot afford rhino horn.

From 2003–2007 the wholesale price for raw rhino horn rose from USD 1,200 to USD 1,700 a kg with horns arriving from some of the last remaining northern white rhinos in Garamba National Park in the DRC, all illegally killed by rebels in 2003 and 2004 (**Vigne and Martin 2006**); Hillman Smith et al. 2014). We learned from traders in Yemen that rhino horn had come from the DRC and Kenya in 2005 and 2006 (**Vigne et al. 2007)**. The Sanaa traders obtained about 60–70 kg of African horn a year from 2003 to 2006, according to information received (**Vigne et al. 2007**). From 2000 to 2005 in Africa 252 poached rhinos were recorded (Milledge 2007); nearly all horns from eastern Africa were destined for Yemen.

We made progress on each visit and documented our findings, repeating the same methodology of surveying, meeting officials, encouraging substitutes and spreading information widely to curb demand for rhino horn. We also produced many academic reports and popular articles in reputable publications to reach a wider audience and to encourage more support for Yemen: Martin 1985c; Martin 1987; Vigne and Martin 1987b; Vigne and Martin 1991a,c; **Vigne and Martin 1993a**; Vigne and Martin 1993c; Martin and Vigne 1995b; Vigne and Martin 1995b; **Martin et al. 1997**; Martin and Vigne 1997b; Vigne and Martin 2000; Vigne and Martin 2001; Martin and Vigne 2003; **Vigne and Martin 2006**;

Martin and Vigne 2007a,b; **Vigne et al. 2007**; **Vigne and Martin 2013a,**b); Vigne and Martin 2018c.

When the economic boom ended, most men could not afford new rhino horn jambiyas after Unification in 1990 and the Gulf war in 1991 during which many lost their lucrative jobs. During the civil war that broke out between north and south Yemen in 1994, we were in Sanaa and were hurriedly evacuated—so our progress at that time came to nothing. And since 2014 fighting against the Houthi tribal rebels has made it impossible to re-visit and has destroyed Yemen's economy. 'Aid' money going into corrupt pockets, however, has maintained a demand by a small 'elite' (anonymous, Yemeni resident, pers. comm., February 2020). Wars make a few rich, so the trade has not collapsed.

There have been hardly any other major reports on Yemen's rhino horn and jambiya industry, except for one for the US government (Varisco1987) that stressed the general need for US action in conservation efforts and development in North Yemen, as well as help in finding an alternative to rhino horn handles. Rhino horn jambiyas were also worn just north in Saudi Arabia, made in Yemen and repaired locally, but this was not a significant market (Vigne and Martin 2000). A gap in our research is Oman, as daggers called *khanjar* of a slightly different style are worn there too, with some rich Omanis traditionally preferring rhino horn. I saw a new expensive one being worn in Muscat in August 2007. This could be a threat to rhinos if new handles are still being made—unlike the old Bedouin daggers for sale as artefacts that I saw, for example, in a boutique shop in Dubai in 2014 where the European shop owner thought they were all of water buffalo horn.

In Sanaa's old souk, for regular monitoring of the hidden-away workshops and stalls, it helped knowing the outlets well in order to find them on each survey for accurate comparisons, as the winding, narrow alleyways are confusing with most stalls not named or numbered. It also helped to know the traders and be a friendly female foreigner as dealers liked to show off their knowledge, liberally sharing information. Wildlife is not a priority in a developing country riddled with other problems where there is smuggling of many goods. A non-native animal is not considered a concern, rather the responsibility of the native country. It was thus important that we shared our data with a supportive and well-educated top politician who could make decisions quickly. We also learned the pitfalls of law enforcement in a developing country such as Yemen with government officials changing positions frequently. We met other influential people including the Grand Mufti who at our request wrote an important fatwa that 'it was against the will of God to kill rhinos for their horns'

(Vigne and Martin 2000). But we learned that in dealing with consumer demand, it was the senior trading family whose expert opinion counted the most.

3.2 The rhino horn trade to eastern Asia

Horns from all five species of rhinos have long been in demand widely in eastern Asia making it particularly difficult to halt trade entirely. In the 1980s and 1990s I researched the poaching in India, focusing on Assam which has the largest numbers of greater one-horned rhinos. The people of the Indian subcontinent, notably India and Nepal, have a long cultural connection with their rhinos (Divyabhanusinh et al. 2018). This charismatic animal has fascinated people for centuries. Many were kept in captivity in India and transported to Europe and elsewhere for people's 'entertainment' (Rookmaaker 1998; Rookmaaker et al. 1998). Nevertheless, most were hunted for sport to near extinction by the end of the 19th century (**Vigne and Martin 2018b).**

In India by 1980 with careful protection thanks to both State and Central government commitment and funding, populations recovered to 1,250 rhinos. Then suddenly from 1982 to 1985 poachers killed a minimum of 233 rhinos in Assam (**Martin et al. 1987;** Martin and Vigne 1989a). This was mostly due to political unrest. From 1986 to 2012 on a number of visits to India and Nepal we interviewed senior staff and patrollers, studying reasons for successes and failures in their efforts to prevent rhino poaching. We also collated data on illegal killing. For example, in Assam, poachers acquired automatic weapons, or used silent pit traps, and also power lines to electrocute rhinos (**Vigne and Martin 1991b;** Vigne and Martin 1994a; Martin et al. 2009a,b). Nepal struggled with serious political disturbances, reducing rhino numbers considerably during those periods (Martin et al. 2008/2009). Nevertheless, with commitment from the top, competent management, effective intelligence systems and local involvement, numbers in Nepal recovered (Martin et al. 2013a). Small, highly protected areas are safest, combined with good relations with the local people living beside the park/buffer zones, who benefit financially (Martin and Vigne 1995a; Vigne and Martin 1995a; Vigne and Martin 2004). Dedicated field staff, good leadership, high Park budgets, and community support have also kept poaching down in India, seeing rhino numbers rise (Martin and Vigne 1996; Vigne and Martin 1998, Vigne and Martin 2012). The Indian subcontinent, despite many challenges, developed methods to protect rhinos and other wildlife with little financial help from the global community for wildlife conservation (Thekaekara 2020). There are lessons to learn for Africa (Martin and Vigne 2012a; Vigne and

Martin 2012; **Vigne and Martin 2018b**), especially today as eastern Asian markets have grown once again (Box 5).

Box 5. Background to eastern Asia's rhino horn trade

Between 1969 and 1976 the official average export of rhino horns from Kenya represented 1,197 rhinos annually. Most horns went to Hong Kong followed by Japan (Parker and Martin 1979). Japan imported rhino horn for traditional Japanese medicine as did Hong Kong which re-exported much to South Korea for sale in their 'Oriental medicine clinics'. In the early 1980s the Philippines was the only Asian country that prohibited its non-Chinese citizens from using these, because the animal products and herbs had not undergone rigorous modern testing and could pose a health hazard (Martin 1983). Hong Kong and Japan stopped importing rhino horn in 1979 and 1980 respectively when joining CITES (Martin 1983). They had the legal capacity to enforce their laws with law abiding citizens who normally complied and accepted substitutes, so demand subsided. In the early 1980s, as the economies grew in other eastern Asian countries, so did their consumption of rhino horn.

South Korea banned imports in 1983 with final legislation passed in 1985 **(Martin and Vigne 1987)** but trade continued, with rhino horn sold mostly as an ingredient in Chung Shim Won (medicine for purifying the heart) 'balls' taken as a tonic. The 'balls' contained 30 ingredients, including rhino horn (Song and Milliken 1990). Despite rhino horn on the world market (over 95% from Africa) halving in quantity from 1979 to 1982 as rhinos numbers shrank, the average wholesale prices for rhino horn in eastern Asia remained stable at USD 550/kg for African horn and USD 9,000/kg for Asian horn; retail prices increased only 8.5% despite the sharp decline in imports (Martin 1983). In Singapore, for example, in 1982/1983 the retail price for African rhino horn was USD 9,876/kg and Asian rhino horn USD 19,170/kg (Martin 1983), much smuggled in from Assam (**Martin et al. 1987**). After considerable pressure, Singapore banned its imports and exports of rhino horn in October 1986 as had Macau 10 months earlier, having previously been a major entrepôt for African and Asian rhino horn for China's government to make medicines for export (Martin 1989b).

Taiwan traders, despite an import ban by 1985, became the biggest importers of African horn, buying most from poached rhinos from Zimbabwe through Taiwanese trade connections in South Africa (Vigne and Martin 1989). Some Taiwanese wished to spend their wealth on valuable wildlife purchases, and stockpiled horns for China's government medicine factories (ACET 2019). In the late 1980s traders in Taiwan paid double the Yemen wholesale price: USD 2,486/kg (Vigne and Martin 1989). Following international pressure, with Esmond Martin as UN Special Envoy for rhinos, and the hard work of the CITES Secretariat and the US government, this trade was finally ended. The threat of US trade sanctions on wildlife through the so-called Pelly amendment on Taiwan and also China in 1993, worked. Both countries effectively ceased their domestic rhino horn trade (Vigne and Martin 1994c; ACET 2019). Thus, rhino populations in the few countries in Africa where they still survived (mainly Kenya, Namibia, South Africa and Zimbabwe) slowly recovered (Emslie et al. 2019).

I first surveyed Bangkok's traditional Chinese medicine shops in early 1990. There I saw a greater one-horned rhino horn on view for sale offered at USD 36,500/kg retail and skin for USD 2,000/kg retail, despite Thailand's international ban since 1983 (**Vigne and Martin 1991d**). Sumatran rhino products, prohibited in Thailand since 1972, were more commonly available with fresh carcasses obtained from poachers in the region before their local extinction. Retail, Sumatran rhino horn was then USD 16,300/kg retail. In the late 1980s Martin (1989a) conducted a survey in northern Borneo of Sumatran rhino horn for sale, and

fresh products were then available from poachers, and sold to other locations in eastern Asia. Now, only a very few rhinos survive in Indonesia. In Vietnam the lesser one-horned / Javan rhinos were all poached by 2010, the remnant population having been discovered and made known to the world only in 1988 (Rademeyer 2012; **Vigne and Martin 2018b**). In late 2019 a rich man living in Singapore explained to me that some newly ultra rich Chinese there today pay whatever money can buy, such as for Sumatran or Javan rhino horn, wanting the rarest (and most shocking) commodities. In contrast, Singapore's established Chinese community has been moving away from ivory items (Webber et al. 2013), considering them passé, especially the younger generation who have a growing conservation ethic.

In the early 2000s, organized crime was growing between traders in eastern Asia and Africa (Emslie et al. 2007; Milledge 2007), which flared up with 83 rhinos killed in South Africa in 2008, peaking in 2015 at 1,175 (Milliken and Shaw 2012; **Vigne and Martin 2018b**). South Africa is home to the greatest number of rhinos in the world (Emslie et al. 2019), and poachers from poor Mozambican villages near the border with Kruger National Park were often easily coerced to poach by middlemen acting like 'Robin Hood' bringing money to the villages (Hubschle 2016; Hubschle and Shearing 2018). As Kruger staff got funds and support to increase their patrols along Kruger's long boundary with Mozambique, more poachers then entered Kruger from the west, as field staff explained to us in 2016. With poaching and smuggling abetted by corruption in South Africa, poachers were often aided by bribed Kruger employees ('inside jobs'), using the Park gates (**Vigne and Martin 2018b**; Scott 2020).

Criminal networks can move their operations around quickly, outwitting police intelligence. In Namibia, despite its excellent community conservation track record with rhino populations growing well since the 1980s (Martin 1993), there was a recent poaching scourge, followed by northern Botswana in 2019/2020 with rhinos illegally killed in extensive areas (Naro et al. 2019; Somerville 2020). 'Diplomats' from Vietnam, North Korea and elsewhere with diplomatic immunity, remain an added challenge (Rademeyer 2012; Rademeyer 2016a,b; ACET 2019; Ndlovu 2019). Although far greater attention has been focused on preventing smuggling of rhino horn in recent years (Moneron et al. 2017) well-protected criminal networks encourage poaching in large areas more difficult to patrol, especially if the 'custodians' of the rhinos, the local communities do not benefit in any material way (Somerville 2020), and particularly if the judicial system becomes flawed as in South Africa reported in the media (Walker and Walker 2017; Neme 2020).

What has been driving the significant poaching once again? From about 2008 citizens of Vietnam and mainland China had, hitherto unavailable, disposable cash to spend on prestige purchases such as rhino horn, famous in traditional Chinese and Vietnamese medicine (TCM and TVM) (Milliken and Shaw 2012). And later, to meet new demand in Vietnam criminal networks operating within South Africa began producing rhino horn beads and bracelets and big sliced rhino horn 'pendants', as well as packaged off-cuts and powder to evade detection at airports and sell to the new buyers in eastern Asia (Moneron et al. 2017). In 2016 I carried out fieldwork in Kruger, the main rhino horn 'producing' end, and studied during several years certain markets in eastern Asia, the chief 'consuming' end. We interviewed dealers, artisans and vendors and found on open display for retail sale newly mass-produced rhino horn items (especially plain bangles and large beaded bracelets) with no artistic merit, unlike the carvings of past China dynasties (Chapman 1999), plus left-over pieces/shavings for TCM. We saw most on retail sale in Vietnam, Lao PDR and Myanmar mainly in Chinese shops for Chinese customers. Wholesale prices for raw horn had shot up in Vietnam from USD 20,000/kg in 2010 to a peak of USD 65,000/kg in 2012/2013, halving in late 2015, and falling further to USD 20,000 and to USD 19,000/kg in Indochina in 2016/2017 **(Vigne and Martin 2018b)**. Prices then fell to an average of USD 17,852/kg in 2018 (WJC 2018). There are now tightened restrictions on shop sales, but an underground illegal trade continues (UNODC 2020). Encouragingly in the first six months of 2020, rhino poaching in South Africa decreased by more than half compared with 2019, thanks to the work of all those protecting rhinos (Creecy 2020), including the private sector, and also due to COVID-19 quarantine/'lockdown' restricting movement. Furthermore, Kruger's gates were shut, resulting in fewer 'visitors' involved in poaching (Scott 2020).

Today's eastern Asian consumer demand has been studied increasingly in the field, with an array of important publications. These include: Ammann (2011, 2013), Liu (2015) and Stoner et al. (2017) investigating sales of new rhino horn and ivory items near Hanoi; Gao et al. (2016) on the previous loophole of China's auctions of old rhino horn items from 2003 to late 2011; Crosta et al. (2017) investigating the cross-border trade and worked rhino horn sales between Vietnam and China; and Shepherd et al. (2018) on the open sale of rhino horn in Mong La, Myanmar, on the China border.

Bribery and corruption continue to sustain smuggling and illegal trade. But rhinos can thrive in well-funded, well managed and safeguarded areas, such as in an 'intensive protection zone'. With enduring support from the top of governments and local community

involvement, plus a high density of manpower in rhino areas (as in India and Nepal with as many as one person/km^2), success in reversing the overall decline in rhino numbers can be accomplished. Intelligence has been especially effective in preventing poaching in India and Nepal (Martin and Vigne 2013a), and covert work can reveal urgent information on smuggling and consumer markets in eastern Asia (Liu et al. 2015; Crosta et al. 2017).

3.3 Ivory markets on the African continent

In the early 1980s, official figures showed that raw ivory trade from Africa to Asia was mounting significantly (Parker and Martin 1982; 1983). There were also well-established legal ivory carving industries in Africa. I helped with publications of Esmond Martin's fieldwork on these ivory industries in southern Africa: Botswana (Martin 1984a), Malawi (Martin 1985b), South Africa (Martin 1985a), Zambia (Martin 1986), and Zimbabwe (Martin 1984b). This work showed that Zimbabwe had the largest ivory industry in the region with most tusks available from culling operations. There was a sharp rise in the price of ivory from 1972 to 1978 on the world market, and Zambia became a target for elephant poaching, with tonnes of tusks illegally imported into Zimbabwe (Martin 1984b; 1986). To rectify such abuses, CITES established an ivory quota system in 1986 for elephant range states; but Burundi was not a CITES Party until 1988 and became a major entrepôt for illegal trade (Somerville 2016). In 1989 due to intense pressure for stronger action to save threatened elephant populations on the continent, CITES member states voted the African elephant onto Appendix I at CITES CoP 7 in Lausanne (Switzerland). This ban initially helped to reduce poaching in much of Africa but affected Zimbabwe badly (Martin 1991) and other countries with well-managed elephant populations, which led to two so-called one-off auctions of ivory from southern Africa (Box 6).

Box 6. One-off ivory auctions

At the1992 CoP8 meeting in Kyoto (Japan), some southern African countries requested a 'split-listing' to get their elephants put back onto Appendix II. Barnes (1996) amongst others argued that in Botswana, numbers of elephants were rising considerably and that a continued ban would jeopardize them as the country needed funds for their management programme. Japan, Europe and the USA, the main markets, had effectively prohibited their imports following the CITES ban in 1990, due to competent law enforcement and awareness campaigns. Researchers tried to examine the impact of the ban objectively (Dublin and Jachmann 1992; Dublin et al. 1995). Debates to keep the ban or not have raged. In 1999 certain southern African countries were permitted to hold CITES-approved ivory auctions to one well-managed customer/user, Japan. Japanese traders then bought nearly 50 tonnes of ivory from Botswana, Namibia and Zimbabwe.

Regular elephant status reports were presented to CITES from the IUCN African Elephant Database. In some regions poaching was a serious threat to elephant populations, but not so in others e.g. much

of southern Africa. By 2007 Africa's elephant numbers were estimated to be between 470,000 and 690,000 (Barnes et al. 1999; Blanc et al. 2007). In late 2008 there was permitted by CITES a second 'one off' auction from certain southern African countries to traders from Japan and China—because China had improved law enforcement with a strict licensing process (O'Connell-Rodwell and Parry-Jones 2002). Traders from Japan bought nearly 40 tonnes of the biggest and best tusks from Botswana, Namibia, Zimbabwe and also South Africa, and 62 tonnes were bought by China (**Vigne and Martin 2010a**; Vigne and Martin 2010b). The average price received was only USD 157/kg while the wholesale price for illegal ivory in much of Asia was about USD 800/kg at the time (CITES 2002). China was not able to deal with the fast growing demand, and illegal ivory consumption then soared (**Vigne and Martin 2014b**).

In the 2000s, yet again there was heavy elephant poaching in tropical Africa. Between 2010 and 2012 the forest elephants of central Africa were most in danger (Maisels et al. 2013; Wittemyer et al. 2014). The *African Elephant Status Report 2016* recorded a decline in elephant numbers overall in the 37 African range states with continental poaching levels above the sustainability threshold from 2010 to 2015 in Africa (Thouless et al. 2016). No CITES-approved auctions have been held since 2008.

My research in Sudan in 2017 showed that where elephant populations have been heavily depleted in South Sudan, poachers had been killing families with small calves indiscriminately to meet Chinese demand for any sizes of tusks. In Khartoum and Omdurman I found the majority of polished tusks on display for sale were small, from very young elephants (Fig 4). Chinese customers were happy to buy them, vendors remarked (**Vigne 2016/2017**; Vigne 2018) and shop owners I interviewed confirmed that nowadays, indeed whole families of elephants were being killed in the region. Large tusks from old male elephants were no more—they had been used up mainly for chopsticks, I was told. The enormous herds of elephants in South Sudan, as I had seen in 1983, had gone (Martin 1998; Martin and Vigne 2005).

I have carried out ivory market surveys in Africa since the early 1990s when I saw very big carved tusks in Ethiopia (Vigne and Martin 1993d). I also worked on Esmond Martin's survey results after the CITES ivory ban when trade reduced (Martin 1998; Martin 2000; Martin and Stiles 2000, Stiles and Martin 2001). In the 2000s my fieldwork included investigating some of the largest growing unregulated ivory markets on the African continent. I found that rapidly rising numbers of Chinese construction workers were the main buyers and were dictating a shift in production from African figures to Chinese-preferred plain jewellery and name seals that were fast to produce, relatively cheap and easy to smuggle home. We published our findings widely (Vigne and Martin 2008b,c,d; **Martin and Vigne 2010**; **Martin and Vigne 2011a**; Martin and Vigne 2012b; **Martin and Vigne 2013b**; Martin and Vigne 2014; **Vigne and Martin 2014a; Vigne 2016/2017**). Our data indicators portrayed the scale of these unregulated markets in Angola, Egypt, Ethiopia, Nigeria and Sudan which needed their governments to enforce their own laws. We learned in Johannesburg at CITES

CoP17 in 2016 that our publications led to efforts to close or regulate some of these open markets, notably in Angola.

Other detailed studies of ivory markets in Africa have contributed to curbing illegal trade. These include Courable et al. (2003) who re-surveyed Cote d'Ivoire, Senegal and Nigeria, finding more ivory than elephants. And Nkoke et al. (2017) surveyed the main markets of Cameroon, Central African Republic, Congo, the Democratic Republic of Congo and Gabon between 2007 and 2017 and counted 12,964 ivory items in 244 outlets. Most were in Kinshasa. They found an increasing production of semi-worked ivory for the Chinese market. The most encouraging improvement has been in Ethiopia with a downward trend in ivory items on view in the retail outlets, due to regular confiscations (Milledge and Abdi 2005); none was seen in 2016 (**Vigne 2016/2017**). In Ghana, police raids in Accra in 2009 then stopped vendors selling ivory items. Martin (2010) counted only 10 items on display in an art gallery in July 2010. Items I have surveyed and percentages of the main items (Tables 4 and 5) point to Lagos and Luanda lacking internal trade controls the most at that time. A recent study on wholesale raw tusk prices in West and southern Africa by the Wildlife Justice Commission (WJC 2020c) point to a price drop from July 2017 to July 2020 by as much as 50% (USD 208/kg to USD 92/kg) with a surplus of tusks for sale, suggesting a fall in demand.

Table 4. Numbers of retail outlets and ivory items on view in African markets, 2009–2017

City	Date	Retail outlets (no.)	Ivory items (no.)	Items/outlet (no.)
Addis Ababa	Jul 2009	37	1,068	29
Cairo	Mar 2011	71	8,343	118
Luxor	Apr 2011	23	918	40
Lagos	Sept 2012	36	14,349	399
Luanda	March 2014	36	10,888	302
Khartoum	Apr 2017	27	4,278	158
Omdurman	Apr 2017	29	2,795	96
Total	9 years	259	42,639	165

Source: surveys by LV (details in publications, Annexes 12,13,14,15,16)

Table 5. Percentages of main ivory items displayed for sale in Africa, 2009–2017

Country	Location	Item and percentage
Ethiopia	Addis Ababa	Ring 28%, Figurine 20%, Bangle 18%
Egypt	Cairo	Figurine 36%, Bead 11%, Scarab beetle 10%
	Luxor	Figurine 47%, Pendant 12%, Obelisk 9%
Nigeria	Lekki Market	Earrings pair 30%, Pendant 26%, Necklace 9%
Angola	Benfica Market	Necklace 23%, Bangle 19%, Pendant 19%
	Central Luanda	Bangle 25%, Necklace 25%, Figurine 17%

Sudan	Omdurman/Khartoum	Pendant 41%, Bangle 23%, Figurine 8%

Source: surveys by LV (details in publications, Annexes 12,13,14,15,16)

3.4 Ivory markets in eastern Asia

3.4.1 Eastern Asia

Between 1976 and 1980 Hong Kong and Japan imported 83% of Africa's official exports of tusks. Japan preferred the largest forest elephant tusks known as hard ivory. In the early 1980s Hong Kong was using an average of 668 tonnes a year and Japan about 270 tonnes a year (Martin 1983). Hong Kong's ivory was carved mostly for European and American customers (Fig. 6) (Caldwell and Luxmoore 1990). Japan's ivory was designed for the Japanese market, except for some of the artistic hand-carved netsuke (tiny figurine toggles) for collectors abroad (Martin 1985d). The Japanese ivory industry, from our fieldwork and discussions with traders and Japanese consumers, has shown a decline in demand for ivory items (**Vigne and Martin 2010a;** 2010b; 2010c; Vigne 2019 unpublished). Japan's domestic ivory trade remains legal with 80% for name seals / signature stamps (*hanko*), and the rest mainly for traditional uses such as musical instrument parts and traditional tea ceremony implements (**Vigne and Martin 2010a;** 2010b, 2010c). Having interviewed the traders in Tokyo and Osaka in 2009 and again in late 2018 and assessed ivory items, I found retail prices seen in the same specialist outlets were mainly stable and turnover extremely slow with many of the same items on view. The fashion for buying big and best tusks for investment, as in the 1970s and 1980s when the Japanese economy was booming, ended, and most Japanese no longer want to buy ivory. But an important much smaller trade remains for traditional ivory items.

The Philippines has a history of carving ivory *santos* or saints for Catholics to worship (Martin et al. 2011) and I saw large new *santos* for sale with ivory heads and hands in 2015 carved from illegally acquired ivory (**Vigne 2016**), just after the visit of the Pope to Manila. There was no sign in Manila of new items to meet old local Chinese demand.

With sales fuelled by China's economic growth, it has been in Indochina where we found most illegal worked ivory in the markets where law enforcement, including on cross-border trade, is most needed: Vietnam, Lao PDR and Myanmar are on the border with China. This region is notorious for wildlife products being traded unsustainably and illegally (World Bank 2005; Nijman 2009) and law enforcement remains a major challenge. I counted a profusion of new ivory items of Chinese style on display for sale from illegal shipments of

tusks smuggled from Africa, mostly landing at ports on the long Vietnam coast (**Vigne 2013a**; **Vigne and Martin 2016a**; **Vigne and Martin 2017a**; **Vigne and Martin 2018a**). Vietnam's relatively cheap labour and carving tradition inherited from China (**Vigne and Martin 2016a**) enabled an illegal ivory carving industry and trade to accelerate alarmingly, mostly for Chinese consumption.

Myanmar had a centuries-old legal domestic ivory carving industry, using ivory from the abundant captive elephant population working in the past in Myanmar's logging industry (Martin and Vigne 1997a; Martin and Stiles 2002; Vigne and Martin 2002; Shepherd 2002; Stiles 2004b). Surveys by Shepherd (2002) and Shepherd and Nijman (2008) found considerable numbers of local souvenir ivory articles on sale to foreigners in Myanmar. The town of Mong La beside the China border became a hub for wildlife trade where Nijman and Shepherd counted more than 3,300 ivory items in early 2014, much carved outside Myanmar—which they publicized on social media that drew a large response and attention to the problem (Nijman and Shepherd 2014a,b). But smuggling and open exhibits continue, and from my surveys in late 2017 (**Vigne and Martin 2018a**) and early 2020 (Vigne and Nijman in prep.) many objects processed from new African ivory apparently are transported into Myanmar from the 'Golden Triangle' area near the Mekong River where Thailand, Lao PDR and China meet. Chinese vendors in 2020 were openly displaying items, but they lamented that Chinese customers were few with dwindling visitors due to increased border travel restrictions.

Lao PDR did not have a traditional ivory carving industry, but in 2013 I inspected several shops selling ivory and found a new large Chinese ivory specialist shop (**Vigne 2013a**; Vigne 2013b). Numbers of Chinese outlets with ivory items rose sharply in the following three years (**Vigne and Martin 2016a**) with Chinese computer-driven machines carving ivory for sale to Chinese customers to take/smuggle home. The wholesale price for average tusks reached USD 2,000 a kg in late 2013 as the market grew but it fell to USD 715/kg in late 2016 with a surplus of raw material and thus slower retail sales (retail prices remained largely stable). In Cambodia the domestic trade was very slight in 2013 with tiny ivory amulets carved for Cambodians (Martin and Martin 2013), and a small growth in 2015/2016 (Nguyen and Frechette 2017). But ivory is now being processed, also with computer-driven machines into the common Chinese style oblong pendants (6cm x 4cm) for the Chinese market (WJC 2020a); thus trade continues to find illegal avenues in the region.

Thailand used to have an extensive ivory carving industry of souvenir trinkets for tourists (Martin and Stiles 2002). Carvers worked both Asian and African ivory. Following much pressure, and with help from TRAFFIC, shops displaying worked ivory in Bangkok have essentially closed down (Krishnasamy et al. 2016b). Most of the shops that I surveyed in Bangkok's famous Chatuchak market in late 2017 and in Chiang Mai in January 2020 no longer displayed ivory for tourists. This shows that visible trade controls are possible.

There has been a growth in field research on ivory in eastern Asia, all calling for better law enforcement where most needed – for example in the 1990s: Martin (1992a) in Vietnam; Martin (1992b) in Lao PDR; Martin and Phipps (1996) in Cambodia; Martin and Stiles (2002; 2003) in eastern Asia. And later: Shepherd and Nijman (2008) in Myanmar; Stiles (2008) in Vietnam; Stiles (2009a,b) in Thailand and Vietnam; Ammann (2011; 2013) in Vietnam; Nijman and Shepherd (2012a,b) in Lao PDR; Martin and Martin (2013) in Cambodia; Nijman and Shepherd (2014a,b) in Myanmar; Nijman (2014) in Thailand. And also: EIA (2015) in Lao PDR; Nguyen and Williamson (2015) in Vietnam; Krishnasamy et al. (2016b) in Bangkok, Thailand; Kitade and Toko (2016) and Kitade and Nishono (2017) in Japan; Nguyen and Frechette (2017) in Cambodia; and more recently in Vietnam (EIA 2018); and Cambodia (WJC 2020a); as well as my work presented in this thesis, and so on.

3.4.2 China

In 2002, China had emerged as the chief ivory carving centre in all of Asia with both legal and the most extensive illegal ivory industry. It was the main destination for illicit African ivory (Martin and Stiles 2003; Stiles and Martin 2003). The government then introduced a strict identification system for ivory produced in licensed factories and retail outlets to allow only a legal market. China was thus permitted by CITES Parties to partake in the second CITES-approved auctions (Box 3) held in southern Africa in 2008 (**Martin and Vigne 2011b**). On a survey in southern China in early 2011 we learned that some licensed ivory carving factories were not getting enough legal ivory for their carvers (Vigne and Martin 2011a,b; **Martin and Vigne 2011b**). The China State Forest Administration allocated legal tusks to 37 registered ivory carving factories and although a study of these showed that the carvings matched their legal output and illegal ivory was not being laundered into the legal ivory system, there could have been an autonomous illegal factory network using illegal ivory (Moyle and Conrad 2014). Indeed, I saw that some of the licensed retail outlets had inconsistencies with identification cards not always identical to the item. It appeared that some vendors were reusing ID cards, as it was not compulsory for the customer to keep the

card (**Vigne and Martin 2014b**:). By 2015 vendors in licensed outlets said they were disillusioned about the future with few customers as most were more thrifty and merely window-shopped; and the state-owned outlets were not replacing ivory items when sold, instead selling other goods, anticipating the domestic ban (**Vigne and Martin 2017b**).

My fieldwork found that wholesale prices for 1–5 kg tusks in China rose from USD 750/kg in 2010 peaking in early 2014 at USD 2,100/kg, and fell to USD 1,100/kg by late 2015 with illegal prices only slightly undercutting legal prices (**Martin and Vigne 2011b; Vigne and Martin 2014b; 2017b**). Poaching and the trade continued nevertheless, and smartphones and online sales enabled easier cheaper sales of illegal items without the bureaucracy and expense of ID cards or shop overheads (**Vigne and Martin 2017b**). The President of China, Xi Jinping, on 31 December 2017 banned all domestic ivory trade, following international pressure to do so and having given a year's warning. Thus ended legal, but not illegal, trade. Wholesale prices in the region were stable from late 2015 to December 2017 at about USD 770–880/kg (**Vigne and Martin 2017a**). Despite analysis and discussion, smuggled ivory, much processed from Indochina into China, continues (UNODC 2020).

In Hong Kong in January 2015 I counted large numbers of ivory objects with many small items that could not be easily dated by appearance, but they were legal in registered shops permitted to sell off their old stock, i.e. pre the 1990 CITES ban. Huge crowds of Chinese shoppers from the mainland were the main customers (**Martin and Vigne 2015**). Hong Kong in 1991 had a model of law enforcement that worked well (Milliken 1991), and the trade remained mostly legitimate as survey work showed a decade later (Martin and Martin 2011). A few Chinese traders, unable to import any more elephant ivory, started importing in the 1990s mammoth ivory, thousands of years old, from Russia's melting summer tundra (Martin 2006). Expensive legal shops in Hong Kong display intricately carved mighty mammoth tusks and tusk pieces recognizable by their brown outer peel and dark fissures (**Martin and Vigne 2015**). Most are carved in factories legally in Guangzhou and Fuzhou as I have seen (with elephant ivory (Fig.1)), legally on display for sale in all 10 cities I have surveyed in China (**Martin and Vigne 2011b; Vigne and Martin 2014b; Vigne and Martin 2017b**). During research (unpublished), I also counted thousands of mammoth ivory items in late 2018 in Guangzhou's jade market. Many stalls specialized in legal mammoth ivory including small trinkets that are difficult to distinguish from elephant ivory and need to be verified in greater detail. Vendors prefer selling mammoth ivory because it is legal, they explained. Most sales are conducted by smartphone orders nowadays. There was a lot of newly carved

material. Unlike in Hong Kong where official import statistics are readily available as I collected there in January 2015 (Hong Kong government 1992–2014), the figures for raw mammoth tusk/pieces entering China are not available. In Hong Kong 54 tonnes were officially imported in 2014 alone (**Martin and Vigne 2015**), and tonnes have been entering China annually, according to dealers, and need controls and clear management as discussed at CITES CoP18 in 2019 so as not to launder elephant ivory in China.

In January 2015 in Macau I saw few ivory items, in contrast to Hong Kong and China. Most was old stock with none in the new luxury shops in the lavish Macau casinos where clothes from top international brands were for sale to their rich mainly Chinese clientele (**Martin and Vigne 2016**). Hong Kong is the place with a reputation for easily available ivory items (Fig. 6), so customers busy in Macau as casino goers not as shoppers, would not choose such items from a smaller selection there (Table 6). Other important studies have been recently conducted on the ivory trade in China and its territories, notably Gao and Clark's work (2014) on trends and drivers for mainland China, and in Hong Kong considerable research is now done on illegal wildlife smuggling and trade (ADMCF 2018). The TRAFFIC Offices also have produced useful reports and updates (Chou 2018; Xiao 2018).

Despite ivory's cultural importance, with patrons of the arts for centuries encouraging carvers, China intends to maintain its domestic ivory trade ban, as officials expressed at CITES CoP18 in Geneva in 2019. The legal trade had become a thorn in China's side. Hong Kong, also as a result of publicity and international pressure, agreed to end its legal domestic ivory trade (all supposedly old stock) on 31 December 2021 (Thomas 2018). Hong Kong, nowadays, is a significant entrepôt for illegal ivory shipments destined for China (ADMCF 2018). A ban will thus simplify enforcement by Customs and in shops (Bennett 2015), although the corrupt underground trade can flourish with criminal networks having the monopoly (Smith et al. 2015). Monitoring and law enforcement will be needed in Hong Kong before and even more after the planned 2021domestic ivory trade ban to monitor trends (Tables 6 and 7).

Fig.6. An ivory animal figurine of 7.2g in Hong Kong priced at USD 872 in 2015

Table 6. Numbers of retail outlets and ivory items on view in eastern Asia markets, 2009–2017

Country (Territory)	Date	Retail outlets (no.)	Ivory items (no.)	Items/outlet (no.)
Japan	Nov 2009	13 dept stores	296	23
China	January 2011	119	6,719	56
China	May 2014	275	8,444	31
Hong Kong	Jan 2015	72	30,856	429
Macau	Jan 2015	22	327	15
Philippines	Feb 2015	24	350	15
China	Nov 2015	159	3,378	21
Vietnam	Dec 2015	242	16,099	67
Lao PDR	Dec 2016	81	13,248	164
Myanmar	Dec 2017	51	14,846	291
Total	9 years	1,058	94,563	89

Source: surveys by LV (details in publications in Annexes 17,23,24,25,26,19,27)

Table 7 Percentages of main ivory items displayed for sale in eastern Asia, 2009–2017

Country (Territory)	Location	Item and percentage
Japan	Tokyo/Osaka (dept. store)	Name seal 70%, Tea container lid 16%, Misc. 14%
China	Guangzhou	Jewellery 65%, Figurine 14%
China	Beijing	Pendant 31%, Figurine 17%, Charm 7%
	Shanghai	Pendant 19%, Figurine 15%, Name seal 11%
Hong Kong	Central/Kowloon	Figurine 31%, Ring 25%, Pendant 14%
Macau	Macau	Figurine 40%, Jewellery 40%, Name seal 5%
Philippines	Manila	*Santos* 32%, Human figurine 16%, Animal figurine 10%
China	Shenyang	Pendant 57%, Figurine 13%, Necklace 7%
	Tianjin	Pendant 40%, Figurine 16%, Necklace 12%
	Nanjing	Pendant 34%, Figurine 13%, Bracelet bead 7%
	Changzhou	Screen 28%, Polished tusk 15%, Paintbrush pot 7%
	Hangzhou	Pendant 44%, Figurine 17%, Necklace 9%
	Suzhou	Pendant 39%, Bangle 17%, Figurine 12%
Vietnam	Ho Chi Minh City	Pendant 51%, Bangle 10%, Figurine 7%
	Buon Ma Thuot	Ring 39%, Pendant, 32%, Bangle 14%
	Tourist village nearby	Pendant 52%, Ring 18%, Earrings pair 12%
	Hanoi	Pendant 44%, Bangle 11%, Figurine 8%
	Village south of Hanoi	Pendant 39%, Bangle 23%, Ring 14%
	Village north of Hanoi	Pendant 36%, Figurine 22%, Bangle 17%
Lao PDR	Vientiane	Pendant 31%, Necklace 21%, Bangle 12%
	Dansavanh Nam Ngum	Pendant 62%, Bangle 24%, Bracelet bead 5%
	Luang Prabang	Pendant 47%, Bangle 15%, Necklace 11%
	Kings Romans	Pendant 22%, Necklace 17%, Bracelet bead 14%
Myanmar	Yangon	Pendant 61%, Necklace 12%, Bracelet bead 7%
	Mandalay	Pendant 57%, Necklace 11%, Figurine 7%
	Tachileik	Pendant 65%, Name seal 10%, Earrings pair 6%
	Mong La	Pendant 59%, Necklace 11%, Chopsticks pair 8%

Source: surveys taken by LV (details in publications in Annexes 17,23,24,25,26,19,27, and Vigne and Martin 2011a,b)

3.5 Trends

3.5.1 Why rhino horn and ivory? – New wealth and expanding uses

Ivory works of art for the rich have been part of the world's cultural heritage for centuries and master carvers' techniques, passed down generations, are still revered around the world, especially amongst collectors and museums. This is despite some recent Western beliefs that antiques encourage poaching (Levy 2018) and ought to be globally banned. Others instead argue that rather than destroying ivory artworks, they should be displayed in museums as educational ambassadors, not only as art and part of history but also for conservation (Good et al. 2019). Historically, and in the last 40 years, ivory continues to be carved as ornaments, decoration and for expensive utilitarian use. For rhino horn, historic expert carving (Box 7) is no more, but new uses have emerged in recent years.

Box 7. Past uses of rhino horn

Rhino horns from both Asian and later African species were carved into fine bowls and large libation cups for the elite in many dynasties of Imperial rulers in China. Some were used to detect poison that would apparently fizz in a rhino horn cup (Martin 1990; Chapman 1999). Rhino horn and other valued rhino products (the Sumatran species being usually most favoured) have been consumed as an expensive traditional medicine for hundreds of years, mainly to reduce high fevers (But et al. 1990; Martin 1980a; Martin 1983). In the early 1990s when China's government factories were still manufacturing patent medicines containing small amounts of rhino horn for export to the richer overseas Chinese (for much needed hard currency), the factories had crates of left-over rhino horn chips from Yemen, and also sacks of Qing and Ming dynasty cups. They were unaware of the latter's value and cultural significance and the precious objects were being smashed up to turn into medicines (Martin 1990; Martin and Vigne 1994). China banned domestic trade in rhino horn in 1993 following US pressure (Vigne and Martin 1994b), but the question remains—what happened to those antiques and all the registered rhino horn stock of 8,497 kg? (Vigne and Martin 1994b) Is it all still sealed up in a government vault?

Rhino products were considered to have many curative properties in TCM that then passed on into TVM, but not historically as an aphrodisiac (Parker and Martin 1980). This idea occurred historically only among a small group of Muslim Indians north of Mumbai. We believe from our research in this region, that Gujarati traders who sailed to Zanzibar in the 19th century were misinterpreted by early Europeans who thought it was used mostly in the Far East as an aphrodisiac (Vigne and Martin 1987a; Divyabhanusinh et al. 2018).

As a new richer class grew in the 21st century in Vietnam, from old uses of rhino horn for artworks and as a still valued and important ingredient in TVM (Dang and Nielsen 2020) so evolved new uses for a prosperous middle class. Many were superstitious regarding medicinal cures, as we were to find. In Vietnam from about 2010 the incorrect Western reporting of rhino horn aphrodisiac use in TCM spread and encouraged some Vietnamese to use it for this purpose. It was also by then being used as a hangover cure for whisky-drinking businessmen at dinner gatherings (neither use recognized in TVM). Rhino horn became

increasingly in demand among the rich to impress fellow officials and business colleagues (Ammann 2011). Another new use in Vietnam was as an expensive cancer cure for desperate people, as we confirmed in Hanoi in a modern hospital where doctors admitted that patients will try to save lives with rhino horn, though it is not prescribed and is illegal (**Vigne and Martin 2016a**). Being the most expensive material, it was considered the best. My fieldwork focused, however, on learning about the new main consumption of the horn in Vietnam—turning it into basic big jewellery items, mostly for rich Chinese men, and also women, with the cheaper leftovers usually for sale as expensive TCM and TVM.

Similarly the North Yemeni traditional use of rhino horn for jambiyas had been for the rich elite. Jambiyas go back at least as far as the 8th century (Varisco 1987; Martin 1990). Very few people could afford rhino horn; but when many poor became rich in the 1970s they wanted a chance to emulate the elite and own a rhino horn jambiya. Now, while most Yemenis are poor again and demand has shifted to the newly rich countries, they are not selling their precious jambiyas unless desperate. Traditional views of people in societies with deeply entrenched customs die hard—especially if they are without Western modern education, and during or after wars.

For ivory also, demand has been dependent on purchasing power and has been part of many rich cultures for thousands of years. Elephant ivory is especially versatile to carve and was highly valued in the Roman and other empires (Walker 2009; Somerville 2016). In Japan, ivory was also historically appreciated by the small elite. Then during Japan's economic boom in the 1970s and 1980s its ivory industry flourished. Not only the CITES ban and campaigns, but also Japan's recession caused a steady drop in consumption as we have seen (**Vigne and Martin 2010a;** 2010b). During interviews with traders in late 2018, I learned that, although legal domestically, consumer decline continues as most Japanese are now more cautious with their money.

The famous ivory industry of India (catering mostly to the rich Western market), ended abruptly, after the CITES ivory ban. A domestic ban was put in place as well, with high level political commitment and effective management. India, Nepal and Sri Lanka have elephants and a long history in carving ornate ivory items for the rich and for export (Martin 1980b; Martin et al. 2013b). In India, over 2,000 ivory carvers produced works of art and souvenir trinkets in 1989 when Esmond Martin and I carried out the last survey of India's ivory industry during a six-week study of the major workshops and markets (Martin and Vigne 1989b). When the CITES ban came into force in January 1990 India effectively stopped its

domestic ivory and mammoth ivory trade without flinching, deciding mammoth ivory was a look-alike material that would mask elephant ivory. They took the most extreme position of all major consuming countries (Vigne 1991). Thus despite having a long ivory carving tradition producing valuable items, and with much human/elephant conflict (Conrad 2012; Shaffer et al. 2019), the ivory industry in this region ended. This was largely due to good political leadership setting an example to officials and law-abiding citizens, which is lacking in those corrupt countries with officials themselves involved in illegal trade.

China's ivory carvings, some of the best in the world, had patronage for centuries from the Imperial City (Martin and Stiles 2003). Following China's recent economic boom (30 years after Japan's economic boom) suddenly rich government officials supported a revival of the nation's cultural heritage: their carved ivory. Chinese businessmen purchased abroad and brought back home expensive Chinese-carved ivory and rhino horn antique artworks, and auctions for these in China were permitted (Gao and Clark 2014; Gao et al. 2016; Chou 2018). Antique centres and antique markets blossomed in China, with mainland Chinese being keen collectors for investment (**Martin and Vigne 2011b; Vigne and Martin 2014b; Vigne and Martin 2017b**).

For President Xi Jinping of China to stop the domestic trade in ivory when at last many could afford to enjoy their rich cultural traditions, was a significant sacrifice (following political pressure from the USA). Master ivory carvers have always been much respected in China for their skill. Yet during my interviews with certain master carvers in China (**Vigne and Martin 2017b**) they were resigned to the ban and could not adapt to inferior mammoth ivory which often crumbled, especially for their most intricate works such as shallow calligraphy carving. They preferred now to carry out this painstaking work on bamboo. Many other ivory carvers did shift to mammoth ivory as a substitute, and I saw in Guangzhou in late 2018 thousands of newly carved items for Chinese (mainly small items) and Western customers (who favour expensive whole tusks). It is uncertain whether mammoth ivory, imported in tonnes from Siberia every year, will help or hinder the survival of elephants. There is a need to research this trade between Russia and China and to inspect regularly, perhaps with trained detection dogs, to deter and check that mammoth ivory trinkets for sale are not mixed with small look-alike elephant ivory objects.

Ironically illegal dealers usually mechanically process rather than hand carve their ivory and rhino horn, selling these expensive materials merely by weight without the added value of craftsmanship (Figs. 7 and 8). Mass production has been meeting demand for a new, bigger

clientele, with poor quality items sold to undiscerning mass consumers. As we now know from our research, beads, bangles and pendants are increasingly made by machines for some of the new undiscriminating middle class buying online (Ammann 2013; **Vigne and Martin 2018b;** WJC 2020a).

It was this sudden 'cash in the hand' that enabled many previously poor people to buy for the first time items made of rare 'luxury' wildlife products (**Martin and Vigne 2011b;** Vigne and Martin 2011a; **Vigne and Martin 2014b; Vigne and Martin 2017b**). There has also been a speculative market for raw or polished tusks with opportunistic traders stockpiling for the future, perhaps 1,000 tonnes. That would explain the sustained high level of elephant killing; and it would explain the recent surge in rhino poaching too (Stiles et al. 2015). This is not a new phenomenon; tusks were stockpiled in Japan and rhino horns in Taiwan in the 1980s and early 1990s (Vigne and Martin 1989; Vigne and Martin 1994c; ACET 2019).

Inflated prices in publications have long promoted demand for raw ivory and rhino horn, for instance writers mixing wholesale prices with retail (Stiles et al. 2011; Vigne and Martin 2016b). For rhino horn, the 2012/2013 wholesale peak figure of USD 65,000/kg (**Vigne and Martin 2018b**) was often misquoted as a later price, although it dropped appreciably (**Vigne and Martin 2018b;** WJC 2018), as for wholesale raw ivory in Vietnam (WJC 2020c). Accuracy is also needed with dates, position on the supply chain, size, and quality etc. (tips being the most expensive) to avoid these incorrectly exaggerated prices that 'sell'.

3.5.2 How has demand spread? – The recent Chinese diaspora

My work showed a precipitate growth in Chinese demand for ivory items in Africa as Chinese traders and construction workers poured into African countries in the 2000s. They bought souvenirs and gifts of worked ivory 'from Africa'. These were much cheaper than in China and on sale in unregulated markets in open view. Chinese visitors, mainly workers and traders, increased in Angola, Egypt, Ethiopia, Nigeria and Sudan (Box 1). I saw some buying handfuls of ivory items in Angola at a tenth of the price in China, to smuggle home to sell, fuelling the illegal trade. In central Africa semi-worked ivory has been available for illegal export (Nkoke et al. 2017) and in South Africa certain Chinese are making semi-worked rhino horn to smuggle more easily out of Africa into China (Moneron et al. 2017). The percentage growth rate of Chinese in Africa will likely continue to be high (Poston and Wong 2016).

With the proliferating Chinese diaspora, trade connections aided by bribery and corruption have encouraged criminal networks, with known 'kingpins' smuggling ivory, rhino horn and

other endangered wildlife products from Africa to eastern Asia. Some of these well-known traders are from China (EIA 2017), Vietnam (EIA 2018), Thailand (Rademeyer 2012), and Lao PDR (EIA 2015). Even back in March 2013 to coincide with CITES CoP16 in Bangkok, the counter-trafficking organization based in Thailand, Freeland, publicized Vixay Keosavang in Lao PDR (Fuller 2013; ACET 2019). This 'trader' used the cover of a wildlife farm and, still well protected, he and his colleagues are free to carry on flourishing businesses. Corruption aids long-distance trafficking, and some 'kingpins' still continue unhindered. Bribery keeps them free or often reduces their sentences. The large profits of illegal trade still outweigh the costs and risks (**Vigne and Martin 2018b**).

Shipping routes have become more complex for bulk items such as raw ivory and pangolin scales, while for smaller items of worked ivory and rhino horn, international airports remain major hubs, with numerous regular flights back and forth between China and countries in Africa (Utermohlen 2020). Raw tusks and rhino horn reaching Indochina can be quickly processed often by machines for speedy turnover for Chinese shoppers nowadays in this region (Figs. 9 and10). In January 2020 I saw many Chinese crossing the Mekong River from Thailand to Lao PDR into the Lao Special Economic Zone in the northwest of the country. I revisited the infamous Lao Kings Romans casino there (the majority shareholder being Chinese), in a follow up to my survey of 2016 when I had found over 1,000 ivory pieces and 77 rhino horn items (**Vigne and Martin 2017a**). Only one shop still had some ivory items (8 small objects) for sale and I saw no rhino horn items on view, due to effective crackdowns against displayed items. It is, of course, unclear what goes on behind the scenes. Further north, in the border town of Mong La on the Myanmar side of the China border there were still many luxury illegal African ivory and rhino horn items openly for sale in January 2020 (Vigne and Nijman in prep). This is a Chinese enclave in an autonomous region of Myanmar and has no effective inspection of shops, yet. On the other hand, in Vietnam ivory and rhino horn items that I surveyed in 2015 have, after police raids, been removed from view (Stoner et al. 2017). But secret production and sale in Indochina continues, as seen most recently in Cambodia (WJC 2020a). Chinese tourists in Vietnam in 2019 in fast-spreading Chinese resorts can buy worked ivory as souvenirs and gifts (Sarah Ferguson, TRAFFIC Vietnam, pers. comm., October 2019). With Chinese investments around the world still expanding, demand is not going away, and this needs further investigation to combat it, even if COVID-19 has slowed down travel and trade for now (WJC 2020c). There appears to be in Central and South America, also, a link between increased Chinese investment and jaguar seizures in international trade coming from poor and corrupt countries with new economic partnerships

with China, rather than from the old established Chinese communities of the region (Morcatty et al. 2020).

3.5.3 What are the changes in marketing and trade? – The digital world

Illegal trade has been blatantly strengthened by the internet and the mobile phone. There has been a growth in online shopping apps making mass marketing and purchasing products easier than ever before. This has been the biggest development since our initial fieldwork in the 1980s and 1990s. As restrictions on rhino horn and ivory trade have increased, more items are sold from mobile phones and on social media. Traders have shown me their products for sale on smartphones in Indochina and China, for example (**Vigne and Martin 2016a; 2017a; 2017b**). Black market sales 'under the counter' have been increasing. Social media especially WeChat that started in China in 2011, makes closed chat groups and sales of ivory and rhino horn simple. Sellers on different sites can switch accounts to cover their tracks and stay anonymous (Guan and Xu 2015; Xiao and Wang 2015). The 'physical' shops in China are often empty as more people shop online with home deliveries arranged. Facebook and Instagram in Southeast Asia enable easy sales of wildlife items (Krishnasamy and Stoner 2016; Krishnasamy and Zavagli 2020; Indraswari et al. 2020). Whole tusks and rhino horns can be quickly bought and sold on the internet by rich Chinese investing their money, especially with the turbulence and uncertainty in the stock market as occurred in 2009 (**Vigne and Martin 2018b**) because both substances are durable and long lasting. Although only a fraction of China's population desire these objects, in a country of over 1.4 billion people (Vietnam's population in 2020 is over 97 million people) there is still a sizeable number of willing buyers.

During 2020, for instance, with the outbreak of COVID-19, the internet enabled new marketing for TCM with rhino horn *Angong Niu Huang Wan* pills (EIA 2020a). These are also called 'Bezoar Chest Functioning pills' that in the late 1980s Esmond Martin found were still being made with rhino horn as an ingredient for exported medicines (Martin 1989b) – which later was stopped by the China government.

Large-scale cybercrime has become a major concern, as discussed at CITES CoP18 (CITES 2019d). The internet encourages organized wildlife crime in many species. The digital world facilitates fast and easy transactions (Bird et al. 2020) with the tropics' high biodiversity worst affected. Chinese traders online sell rare and valuable products to maximize their profits, with critically endangered animals, being the scarcest, making the most profit (Mason

et al. 2012; 't Sas-Rolfes et al. 2014). And the internet easily allows money laundering, notably through ivory and rhino horn sales (UNODC 2020).

3.5.4 Which direction is demand going? – A greater threat to many species

Demand for wildlife resources from a growing and richer globalized human population is a devastating threat to our increasingly fragile biodiversity. Nearly 6,000 different species of fauna and flora were seized from 1999 to 2018 (UNODC 2020). I saw in early 2013 in northern Lao PDR, as well as incipient, steady deforestation, an array of hunted, trapped, dead and alive wild animals for sale on the road-sides, including piled cages for pangolins (*Manis* spp.).Vietnamese and Chinese ordered pangolins to take away in their car boots back home across the border (Vigne 2013b; Heinrich et al. 2017). Three years later I saw the same indigenous forest replaced on the hillsides by rubber plantations to meet Chinese demand. The local people regretted that they had been persuaded to cut down their indigenous forests for Chinese desire for rubber, because the price of rubber had fallen and their natural habitat ruined. Hardwood trees are being rapidly cut down in the tropics and wildlife plundered. I saw helmeted hornbill on display (Table 1) selling for over USD 2,000 for a casque in an expensive hotel gift shop (Fig. 3) in Lao PDR in 2016 (**Vigne and Martin 2017a**). In January 2020 helmeted hornbill jewellery items were selling in Mong La (Vigne and Nijman in prep). This critically endangered Southeast Asian bird is greatly threatened (Krishnasamy et al. 2016a). Also in Mong La in January 2020 were boxes-full of pangolin scales destined for the Chinese market as "China has run out of its own pangolins", vendors explained (Vigne and Nijman in prep). Small border towns allow easy trans-boundary crossings for many wildlife species. Boten town in the biodiversity-rich forests of north Lao PDR is beside the southern China border, a designated special economic zone enabling Chinese traders to buy wildlife and products (Krishnasamy et al. 2018; **Vigne and Martin 2018b**).

The mounting demand for pangolin scales from Asia and more recently Africa prompted CITES Parties to vote all eight species onto Appendix I in 2016 (that came into force in 2017) (UNODC 2020). A prior CITES zero quota on all four Asian species had not worked (Challender et al. 2019). And Appendix I prohibition appears not to have worked yet either. Tonnes are smuggled in ever bigger shipments from Africa (WJC 2020b).

The need to monitor and find workable strategies to save ever more species is desperately urgent. Overall, however, for rhinos and elephants in 2019/2020, it appears that poaching has been reduced in most range states (Emslie et al. 2019; Thouless pers. comm., Save the Elephants (STE), September 2020). Greater law enforcement in China (EIA 2017) appears to

have assisted in rhino horn and ivory prices falling (WJC 2018; WJC 2020c), allowing cautious optimism, but post COVID-19 is yet to come (WJC 2020c). Meanwhile, tremendous numbers of wildlife, especially in tropical countries, are being poached or taken brutally for illicit trade – with their suffering largely ignored (Baker et al. 2013), in Africa and also in Southeast Asia and South America (TRAFFIC 2008; Charity and Ferreira 2020).

The illegal and unsustainable wildlife trade is a colossal threat to the health of the planet and needs urgently to be defeated. Substantial international funding is needed. (Dobson et al. 2020). Policy makers and stakeholders require updated empirical trade data on ivory, rhino horn, and other species, in order to take action against over-exploitation. Wildlife habitats when fragmented decimate species' numbers (Chase et al. 2020). With future uncertainties about COVID-19, researchers are aware of the need to find greater financial incentives to guard wildlife. (Lindsey et al. 2020; Roe et al. 2020). Humanity must seek new and effective methods to save the world's biodiversity (Challender et al. 2020), not only for elephants and rhinos as so-called keystone / flagship / umbrella species, but for species not sheltered under that umbrella.

We have learned that rhino horn and ivory bans in range and consumer states lacking local community support and also effective law enforcement do not work. CITES was never designed as a law enforcement body. A coordinated programme to galvanise Customs and Police with international teamwork is needed to tackle wildlife crime. Important strategies are intelligence gathering, internet research, and preventing trafficking through ports/airports. COVID-19 has brought the lethal dangers of wildlife trafficking to the forefront of government challenges at vast expense. There has been media coverage about increased wildlife market restrictions in China (Gorman 2020), China's controls of industries (TRAFFIC 2020), and wildlife trade government investigations in Vietnam (Tatarski 2020). Countries need shared aims and objectives for workable solutions, as for climate change.

Stockpiles of ivory and rhino horn must also be dealt with and managed properly and transparently to prevent theft, particularly as quantities accumulate in African range states (Martin et al. 1993; Mason et al. 2012; 't Sas-Rolfes et al. 2014). Despite much funding through Western NGOs for 'demand reduction' campaigns in China and Vietnam, demand continues. More research has now been conducted to look into this issue (Hanley et al. 2017; Burgess et al. 2018; Thomas-Walters et al. 2020). People do not always respond well to outsiders' views (Dang et al. 2020), or those of non-experts as we witnessed in Yemen. Local knowledge and scientific collaboration, with government support, is needed to find/promote

acceptable alternatives/substitutes, as appropriate. In the past domestic water buffalo horn and Saiga antelope horn were used in TCM for rhino horn (**Martin and Vigne 1987**). But great care is needed with species substitution. Disease destroyed many of the immense numbers of Saiga antelope in the Central Asian steppe, requiring them to go onto Appendix II in 2008 (Table 1). Future substitutes with biotechnology improvements are still being considered (Chen 2017; Mi et al. 2019), and perhaps a suitable substitute will be found for Yemeni jambiyas too.

Forensics and molecular research are fast developing areas that can reinforce law enforcement. Rhino horn DNA testing that started in South Africa (Harper et al. 2018) is expanding, and a DNA ivory testing lab in Cambodia was more recently initiated (FFI 2017). Hong Kong researchers can now molecularly test captive birds to see if they are wild-caught (illegal) or bred in captivity (Toropov 2020a), and we need ways easily to distinguish ivories, rhino horn and other materials with fast and cheap methods.

Corruption is a major obstacle undermining governance, but can be overcome. For example, thanks to China's anti-corruption campaign under President Xi Jinping (announced in late 2012) 'gift-giving' of carved ivory pieces as favours/bribes to officials fell significantly. This reduced sales of expensive ivory carvings and helped raw ivory prices come down (**Vigne and Martin 2014b; Vigne and Martin 2017b**). Corruption occurs all along the supply chain; demonstrable accountability with new technological tools is essential (**Vigne and Martin 2018b**; Smith et al. 2015).

Legislation and penalties for illegal ivory and rhino horn trade have increased on paper in various countries but often fail to be implemented. Prompt prosecutions and appropriate sentencing are imperative (Shamini Jayanathan, criminal barrister on illegal wildlife trafficking, September 2020). In Hong Kong a new strategy of 'giving wildlife a voice' could save time in court by providing briefing documents for magistrates to learn the severity of wildlife crimes and help them give proportionate sentences (Toropov 2020b). Incentives/rewards according to enforcement success would help identify 'kingpins' (ACET 2019). Criminal networks must be dismantled (Haas and Ferreira 2016) with top/'kingpin' traders appropriately convicted and their assets seized for restitution funds. Jailing low level poachers who are 'dispensable' is comparatively useless. (**Vigne and Martin 2018b;** ACET 2019). Wildlife trafficking is slowly joining the ranks of other international serious crimes such as drugs, money laundering and sexual slavery (Smith et al. 2015; Wingard and Pascual 2018; Grobler 2019; FATF 2020; EIA 2020b; UNODC 2020).

3.6 Concluding remarks

After my initial research collating substantive data on plummeting rhino numbers in Africa in the early 1980s, I focused on research in the biggest consumer country of African rhino horn at the time: North Yemen. I worked with Yemenis and the government, including finalizing Yemen's joining of CITES, with my long-term colleague Esmond Martin. Since the 1980s we also worked on combating rhino poaching on the Indian subcontinent, again spreading awareness of the problems being faced. I carried out numerous ivory and rhino horn market surveys in sometimes dangerous and difficult conditions, in the struggle against illegal sales in relation to shifting demands, contributing to weaken this threatening trade. I helped bring much needed worldwide attention to the trafficking of rhino horn and ivory, encouraging more researchers and nations to help combat it.

China's economic boom in the 2000s triggered a revival in illegal ivory and rhino horn uses after a decade of reduced poaching and trade. Indochina also has witnessed an expansion in illegal ivory and rhino horn trafficking, mainly to supply Chinese demand. My survey work again has helped to restrict this trade, providing evidence about physical markets of major concern, needing firmer law enforcement.

The internet now enables swift illegal sales transactions. But advances in technology are helping to impede these. There is greater global focus on the importance of adequate funding, collaborative digital intelligence, and investigative skills to dismantle today's international smuggling cartels. Improved monitoring and law enforcement with committed Police, Customs, the judiciary and civil society engagement are key. It is vital to blunt the plundering of wild fauna and flora, notably high value species, and subdue unsustainable consumer demand. There must be good leadership, and greater involvement from local communities living close to rhinos, elephants and all wildlife, as well as from consuming nations, to protect biodiversity from international criminal networks who are the profiteers of illegal trade.

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APPENDIX

Fig. 7. Ivory bead-making from smuggled African tusks in northern Vietnam, 2015

Fig. 8. Rhino horn and ivory items for sale in northern Vietnam, 2015

Fig. 9. Jewellery made from illegal African ivory for sale in Vientiane, Lao PDR, 2016

Fig. 10. Rhino horn chips for TCM in a Chinese market in Vientiane, Lao PDR, 2016

(Publications (Annexes 1-27) selected for the PhD by Published Work are listed in Box 1 and are within the hard copy.)