

# Patterns of illegal wildlife trade:

Characterisation of environmental law violations and wildlife seizures in Portugal, 2003-2019

Mariana Tavares Martins

Dissertation for the Master's Degree in Forensic Sciences and Laboratory Techniques

Gandra, April 2021

Mariana Tavares Martins

Dissertation for the Master's Degree in Forensic Sciences and Laboratory  
Techniques

# Patterns of illegal wildlife trade: Characterisation of environmental law violations and wildlife seizures in Portugal, 2003-2019

**Supervisor:** Doctor Diana Dias da Silva

**Affiliations:** UCIBIO – Applied Molecular Biosciences Unit, REQUIMTE Laboratory of Toxicology, Biological Sciences  
Department, Faculty of Pharmacy, University of Porto & TOXRUN, Toxicology Research Unit & IINFACTS,  
Department of Sciences, Institute of Research and Advanced Training in Health Sciences and Technologies,  
University Institute of Health Sciences (IUCS-CESPU)

**Co-Supervisor:** Luís Marques Fernandes

**Affiliation:** GABAI – Trace Elements Analysis Unit, REQUIMTE Laboratory of Applied Chemistry, Faculty of  
Pharmacy, University of Porto & IINFACTS, Department of Sciences, Institute of Research and Advanced Training  
in Health Sciences and Technologies, University Institute of Health Sciences (IUCS-CESPU)

**Co-Supervisor:** Frederico Lobo

**Affiliation:** ICNF – Instituto da Conservação da Natureza e das Florestas, I.P.

## Declaração de Integridade

Eu, acima identificada, declaro ter atuado com absoluta integridade na elaboração deste trabalho. Confirmando que em todo o trabalho conducente à sua elaboração não recorri a qualquer forma de falsificação de resultados ou à prática de plágio (ato pelo qual um indivíduo, mesmo por omissão, assume a autoria do trabalho intelectual pertencente a outrem, na sua totalidade ou em partes dele). Mais declaro que, todas as frases que retirei de trabalhos anteriores pertencentes a outros autores foram referenciadas ou redigidas com novas palavras, tendo neste caso colocado a citação da fonte bibliográfica.

## Acknowledgements

After a long journey, I see another academic stage of my life come to fruition, and as such, I could not fail to acknowledge and thank everyone that made it possible.

I would like to express my special thanks of gratitude to my supervisor, Professor Doctor Diana Dias da Silva, for the unique kindness, unquestionable commitment, guidance, availability, patience and above all, for never giving up on me.

To my co-supervisor, Professor Luís Marques Fernandes, thank you for giving me the golden opportunity to work on this project and for the availability, dedication and transmitted knowledge.

To my co-supervisor, Frederico Lobo, for accepting being part of this project, the availability and commitment.

To the Director of the Department of Nature Conservation and Biodiversity, Doctor João Loureiro, thank you for the availability, transmitted knowledge, and most importantly, for providing access to the database used in this project.

A special appreciation and thanks to my parents for supporting and believing in me throughout my academic journey.

This work was supported by the UCIBIO–Applied Molecular Biosciences Unit (UIDB/04378/2021), which is financed by national funds from FCT–*Fundação para a Ciência e a Tecnologia*, by IINFACTS–Institute of Research and Advanced Training in Health Sciences and Technologies, University Institute of Health Sciences (IUCS-CESPU) and by the ICNF–Instituto da Conservação da Natureza e das Florestas.



## Scientific Production

### Publications in international peer-reviewed journals

Martins M, Fernandes L, Lobo F, Loureiro J, Dias da Silva D (2021). Patterns of illegal wildlife trade: The scale of the problem. Manuscript under preparation for submission to *Forensic Science International* (JCR IF 2.395, 2020).

Martins M, Fernandes L, Lobo F, Loureiro J, Dias da Silva D (2021). Characterisation of environmental law violations and wildlife seizures in Portugal, 2003-2019. Manuscript under preparation for submission to *Forensic Science International* (JCR IF 2.395, 2020).

### Oral Communications in International Congresses

Loureiro J, Lobo F, Saavedra N, Machado L, Martins M (2020). Good practices in the implementation of the EU Action Plan against Wildlife Trafficking (2018-2020). IMPEL Best Practice: National IMPEL Network. 14 February. Madeira Island.

## Abstract

An accelerated decline of biodiversity and species loss has been observed over the last decades. However, the illegal global wildlife trade, which is paramount for exacerbating the problem, continues to grow. The characteristics and trends of illicit wildlife trade are of undeniable relevance as the development of targeted enforcement strategies and preventive interventions require comprehensible knowledge of the specific wildlife trade dynamics in a particular region. In Portugal, the study of wildlife seizures and environmental law violations is virtually non-existent. To better understand the problem's dimension, we herein retrospectively analysed the wildlife and environmental law contraventions reported in the country to the National Institute for Nature Conservation and Forests, I. P. (ICNF), between 2003 and 2019.

From the 3,202 cases of wildlife seizures and environmental law violations analysed during this period, 16.6% concerned cases that fell under the Berne Convention on the Conservation of European Wildlife and Natural Habitats, 47.3% fell under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 2.7% of the cases were violations of the Natura 2000 directives, and 0.8% were *Ilex aquifolium* law-related violations. During the study period, the number of such reports peaked in 2012 (426 cases; 13.3%), the majority of violations being reported by the National Republican Guard (2,043 cases; 63.8%). The most seized taxonomic class was birds (791 cases; 47.6% of the cases for which this information was available) – which comprised an assortment of exotic (e.g., *Psittacus Erithacus*) and native species (e.g., *Carduelis carduelis*), followed by reptiles and their parts and derivatives (242 cases; 14.6%) and ivory (207 cases; 12.4%). Of note, *I. aquifolium*, protected in Portugal since 1989 (DL No. 423/89), was the most relevant plant species apprehended (25 cases; 26.9%). Despite Portugal being considered one of the primary exporters of European eel, only 5 apprehensions (23.8% of fish cases) were reported during the study period. Most of the law infractions with administrative decision resulted in the administrative abandonment of the prosecution, as the cases were dismissed (802 cases; 44.3%) or a fine was applied (865 cases; 47.8%) – corresponding to an overall amount of 1,026,038.75 euros; mean value per case of 1,214.24 euros (only 28.9% of which was paid). Only 86 cases (4.7%) followed to a court trial.

Effective enforcement policies and interventions should be strengthened, and initiatives to promote change in consumers' behaviour should be implemented. This work aims to depict the areas where further work should be done with additional investment, increasing studies and continuous training of the enforcement agents in the interest of improving interventions and enforcement.

**Keywords:** Wildlife crime; Endangered species; Fauna and flora trading; CITES, Convention on International Trade in Endangered Species of Wild Fauna and Flora; Berne Convention on the Conservation of European Wildlife and Natural Habitats.



## Resumo

Um declínio brusco da biodiversidade e perda de espécies têm sido observados ao longo das últimas décadas. Contudo, a nível global, o comércio ilegal de espécies selvagens, que representa um papel primordial no agravamento do problema, continua a crescer. As características e tendências do comércio ilegal de espécies selvagens manifestam uma relevância inegável, para o desenvolvimento de estratégias e intervenções direcionadas, requer um conhecimento extensivo das dinâmicas do comércio de espécies selvagens. Em Portugal, o estudo de apreensões de espécies selvagens e infrações ambientais é quase inexistente. Aqui, tencionamos analisar os padrões do comércio de espécies selvagens em Portugal para compreender e dispor a dimensão do problema.

A análise retrospectiva de transgressões, utilizando informação do Instituto da Conservação da Natureza e das Florestas, I. P. (ICNF, I. P.), sobre apreensões de espécies selvagens e infrações ambientais em Portugal entre o ano de 2003 e 2019.

De 3202 casos analisados de apreensões de espécies selvagens e infrações ambientais reportadas durante este período, 16,6% dos casos diziam respeito a casos abrangidos pela Convenção sobre a Vida Selvagem e os Habitats Naturais na Europa (Convenção de Berna), 47,3% dos casos enquadravam-se na Convenção sobre o Comércio Internacional de Espécies da Fauna e da Flora Selvagem Ameaçadas de Extinção (CITES), 2,7% eram casos de violação das diretivas estabelecidas pela Rede Natura 2000 e, 0,8% dos casos eram referentes a infrações relacionadas com o azevinho (*Ilex aquifolium*). Ao longo do estudo foi possível verificar que o número de infrações reportadas atingiu o seu auge em 2012 (426 casos; 13,3%), a autoridade que reportou a maioria das infrações foi a Guarda Nacional Republicana (GNR) ( 2043 casos; 63,8%). As aves foram o produto mais apreendido (791 casos; 47,6% dos casos para os quais esta informação estava disponível) – esta classe taxonómica era compreendida por uma variedade de espécies exóticas (e.g., *Psittacus Erithacus*) e nativas (e.g., *Carduelis carduelis*), seguiu-se a classe taxonómica dos répteis as suas partes e derivados (242 casos; 14,6%) e o marfim com 207 casos (12,4%). De salientar, *I. aquifolium*, que é uma espécie protegida em Portugal pelo Decreto-Lei nº 423/89 desde 1989, foi a espécie mais relevante na classe taxonómica das plantas (25

casos; 26,9%). Embora Portugal seja considerado como um dos principais exportadores de enguia-europeia, apenas 5 casos (23,8% dos casos relativos à categorias dos peixes) foram reportados durante o período estudado. Para os casos com uma decisão administrativa, 802 casos (44,3%) foram arquivados, uma coima foi aplicada em 865 casos (47,8%) – correspondendo ao valor total de 1026038,75 euros; média de valor por caso de 1214,24 euro, (apenas 28,9% do qual foi pago). 86 casos (4,7%) seguiram para tribunal judicial.

Políticas e intervenções eficazes devem ser fortalecidas e iniciativas para promover a mudança no comportamento do consumidor devem ser implementadas. Este trabalho visa retratar as áreas onde se deve continuar a trabalhar com investimentos adicionais, aumentando o número de estudos nesta área bem como, treinamento contínuo dos agentes como intuito de melhorar a fiscalização e intervenções.

**Palavras-chave:** Comércio ilegal de espécies selvagens; Espécies ameaçadas; Comércio de fauna e flora; CITES, Convenção sobre o Comércio Internacional de Espécies da Fauna e da Flora Selvagem Ameaçadas de Extinção; Convenção sobre a Vida Selvagem e os Habitats Naturais na Europa.

## Table of Contents

Index of figures .....	XII
Index of tables.....	XIII
List of Abbreviations .....	XIV
I. Introduction .....	1
1.2 Organised wildlife crime.....	2
1.3 Enforcement counterback .....	4
1.4 Financial flows of illicit wildlife trade .....	5
1.5 Impact of illegal trade of flora and fauna.....	5
1.6 Targets for the illegal wildlife commerce .....	7
1.6.1 Hare coursing .....	9
1.6.2 Deer poaching .....	10
1.6.3 Pangolin persecution .....	12
1.6.4 Ivory.....	13
1.6.5 Rhino horn.....	15
1.6.6 Bird trade.....	16
1.6.7 Illegal fishing .....	18
1.6.8 Illegal logging .....	22
1.6.9 Trade in ornamental plants.....	24
II. Aims .....	26
III. Methods .....	27
3.1 Study design .....	27
3.2 Statistical analysis .....	28
IV. Results and Discussion.....	29
V. Conclusion and future perspectives.....	39
VI. Bibliography.....	41

## Index of figures

<b>Figure 1.</b> Annual wildlife seizures and environmental law violations recorded in Portugal, between 2003 and 2019. ....	29
<b>Figure 2.</b> Enforcement authority which recorded the wildlife seizure and/or environmental law violation in Portugal, between 2003 and 2019. ASAE: Food and Economic Security Authority; DGAIEC: General Directorate of Customs and Special Consumption Taxes; GNR: National Republican Guard; ICNB: Institute of Nature Conservation and Biodiversity; ICNF: Institute for Nature Conservation and Forests; PSP: Public Security Police. ....	30
<b>Figure 3.</b> Seized wildlife commodities in Portugal, between 2003 and 2019. Cases for which no information on the commodities was available (n=1,539 cases; 48.1%) were excluded from this statistical analysis. Fish, mammal and reptile categories comprehend both the animal specimen and its parts and derivatives. The bird category comprehends birds, bird eggs and nests. The medicinals category comprehends medicinal products including health and food supplements.....	33
<b>Figure 4.</b> Administrative decision on the cases of wildlife seizures and environmental law violations recorded in Portugal, between 2003 and 2019.....	34
<b>Figure 5.</b> Court decision on the cases of wildlife seizures and environmental law violations recorded in Portugal, between 2003 and 2019. ....	37

## Index of tables

**Table 1.** Number of cases of wildlife seizures and environmental law violations recorded in Portugal, between 2003 and 2019, with initial decision. ASAE: Food and Economic Security Authority; DGAIEC: General Directorate of Customs and Special Consumption Taxes; GNR: National Republican Guard; ICNB: Institute of Nature Conservation and Biodiversity; ICNF: Institute for Nature Conservation and Forests; PSP: Public Security Police. ....36

## List of Abbreviations

CITES – The Convention on International Trade in Endangered Species of Wild Fauna and Flora

EU – European Union

EU-TWIX – The European Union Trade in Wildlife Information Exchange

ICNF – Institute for Nature Conservation and Forests, I. P.

IUCN – International Union for Conservation of Nature

IUUF – Illegal, Unreported and Unregulated Fishing

UK – United Kingdom

UN – United Nations

US – United States

## I. Introduction

Trade in animals and plants through the over-exploitation of wild species has proven to be the second most influential cause of global biodiversity loss after changes in land and sea use (Burgess & Broad, 2020). The problem is aggravated by the fact that (il)legal trade predominantly exploits already vulnerable species (Wasser et al., 2008), despite the increased international conservation efforts and regulations over the past 50 years, notably under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Burgess & Broad, 2020). The increasing demand for wildlife commodities took advantage of the globalisation and modern commercial and technological developments, the internet being now a powerful motor for the illegal wildlife trade, rendering many enforcement efforts fruitless (Wasser et al., 2008).

Illicit wildlife trafficking can be described as any crime against the environment that concerns the trade, smuggling, poaching, capture or collection of endangered species or protected wildlife, native or exotic, including animals and plants that are subdued to harvest quotas and regulated by licenses, and their derivatives or products thereof (WWF, 2012). In this context, estimates indicate that, since 2000, the United States (US) alone has imported more than 1.48 billion live animals, mainly from Southeast Asia (Smith et al., 2009); while reports of wildlife seizures in the European Union (EU) between 2001 to 2010, from the EU Trade in Wildlife Information Exchange (EU-TWIX) database, revealed that most of the apprehensions (82%) concerned animal products (the vast majority derived from mammals, such as ivory and other products used in traditional Chinese medicine) (van Uhm, 2016). Seizures involving live animals were less representative (15%), from which reptiles made up more than half of all live animals confiscated, followed by birds and mammals, with amphibians representing only 1%.

Although the illegal wildlife trade is not a recent occurrence, as it always presented a market for food, clothing, companion pets or unusual objects (van Uhm, 2016), in the past decades, it has attracted global attention and imposed major concerns, being described as an environmental crime crisis with overwhelming financial, environmental and social impact (Mayer, 2019).

Sanctions for the exportation, importation, sale, purchase, hunting or harvesting of wildlife might vary among different countries, according to the international treaties and domestic laws (Wyler & Sheikh, 2013). Nevertheless, the inherent risk for criminals is low compared to other crimes and given the high profits produced.

Motivations behind this type of criminality may vary and go beyond the pursuit of profit, resulting, for instance, from thrill-seeking connected to sport or food, as a part of cultural traditions, or hostility and disrespect towards law enforcement and governments (Wyatt, 2016). Also, culture and fashion trends deeply influence the consumption of wildlife products. According to Panter et al. (2019), one-fifth of the global wildlife trade is attributable to increased demand for animals used as pets and entertainment purposes. Hundreds of millions of plants and animals are imported to fulfil the continuous consumer demand, which currently exceeds what can be legally supplied for trophies, pets, food, clothing, decorative items, and traditional medicine (van Uhm, 2016; WWF, 2012; Wyler & Sheikh, 2013).

Although some authors argue wildlife crime as a victimless crime, as it is impossible to readily identify an injured party or sufferer (Miller, 2009), the environment and society, as a whole, portray the real victims, as it causes harm to numerous species of plants and animals, which have too a right to live without suffering, unscathed from painful deaths (Wyatt, 2016); and jeopardises the livelihoods of the many who depend on wildlife to survive (e.g., hunters, anglers, nature photographers). Furthermore, human welfare and safety is also a concern, as illegal wildlife trade is often linked to organised criminal networks, which perpetrate crimes and use violence against rangers and wildlife crime officers tasked with protecting wildlife.

In the further sections, the information on wildlife trade (i.e., intent, financial flows, targets and impact, threats and the response to these threats, motivations behind this type of criminality, possible connections to organised crime and entwinement with other forms of illicit trade) will be provided.

## **1.2 Organised wildlife crime**

The core purpose of organised crime is a vast economic gain, only accomplished by distorting the legal commerce regulations to establish unlawful business activities ( Siegel, 2010). In this sense, illicit trade implies that a(n) (inter)national law or decree is broken, but the (il)legality of the matter is not always straightforward to assess. Depending on the circumstances, a product can be: i) produced, exported, and imported illegally; ii) produced and exported legally within its country of origin, but then illegally imported into a destination country; iii) illegally produced and exported in its country of origin, but legally imported to a destination country, which represents a problem in regions that lack regulatory agreements; and lastly, iv) legally produced within the source country,



but its international trade is illegal such as the case of the trade of regulated endangered species (OECD, 2012).

Organised criminal groups recognise the illicit trade in wildlife as a lucrative opportunity with a low risk of detection, compared to other forms of illicit trade. The demand for and value of endangered species increases as the species becomes rare. Of special concern, deforestation and defaunation occur at alarming rates causing enormous declines in endangered species, which are the most desirable scenario for collectors as the depletion of threatened wildlife populations drives increases in prices on the black market (van Uhm, 2016).

The chain of wildlife trafficking comprises the capture or harvesting, the transportation and the marketing to consumers, starting primarily by recruiting and training poachers, and then supplying the animals, plants or their thereof products to be smuggled into the destination country, frequently across several boards. Organised criminal groups form distribution networks linking source to consumer countries, commonly resorting to bribery and corruption of law enforcement officers while collecting large profits (Haken, 2011; McCusker, 2006; WWF, 2012).

Illicit wildlife trade has been associated with other forms of illegal trade and takes advantage of pre-existing infrastructure behind the smuggling of other illegal goods (e.g., drugs, weapons, stolen cars and human beings) (Wittig, 2016; WWF, 2012; Wyler & Sheikh, 2013). As dynamics between the two illicit trades often intertwine, wildlife is often used to smuggle and conceal an assort of narcotics (e.g., using snakes to conceal drugs in to avoid detection), to launder money from the drug trade, or is used as a trading commodity for products like drugs and weapons (e.g., using wildlife as currency for the acquisition of other illicit goods) (OECD, 2012; South & Wyatt, 2011; Wyler & Sheikh, 2013).

Some criminal groups and militias are linked to wildlife trafficking to fund destabilising political activities and military operations, and a vast number of organised criminal syndicates are also highly involved in some sectors of wildlife trafficking (Haken, 2011; Wittig, 2016; Wyler & Sheikh, 2013). In this regard, the Russian mafia has been found by the illicit caviar trade, while some Asian gangs have been entangled in the trafficking of rhinoceros horns and elephant tusks (Neo, 2009). Heavily armed groups in Africa use professional and sophisticated equipment, like high power rifles, helicopters, night-vision goggles, and military-grade weapons for poaching (Kiser, 2013). Although this illicit trade moves large sums of money and brings about vast economic loss for governments, authorities do not give the issue a high enough priority as it demands significant investment,

making the dynamics between wildlife trafficking and the underworld commerce still sparse and poorly understood (Dinerstein et al., 2007; Wittig, 2016; WWF, 2012).

### 1.3 Enforcement counterback

For a long time, massive economic and industrial interests blocked efforts to reduce the trade of endangered species. However, environmental and ecological protection had gained new fuel by the second half of the twentieth century. In 1940, the Washington Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere was established (van Uhm, 2016). The Convention aimed to control the trade of endangered species by creating a licensing system that was signed by 22 States (Argentina, Bolivia; Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Trinidad and Tobago, US, Uruguay and Venezuela), and was the precursor for the regulations that followed (van Uhm, 2016; Bowman et al., 2010).

Increased awareness and perception of the magnitude and threats that wildlife transnational organised crime presents to national and international security have led to developing strategies and an alliance to counteract the international illicit trade (Passas, 2003; WWF, 2012). In this sense, CITES was signed in March 1973 to serve as the foundation for international legal and regulatory purposes, currently regulating the trade of more than 37,000 species of animals and plants, with the treaty ratified by 183 members (known as parties) (Rosen, 2020; Collis, 2019). CITES is possibly one of the most noteworthy international conservation instruments, even if it only controls trade and not the criminalisation – it is generally not a self-executing treaty, in the sense that it cannot be fully implemented until specific domestic legislation has been adopted for such purpose (de Klemm, 1993). Nevertheless, the parties lack resources, with the incomplete and inadequate regulatory frameworks, the corruption, and the shortage of law enforcement agents being some of the many difficulties preventing an accurate and effective implementation and execution of the legislation (Dinerstein et al., 2007; McCusker, 2006; OECD, 2012; UNODC, 2016a; WWF, 2012).

In recent years, poaching and wildlife trafficking, once viewed and approached with mere regulatory measures, was deemed an escalating issue demanding serious consideration, as it was recognised by the United Nations (UN) on the Thirteenth United Nations Congress on Crime Prevention and Criminal Justice, as a severe form of transnational organised crime with a serious

impact on the environment. The UN urged the international communities to adopt effective measures by strengthening legislation, international cooperation, capacity-building, criminal justice responses and law enforcement efforts aimed at, inter alia, dealing with transnational organised crime, corruption and money-laundering linked to such crimes (United Nations, 2015; Wittig, 2016).

#### **1.4 Financial flows of illicit wildlife trade**

Despite the global scale of wildlife trade – this is the fourth most worldwide spread criminal market, generating billions of US dollars annually (Brandis et al., 2018; Schneider, 2012), reliable estimates for the financial value of illegal trade are difficult to come across, mainly because of the illegality of the trade and the existence of too many inaccuracies, exaggerations, and mis-conceptualizations (Passas, 2003; WWF, 2012). The illegal wildlife trade (not including logging and fishing) is estimated to be worth between 7–10 billion US dollars per year (Haken, 2011; World Bank Group, 2018), representing a significant economic loss for the governments. Estimates for illegal and unreported fishing are between 10–23.5 billion US dollars annually (Agnew et al., 2009), while the illegal timber trade can account for values of 30–100 billion US dollars annually (Nellemann et al., 2016). Data from 2016 indicate that the financial value of EU imports of CITES-listed animals (excluding sturgeon extract and cosmetics) was 1,430 million euros, representing an increase of 32% when compared to the previous year (UNEP-WCMC, 2018).

#### **1.5 Impact of illegal trade of flora and fauna**

Illegal global trade has intrinsic detrimental public health implications, high ecological and economic costs, as well as national and international security consequences (Mayer, 2019; Rosen & Smith, 2010).

In what concerns ecological damage, globalisation harmed wildlife by exponentially increasing the amount of wildlife traded across borders, thus unprecedentedly and abruptly diminishing plants and animals at the risk of annihilation. Of note, many experts on evolutionary history consider that we are experiencing the beginning of the sixth mass extinction, but for the first time, extermination seems to have an anthropogenic cause due to the unsustainable exploration of global fauna flora (Ehrenfeld, 2003; van Uhm, 2016).

Of special concern, the deforestation of tropical rainforests in order to accommodate the expansion of agricultural commodities, such as soy, palm oil, cattle and timber (Global Canopy, 2019), is prompting the loss of natural habitats, creating dangerous CO<sub>2</sub> emissions and threatening species with extinction (Koh & Wilcove, 2007; Tan et al., 2009). The average yield of palm oil vastly exceeds other vegetable oils, making its production cheaper when compared to other vegetable oils used in the food industry and biodiesel production (Tan et al., 2009; Vijay et al., 2016). However, palm oil production pales compared to cattle ranching and beef production contribution to forest loss (Nellemann & UNEP, 2012).

Conservationists and animal rights activists have been expressing concerns about the wildlife trade both due to its overwhelming devastating role in the decrease of endangered species and the cruelty associated with the capture, handle and transport of live specimens, with reports stating that the percentage of live animals that die during transit could be up to 90% (Pearl, 2004; Wilson-Wilde, 2010). The current unsustainable international wildlife trade presents a serious threat to habitat and biodiversity loss, climate change, as well as long-term survival of wild species population by abandoning exotic imported pets in non-native habitats, which threatens the global ecosystem functioning (Collard, 2013; Engler & Parry-Jones, 2007; Frank & Wilcove, 2019; Siegel, 2016).

Furthermore, illegal wildlife trade has a substantial implication on human health with the potential risk of disease spreading and proliferation of invasive pathogen species that threaten humans, livestock and indigenous wildlife populations, dragging additional tremendous global economic losses (Karesh et al., 2005; Wyler & Sheikh, 2013). Despite the awareness of the risks that the wildlife trade poses to human health, the vast majority of wild-caught animals in markets and pet shops are not tested for diseases and parasites (Pearl, 2004). From all the emerging infectious diseases, three-quarters are zoonotic, transferred from animals to humans, as a consequence of environmental destruction and wildlife crime (UNODC, 2020). In this sense, the emergence of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), responsible for the outbreak of severe respiratory illness (COVID-19) and believed to have origin in a wet market in Wuhan City, China, spread rapidly throughout the world (Aguirre et al., 2020; Zhu & Zhu, 2020) and led China to temporarily ban the sale of wildlife in markets, restaurants and online (Zhou et al., 2020). However, wet markets are returning across China, evidencing that a total ban can only be effective if the Chinese government is willing to continue the ongoing wildlife reforms and revisions to the Wildlife Protection Law, rather than it be internationally imposed (Zhu and Zhu, 2020). This

is a susceptible subject as it can be deemed as an attack on Chinese culture and tradition. However, this was not the first time an outbreak of SARS (severe acute respiratory syndrome) emerged from East Asia. In 2003, an outbreak of SARS in China, Hong Kong, and Taiwan sparked the Western world's attention to some unusual food items on an Asian menu (Ellis, 2005).

Noteworthy, austere poverty dwells the vast majority of the countries where the bulk of the endangered species are being harvested by the rural populations living in profound impoverishment. Without access to farming land and not many other options for subsistence, these natives are ransacking their natural resources for scarce but crucial financial income (Rao et al., 2011). The low income driven by trade makes a critical difference in the livelihood of developing countries local communities.

Some authors argue that the negative impact inflicted upon these rural populations may be caused by a lack of trade control instead of a regulation deficit. With the increasing trade control, new strategies and systems started being established to supply consumer demand (e.g., captive breeding). However, these systems are developed in consumer countries rather than source countries, remaining the economic profit in the developed nations (Roe et al., 2002). Some authors go even further and present "conservation hunting" as one way to support conservation programmes and promote rural development. This instrument developed in the tourist hunting industry, whose regulatory framework is assembled with suitable biological and government restraints, has proven beneficial to local livelihoods and the survival of wildlife and ecosystems sustainability, primarily by employing the profits from trophy hunting to impulse incentive-led conservation programmes. Still, this system has severe flaws predominantly concerning the benefits assigned to landholders, which are not being collected due to excessive bureaucracy, government fees, and corruption. Beyond that remains the paradox of the monetary profits that reside in killing wild animals, which for many conservationists contradicts any conservation efforts (Dickson et al., 2009).

## **1.6 Targets for the illegal wildlife commerce**

Numerous world countries are involved in the smuggling of wildlife as a source, transit or destination. However, certain types of wildlife are highly connected to some regions (e.g., birds' traffic is largely associated with Central and South America, mammals with Africa and Asia, reptiles with Europe and North America, and corals with Oceania) (UNODC, 2016b). Wildlife smuggling may

assume various *modi operandi*, body packing (e.g., eggs in underwear, iguanas hidden in prosthetic legs, birds in leg bags), and containers (e.g., ivory in hidden compartments, frogs in film canisters, smoked monkeys hidden under declared food imports) (Uhm, 2016). Disguising wildlife is another method used by criminal networks (e.g., seahorses declared as plant material, stony coral camouflaged with spray paint, rhino horns camouflaged as wood products).

As herein further explored, mammals, birds, reptiles, fish, coral, and molluscs are the most traded for the pet and fashion industry, but also as trophies, food, entertainment, personal collections, or traditional medicine (Sollund, 2017; van Uhm, 2016; Wilson-Wilde, 2010).

## 1.6.1 Hare coursing

Hare coursing is a contest that involves comparing the agility and speed of two dogs (usually greyhounds and other sighthounds) while pursuing a live hare. These contests are fostered by coursing clubs, which are issued Government licenses to capture hares from the wild using nets and held them captive before the contest (Bronner, 2007; Kelly, 2020; Reid et al., 2010).

After banned hare coursing in Scotland in 2002, the “Hunting Act 2004” prohibited hunting wild mammals with dogs in England and Wales, penalising the participants of hare coursing events and the spectators (UK Government, 2004). Following Scotland, England and Wales, Northern Ireland also banned hare coursing in 2010 (Bowcott, 2010). However, hare coursing is still legal in three EU Member States, i.e., Portugal, Spain and Ireland (Kelly, 2020). Despite being illegal in most EU Member States (Kelly, 2020), illegal coursing still occurs (Kelly, 2020; Reid et al., 2010; Swift, 2019). Of note, with the bans, restrictions and large sums of money involved, the coursing communities resort to illegal underground events that pose a significant animal welfare issue with major population decline threats. The police have difficulties with the detection and prosecution because these illegal events are held in rural areas with few witnesses or live-streamed on the dark web, leading to sparse convictions (Anderson, 2017; Kelly, 2020; Swift, 2019).

European hare (*Lepus europaeus*) and mountain hare (*Lepus timidus hibernicus*) are highly regarded as game species across European countries (Reid et al., 2010). In the Iberian Peninsula, European rabbits (*Oryctolagus cuniculus*) are viewed as a cornerstone game species (Delibes-Mateos et al., 2009), although wild populations have substantially decreased over the past decades (Delibes-Mateos et al., 2009; Ríos-Saldaña et al., 2013), as a result of habitat loss, disease and unsustainable hunting (Ferreira et al., 2012), and are currently endangered with wild populations decreasing (Villafuerte & Delibes-Mateos, 2019).

This competitive event has sparked the debate between the coursing community and Animal Welfare organisations, with supporters arguing that hare coursing is “a noble countryside tradition” and protestors describing it as a “barbaric bloodsport”, comparing it to “cock and dog fighting” (Bronner, 2007). In Ireland, the coursing community claims that coursing contributes to hare conservation, leaning on studies stating that the abundance of hares within the Irish coursing club preserves were up to 18 times higher than in the wider countryside (Kelly, 2020; Reid et al., 2010). Nonetheless, the findings of this study are controversial and need further confirmation. As

stated by Kelly (2020), the study was conducted in just one county (Donegal), with the support of the East Donegal Coursing Club, and the hare abundance was estimated by comparing data from 2007 preserves with data from the wider countryside mainly gathered in 2003, presenting a possible fault as it does not account for the fluctuation of hare population through the years.

While most hares are released back into the wild, the number of hares killed during the coursing season is a point of contention. The British Field Sports Society (BFSS) alleges that less than three hundred hares are killed, but The National Society for the Abolition of Cruel Sports (NSACS) states that the numbers may be twice as much, with some estimates going as far as half of the hares being killed during a coursing season (Bronner, 2007). Although the impact of coursing on individual hares' welfare is still not researched or documented, it is acknowledged that the amount of stress that hares are subjected to during captivity and coursing may impact their reproduction and immune system leaving them vulnerable to diseases (Kelly, 2020).

Although the numbers of wild mountain hare populations were in decline in past years, more recent reports classify the species as stable (Reid et al., 2010; Smith & Johnston, 2019). As for the European hare, The International Union for Conservation of Nature (IUCN) Red List of Threatened Species™ assesses it as the least concern, although the wild population trend appears to be decreasing (Hacklander & Schai-Braun, 2019).

## 1.6.2 Deer poaching

Musk deer (*Moschus* spp.) has been poached for centuries (Homes, 2004; King, 2017) due to the production of musk, which has been coveted since the medieval period due to its uses in pharmacology and perfumery (King, 2017). Musk is used in traditional medicine to treat an assortment of afflictions (Shrestha, 1998; Zhou et al., 2004), with the vast majority of musk coming from East Asia (Li et al., 2016; Shrestha, 1998; Zhou et al., 2004). Musk is ranked as one of the most valuable animal-derived aromatics and is believed to be more expensive than gold, mainly due to the demand, significantly surpassing the legally available supply (King, 2017; Li et al., 2016; Zhou et al., 2004).

Although only the adult male possesses the gland responsible for the production of musk, this does not prevent females or juvenile musk deer from being killed due to non-selective means of hunting (e.g., snares). Accordingly, it was previously reported that three to five musk deer might be killed for each male with a sufficiently large musk gland (Homes, 2004). On the other hand,



removing the musk from the gland, which is located beneath the skin, between the reproductive organ and the umbilicus, is possible without killing the deer, with a small operation lasting approximately 15 minutes, but fatal poaching is most broadly promoted. Anthropogenic actions allied to the modernisation of hunting equipment are driving the species to the brink of extinction (Homes, 2004; Shrestha, 1998).

The Himalayan musk deer (*Moschus leucogaster*), once very prominent across the Himalayas, Afghanistan, India, Pakistan, Nepal, Bhutan and Myanmar, is currently endangered as a result of poaching and habitat degradation and can only be found in remote places with the numbers for wild populations continuing to decline (Shrestha, 1998; Singh et al., 2019; Timmins & Duckworth, 2015). The same occurs for the wild populations of Black musk deer (*Moschus fuscus*), Siberian musk deer (*Moschus moschiferus*), Forest musk deer (*Moschus berezovskii*) and the Alpine musk deer (*Moschus chrysogaster*) (Harris, 2016; Nyambayar et al., 2015; Wang & Harris, 2015b, 2015a; Zhou et al., 2004). Consequently, musk deer (*Moschus* spp.) is currently listed under Appendix I of CITES, the trade of musk deer products being either prohibited or restricted (Shukla et al., 2019).

With the musk deer wild population in decline, China began establishing protective measures, one of those being musk deer farming, but regardless of the efforts, this was not proven to be a successful plan due to the shy and solitary behaviour of these animals, with many of the farms ending up closed (Zhou et al., 2004).

Also, across the US, the white-tailed deer (*Odocoileus virginianus*) is being illegally harvested for their antlers (Eliason, 2012; Haines et al., 2012), which have fascinated humans for centuries and been traded as a trophy to be commonly displayed on the wall (Yudha et al., 2019).

As for the United Kingdom (UK), reports link deer poaching to illegal meat trade and organised crime. Accordingly, the increase in deer poaching between 2006 to 2011 was believed to be linked to the economic recession as well as to the increase in the price of venison. In addition, the glamorisation of cooking alternative meats provided an economic motivation behind poaching, potentially compromising human welfare because the meat is not suitably inspected for diseases (Wyatt, 2016).

### 1.6.3 Pangolin persecution

Pangolins (*Manis spp.*) are listed in CITES appendix II, which accounts for the species whose trade must be controlled to avoid incompatibility with the species survival. The exceptions are *Manis crassicaudata*, *Manis culionensis*, *Manis gigantea*, *Manis javanica*, *Manis pentadactyla*, *Manis temminckii*, *Manis tetradactyla*, *Manis tricuspis*, which are listed under appendix I and therefore considered highly endangered species, so their international trade is prohibited (CITES, 2020). The latter species were assessed as Critically Endangered, Endangered or Vulnerable, with the population decreasing by The IUCN Red List of Threatened Species™ (Challender & Waterman, 2017). Pangolin vulnerability is also highly accentuated by their slow growth and low reproductive rates (Mwale et al., 2017; Zhou et al., 2014).

Throughout history, pangolins have been used for human subsistence, livelihood, medicine and cultural grounds (Ingram et al., 2019; Xu et al., 2016). Nowadays, pangolins are often described as the “most trafficked mammal in the world”, having their scales used in traditional medicine, their skin processed into leather products, and their meat consumed as a luxury food (Heinrich et al., 2017; Olsson, 2013). Unlike other animals, for which only parts or derivatives are commonly traded, the entire live animal is trafficked, leading to astonishing cruelty and begging the question of where are these animals placed once seized, many being inappropriately released into forests or euthanised (Zhou et al., 2014).

Even though there is a ban on international trade, this species still suffers from human predation, with millions being poached and illegally traded over the past decades to fulfil consumer demand in Asia (van Uhm, 2016; Xu et al., 2016). Overexploitation of Asian pangolin populations has driven the species to an abrupt decline. In what concerns pangolin products’ demand, it appears to be supplied by poaching and illicit trading of African pangolins across international boards, as an increasing number of seizures of African pangolin derivatives have been detected in Europe and Africa, destined for Asia (Ingram et al., 2019; Nuwer, 2020; Olsson, 2013).

Pangolin meat is also consumed among the higher Chinese socioeconomic classes as a display of social status and hospitality, despite being illegal since 1989 (Xu et al., 2016). As for the African pangolins, evidence has shown that they are consumed as wild meat, and their body parts are used for an array of applications in traditional medicine. In Central Africa, 0.4 to 2.7 million pangolins are estimated to be poached every year for their meat (Ingram et al., 2019). Boakey (2018)

linked the use of wild animals in Africa for traditional medicine and bushmeat with ethnicity, stating that the practice is “deeply rooted in the continent’s cultural values”.

Dried pangolin scales are also gifted as a wish for good health and appear to be easy to buy at any traditional medicine store in Vietnam (Globescan, 2018).

Pangolin trafficking appears to be increasing over the years, with the number of seizures and seizure’s amounts rising (Heinrich et al., 2017; Lo, 2020; Xu et al., 2016). A 2018 United States Agency for International Development (USAID) study conducted by GlobeScan in Vietnam profiled the buyers as males, with high income and an average age of 35.8 years old; the “past 12-month buyers” claimed to have spent, on average, approximately 799 US dollars on their last purchase, and two-thirds of the buyers were willing to pay up to 10% more than the actual price for the next purchase of the same product, although half stated that they should pay less if the product comes from illegal trade. In this study, the main deterrents to buyers were related to endangered species, animal cruelty and heavy penalties (Globescan, 2018).

At the 2020 UN Summit on Biodiversity, the UK Prime Minister demanded concerted and coordinated global action to prevent further biodiversity loss, addressing the pangolin. The tragedy would be to “bequeath a planet on which pangolins are as unfamiliar to future generations as dinosaurs and dodos are to us today” (UK Government, 2020).

#### **1.6.4 Ivory**

Illicit ivory trade has been identified as one of the leading causes of the decline in the wild African elephant (*Loxodonta africana*) and Asian elephant (*Elephas maximus*) populations, and are both listed under CITES Appendix I, except for the Botswana, Namibia, South Africa and Zimbabwe populations which are listed under the appendix II (CITES, 2020).

The IUCN Red List of Threatened Species™ assesses the African elephant (*Loxodonta africana*) as vulnerable with the population increasing, and the Asian elephant (*Elephas maximus*) as endangered with its decreasing (Blanc, 2008; Williams et al., 2020).

A severe decline in the African elephant population between 1979 and 1987 prompted CITES Parties to take action. In 1989, a ban on the ivory trade was implemented (Wasser et al., 2004). However, legal domestic trade was still available in some countries, where almost no efforts were made to regulate, register or license raw, worked or semi-worked ivory. Thus, such legal loopholes allow illegal ivory to be laundered into mainstream legal markets (Harris et al., 2019; Milliken, 2004).

In 2016, on the CITES Seventeenth Conference Meeting of the Parties (CoP17), it was recognised the “urgency” in closing the domestic markets for trade in raw or worked ivory (CITES, 2016; L. Harris et al., 2019). China, which is regarded as one of the largest markets for illegal ivory worldwide and has a deeply rooted cultural history that considers ivory as a symbol of status and wealth, promulgated in 2016 the Notice of the General Office of the State Council on Orderly Stopping the Commercial Processing and Sale of Ivory and Ivory Products, which required the closure of all legal carving factories and retail stores by 31 December 2017 (Canby, 2017; Chou, 2018; Xiao, 2018). Pursuant to this, the vast majority of “accredited retail stores” ceased the sales of ivory and have now started to provide mammoth ivory products to bridge the gap of consumer demand (Xiao, 2018). Nevertheless, this ban can be seriously undermined by the remaining opened markets nearby (e.g., Thailand, Myanmar, Vietnam, Cambodia and Laos) (AFP, 2014; WWF, 2018), recent research showing that the number of regular people who travel overseas to buy ivory outside mainland China, continues to increase (Meijer et al., 2019).

It is estimated that no fewer than 20,000 African elephants are illegally killed annually for their tusks to supply the continuous demand for ivory and thereof products (WWF, 2018). Between 2000 and March 2019, over 293 tonnes of ivory were apprehended in 175 seizures, representing an estimated number of 43,834 elephants (EIA, 2019).

Illicit ivory might be shipped across various counties until reaching the destination, being seized anywhere along the trade chain. Seizures may include tusks or tusk pieces, classified as “raw ivory” or “worked ivory”, respectively (TRAFFIC, 2019; Underwood et al., 2013).

The illicit ivory trade further highlights the risks to the national and international security and loss of government revenue, being a high-profit enterprise with exceptionally low risks for organised criminal groups taking notice of the massive profits achieved (Kerry et al., 2012; Kiser, 2013).

Tools like The Elephant Trade Information System (ETIS) and Monitoring the Illegal Killing of Elephants (MIKE) are essential information providers of elephant poaching and ivory trade and aid in decision-making for elephant conservation (TRAFFIC, 2019; Underwood et al., 2013).

### 1.6.5 Rhino horn

An international ban on rhino horn trade has been in place since 1977, all rhinoceros family (*Rhinocerotidae spp.*), except for the subspecies *Ceratotherium simum ssp. Simum*, being listed under CITES appendix I (Biggs et al., 2013; Brown et al., 2019; CITES, 2020).

White rhinoceros are the largest living land animals after African and Indian elephants. Black and white rhinos have two horns, the front one being usually longer than the rear one (Ellis, 2005). Rhino horn is entirely composed of keratin and regrows when cut, but in spite of sedating a rhino to shave its horn might be done for 20 dollars, poaching levels continue to rise (Biggs et al., 2013). Debate on regulated, nonlethal rhino horn trade has emerged as a way to meet the demand for horn and generate income for conservation efforts (Biggs et al., 2013; Brown et al., 2019; Rubino & Pienaar, 2020).

Rhino horn has been extensively used for dagger handles (jambiyas) in Yemen and for centuries in traditional Chinese medicine (Biggs et al., 2013; Ellis, 2005), even after the Chinese government ban on the trade in 1993 (Gao et al., 2016). Currently, the rhino horn is more valuable by weight than gold and cocaine (Biggs et al., 2013). Considering that a single horn may weigh up to 6–7 kilograms, professional poachers absorbed by the enormous financial profits started using sophisticated equipment (e.g., heavy-calibre rifles, dart guns, infrared sensors, helicopters and tranquilising drugs) to immobilise the rhino and then cut off the horn to supply the black market for tonics and other remedies claimed to cure or alleviate an array of ailments (e.g., cancer, erythema, purpura, heart disease, convulsions, cramps and fever) (Biggs et al., 2013; Gao et al., 2016; Milliken & Shaw, 2012; van Uhm, 2016). It is also sought after to be used in China as a carving material and transformed into cups, bowls, hairpins, thumb rings, and other ornamental pieces (Gao et al., 2016).

Trophy hunting has also been deeply connected to rhinos in South Africa, with white rhinos having been hunted for trophies since 1968. However, with an increased market for rhino horn in Asia, new regulations had to be implemented by the South African government in past years, restricting the number of hunts per hunter to one a year and imposing supervision of all hunting events by government personnel. Each rhino horn trophy must be micro-chipped, and DNA samples are taken for inclusion in the Rhino DNA Index System. Exports of live rhinos to *ex situ* locations

are restricted to members of the World Association of Zoos and Aquariums (WAZA) (Milliken & Shaw, 2012).

Protection of rhinos has become extremely expensive, not only financially but also in the loss of human lives, and not even the rhino dehorning has proven to be effective in reducing poaching (Biggs et al., 2013). The private wildlife sector (e.g., private wildlife ranchers) has also witnessed an increase in security costs as poaching escalates and consequently, private rhino ownership becomes more expensive in order to provide protection to rhinos (Rubino & Pienaar, 2020).

### 1.6.6 Bird trade

Overexploitation continues to be a key factor threatening over one-third of all bird species, which are caught from the wild to be traded as pets, food or used in sport (Daut et al., 2015; Panter et al., 2019, 2019; Siriwat & Nijman, 2020).

In particular, the misuse of parrots dates centuries ago, with reports linking them to the Aztec empire in Mexico where, in addition to serving as pets, parrots were a source of food and their feathers were used for clothing and decoration (Pires, 2012). The parrot trade has since raised the interest of organised criminal groups, which export thousands of parrots to Europe and the US (Pires, 2012). The taxonomic Order Psittaciformes is of particular concern as its popularity has caused the decline of wild populations and threatened many species with extinction (Pires, 2012; Ribeiro et al., 2019; Sánchez-Mercado et al., 2020). Some species are sold for high profit, such as the Hyacinth Macaw (*Anodorhynchus hyacinthinus*) and the African grey parrot (*Psittacus erithacus*), which are common household pets across the neotropics, being worth as much as 10,000 dollars in the international markets (Pires, 2012; Pires et al., 2016). These species are assessed on the IUCN Red List of Threatened Species™ as vulnerable and endangered, respectively (BirdLife International, 2018, 2016).

Panter et al. (2016) described that poachers hunt and trap parrots, then getting the animals to consumers in one of three ways: by selling them i) to middlemen; ii) to marketplace sellers who will then sell them to the public consumers; or iii) directly to the consumers, ensuring no intermediates. Another character in the parrot trade is “the conduit”, who does not poach or sell the animals, merely connects the seller and consumer.

A 2012 survey stated that the trade of wild birds in Brazilian street markets could be worth 630,000.00 US dollars annually, consequently endangering nearly 67,000 birds caught from the wild to supply the surveyed marketplaces (Regueira & Bernard, 2012).

The trade in diurnal (Falconiformes and Accipitriformes, commonly referred to as raptors) and nocturnal (Strigiformes) birds of prey is also worthy of attention, given that it substantially contributes to the avian trade (Siriwat & Nijman, 2020). Falconry is a significant factor in the raptor trade, being a widely practised sport in the Middle East and the US (Panter et al., 2019; Siriwat & Nijman, 2020). Nonetheless, it is not the only threat plaguing the raptors, with the intentional killing for the protection of livestock or game species, the pet trade, and the hunting for consumption as medicines or bushmeat, all playing a part in the decreasing of wild populations (Madden et al., 2019; Siriwat & Nijman, 2020). Social media platforms have also been reported as an upcoming hub for illicit raptor trade (Iqbal, 2016; Panter et al., 2019; Siriwat & Nijman, 2020).

According to Panter et al. (2019), the number of traded raptor and owl species has increased since 1975, with Japan being one of the most significant global importers, contributing to 94% of wild-caught imports since then. Portugal ranks second on wild-caught raptor species imports, while Spain is the second-largest importer of wild-caught owls. The United Arab Emirates is the largest importer of captive-bred raptors. On the other hand, in the podium as the largest wild-caught raptors exporter and re-exporter countries are Guinea, the UK and Germany (Panter et al., 2019). Germany has been known as the most prominent black market hub for birds of prey (van Uhm, 2016). The main exporters and re-exporters of wild-caught owls are the UK, Russia, and The Netherlands.

The avian influenza viruses outbreak in 2005 impelled the EU to implement a ban on the imports of wild-caught birds into the EU countries. This measure was initially temporary, but eventually made permanent in 2007 (Cardador et al., 2019; Ribeiro et al., 2019). Before that, the EU market demand for wild birds listed under CITES was prominent, with the EU importing 2.8 million protected birds between 2000 and 2003, which represented 93% of registered imports worldwide (van Uhm, 2016). These changes shifted the core trade from wild-caught birds to captive birds to supply the demand. However, and as noted for some other species, these bans often increase financial incentives for poaching and the involvement of criminal organisations (Ribeiro et al., 2019; van Uhm, 2016).

### 1.6.7 Illegal fishing

Fish populations and already endangered fish species are under a tremendous strain due to illegal, unreported and unregulated fishing (IUUF), which jeopardises conservation and sustainable fishing efforts, further leaving wild fish populations vulnerable (Agnew et al., 2009; Donlan et al., 2020; Free et al., 2015; Nielsen et al., 2012; Österblom et al., 2011). The problem is particularly evident at the high seas, designated as international waters, outside coastal states jurisdiction, and in coastal waters of developing countries (Flothmann et al., 2010).

According to Flothmann et al. (2010) and the Food and Agriculture Organization of the United Nations (FAO), 11 to 26 million tons of fish, the equivalent to one-fifth of the global fish catches and worth over 23 billion US dollars, are lost to IUUF, every year. For instance, in 2020, Hong Kong Customs seized more than 274 kilograms of fresh totoaba fish maws, worth roughly 44 million US dollars (Standard, 2020). *Totoaba macdonaldi* is listed as critically endangered on The IUCN Red List of Threatened Species™ (Findley, 2010).

The continued overfishing crises spawned a lack of transparency, accountability and traceability of the supply chains, allowing for large quantities of illegally caught fish to reach consumer markets (Pramod et al., 2014). In this line, the depletion of global fish stocks has been a significant concern due to its impact on ecosystems, food safety, and countries' economies, in particular of the developing ones (Chapsos & Hamilton, 2019; Doumbouya et al., 2017; Pramod et al., 2014).

In West Africa, where estimates indicate that around 40% of all the fish caught comes from IUUF, nearly 7 million people are employed by the fishing industry, and the over-exploitation, overcapacity and illegal fishing pushed the region's fish stocks to a decline, mainly impacting a population that relies primarily on fish as its primary source of protein, or as a source of income (Doumbouya et al., 2017). In addition, industrial fishing continues to replace the artisanal fishing sector, hindering the assessment of illegal fishing conducted by the industrial vessels, and broadly reducing the number of jobs in the artisanal sector, leaving impoverished populations more vulnerable (Doumbouya et al., 2017).

As in the other types of illegal trade, illegal fishing is also shaped by weak governance and corruption (Battista et al., 2018; Doumbouya et al., 2017). Some authors also interlink IUUF to transnational organised crime (Chapsos & Hamilton, 2019; Österblom et al., 2011). In some



circumstances, IUUF goes hand in hand with human trafficking and forced labour (Chapsos & Hamilton, 2019).

Evasion techniques, designated as “detection escape”, such as interfering with electronic monitoring systems, using different flags, multiple vessel names and forgery of registration certificates, are often used simultaneously to avoid proper vessel identity and evade prosecution, ensuring that illegal fishing continues to be highly profitable (Doubouya et al., 2017; Pramod et al., 2014). According to Doubouya et al. (2017), between 2009 and mid-2016, through Monitoring Control and Surveillance (MCS) systems, approximately 29 million US dollars were recovered or sanctioned in fines in West Africa. Overall, illegal fishing is liable for an annual economic loss in West Africa of over 2.3 billion US dollars (Doubouya et al., 2017).

New regulations have been imposed to counteract the global fish overexploitation, such as eco-certification and catch certificates that state the origin of all fish and/or fish products traded within the EU (Nielsen et al., 2012).

#### **1.6.7.1 Caviar trade**

Caviar (sturgeon and paddlefish eggs) is one of the most highly-priced wildlife products (Carmona et al., 2009). Regarded as a delicacy and consumed as a luxury food worldwide, in 2005, one kilogram of Beluga (*Huso huso*) caviar was sold for approximately 4,290 US dollars on Western markets (Ludwig, 2008).

Until the early 1990s, it was exclusively produced in the Soviet Union and Iran (Carmona et al., 2009). By 2002, sturgeon catches in Russia – once one of the main actors in caviar production, dramatically dropped and were far from the 2,000 tonnes reached in the late 1990s (Carmona et al., 2009). Over-fishing and loss of natural habitat due to ecological and anthropogenic circumstances have been critical factors for the vulnerable status of sturgeon (Carmona et al., 2009). Continuing high demand for wild-sourced caviar and limited legal supplies offer organised criminal groups an opportunity to get involved in caviar’s illegal trade, collecting large profits (Musing et al., 2019).

All sturgeon and paddlefish (*Acipenseriformes spp.*) species are included in Appendix I and II of CITES (CITES, 2020; Ludwig, 2008). In this regard, international regulations and awareness for exports of sturgeons and sturgeon products, mainly caviar, lowered illegal exports (Carmona et al., 2009). However, it did not do very much in reducing illegal fishing, and in the Caspian and Azov

Seas basins, the level of illegal sturgeon catches exceeds eight to eleven times the legal limit (Carmona et al., 2009).

The decrease in the supply of wild caviar has increased caviar's aquaculture production, which, according to CITES data, between 2000 and 2015, had sourced all the legal caviar trade (Musing et al., 2019; Wuertz et al., 2009).

### **1.6.7.2 Sea cucumbers trade**

Sea cucumbers or *bêche-de-mer* (i.e., the dried form) are highly valued in culinary use as a delicacy, particularly in the Asian markets, and for their medicinal benefits (Choo, 2018; Toral-Granda et al., 2008). Recently, fucosylated chondroitin sulfate found in sea cucumbers body wall has been used in Eastern medicine drugs as an anticoagulant, antithrombotic (Mou et al., 2018) and to treat some types of cancer (Borsig et al., 2007). Intense exploitation in the Pacific islands, which have been occurring for over 170 years, had substantially decreased the resource in Asian waters, being sea cucumbers now supplied from other fishing grounds (Purcell, 2014). Consumer demand exceeds the supply, raising the price, particularly for the more sought-after species, encouraging poor practices and mismanagement (Carleton et al., 2013). Coastal communities began harvesting sea cucumbers as an alternative source of income (Toral-Granda et al., 2008), as the sea cucumber trade is very lucrative (Choo, 2008).

Aquaculture for some sea cucumbers species has proven promising, particularly for high-value tropical sea cucumbers (Anderson et al., 2011; Purcell, 2014).

### **1.6.7.3 Shark fin**

According to Shiffman and Hueter (2017), sharks are the most threatened vertebrates. They are experiencing severe over-fishing (e.g., targeted catch and bycatch, fishing associated with shark fin trade), driving wild shark populations to a decline (Carr et al., 2013; Shiffman & Hueter, 2017). In this regard, the EU is the primary shark fin exporter, and China the largest market (Santana-Garcon et al., 2012). Fins are dried and exported to Asian markets to eventually be used in Chinese cuisine (e.g., shark fin soup) (Carr et al., 2013; Hareide et al., 2007).

Terms like shark fishing, shark finning, and shark fin trade are often misused and misunderstood. Under US law, shark finning is illegal and applies only to removing shark's fins and

discarding the carcass at sea. If a shark carcass is landed (i.e., brought to the port) with fins still attached to the body to be removed and sold later, it is not a felony unless the specimen is from an endangered species (Shiffman & Hueter, 2017). This interpretation was also adopted by the EU, which implemented regulations in 2003 on the removal of fins of sharks on board vessels (OJ, 2003). More so, finning is viewed as an objectionable fisheries' practice since it contributes to an immense waste of protein and compromise food security (Santana-Garcon et al., 2012). This wasteful practice may be explained by the monetary disparity between shark fins and shark meat; shark fins are far more profitable, reaching as far as 500 euros per kilogram (Hareide et al., 2007; Santana-Garcon et al., 2012).

#### 1.6.7.4 European eel

According to TRAFFIC (2021), in 2019, 6,441 wildlife seizures were reported by the EU Member States, representing an increase of 7% compared to 2018. From the total seizure records in 2019, only around 17% estimated the value of the commodities. Live eels were the commodity with the highest reported value, totalling 2.9 million euros, mainly reported by Portugal (TRAFFIC, 2021), where glass eel fishery was banned in 2000, except for the Minho River (Correia et al., 2018). The most reported point of seizures was on export (TRAFFIC, 2021).

The number of seizures of the European eel in 2019 was lower than in 2018, i.e., 46 and 107 seizures, respectively (TRAFFIC, 2021). In 2018, Portugal was reported as an export country for multiple large live European eel apprehensions at airports (451 kilograms) (TRAFFIC, 2020). However, it should be noted that the enforcement efforts could vary across the EU Member States and over time, impacting and influencing the number of seizures reported over the years and the estimated patterns of illegal wildlife trade ascertained from the seizure data. Consequently, variation in the number of seizures reported may not necessarily indicate shifts in demand or changes in illegal wildlife trade dynamics (TRAFFIC, 2021).

Population decline and substantial international demand led the European eel (*Anguilla Anguilla*) to be listed in Appendix II of CITES in 2007 (Cardeñosa et al., 2019). The species is exposed to a range of threats, including habitat modification and loss, migration barriers, pollution, parasitism, fluctuating oceanic conditions and exploitation (Musing et al., 2018; Richards et al., 2020). It is currently listed as a critically endangered species on The IUCN Red List of Threatened Species™

(Pike et al., 2020). As such, a zero import/export policy was imposed, banning all commercial trade of *A. Anguilla* to and from the EU from December 2010 onward (Richards et al., 2020; TRAFFIC, 2021).

*A. Anguilla* is a freshwater eel that migrates from continental waters of Europe, North Africa and the Mediterranean to spawn, presumably, in the Sargasso Sea (Cardeñosa et al., 2019; Richards et al., 2020).

The European eel is harvested across all continental stages of its life cycle, being further traded and used for human consumption (Musing et al., 2018; Richards et al., 2020). Wild juvenile eels, commonly designated as “glass eels” by virtue of their transparent appearance, are illegally harvested to “seed” farming operations in Europe and East Asia (Musing et al., 2018; Richards et al., 2020; UNODC, 2020).

East Asia emerges as a common destination, as European eels are illegally exported from the EU mainly to Vietnam and Malaysia, according to the TRAFFIC report on seizures of CITES-listed Wildlife in 2019 (Cardeñosa et al., 2019; TRAFFIC, 2021; UNODC, 2020).

Unlike other highly coveted edible fishery products (e.g., sturgeon caviar), ongoing demand for wild-caught eels cannot be replaced by captive breeding, which at present, is not economically viable (Cardeñosa et al., 2019; Musing et al., 2018; Richards et al., 2020; UNODC, 2020).

Visual identification characteristics distinguishing European eels from other commonly traded eel species are limited, alluding to the challenge in detecting illegal international trade of live and processed European eel. In this sense, the use of forensic tools for species identification (e.g., DNA barcoding) would be of utmost relevance to implement (Cardeñosa et al., 2019; Richards et al., 2020).

### **1.6.8 Illegal logging**

The illegal trade of timber and timber products assumes a prominent position on the environmental crime spectrum, being perhaps the most economically lucrative form of illicit trade. Estimates indicate that 15 to 30% of the amount of timber globally traded has been obtained illegally, accounting for profits exceeding 15 billion US dollars annually (Brack & Hayman, 2002; Hansen & Treue, 2008). In many countries, the magnitude of illegal and unsustainable logging is identical or vastly exceeds the legal amount of timber harvested (Brack & Hayman, 2002; Kuemmerle et al., 2009; Nellemann & UNEP, 2012).

Depending on the nation laws, illegal logging occurs when the timber is harvested and/or transported, bought or sold, infringing national laws and international treaties. These activities are predominantly carried out in the most vulnerable regions, such as the Amazon Basin, Central Africa, Southeast Asia and the Russian Federation (Brack, 2003; Brack & Hayman, 2002; Hansen & Treue, 2008; Innes, 2010; Nellemann & UNEP, 2012).

The extraction of timber from protected areas without a permit, the cutting down of protected species, the non-compliance with extraction numbers, the forge or re-use of permits, misdeclaration to customs and tax evasion are not exclusive to developing countries. However, these issues are exacerbated in some of the poorest countries, which exhibit the richest rain forests, as a result of limited police resources, corruption and dubious alliances between the private sector and governments (Alemagi & Kozak, 2010; Brack & Hayman, 2002; Smith et al., 2003; Vandergert & Newell, 2003; Wyatt, 2014).

Significant deforestation is also one of the core contributors to environmental damage, responsible for up to 20% of global anthropogenic greenhouse gas emissions (Lawson, 2010; Menon, 2019; Tacconi, 2008). Illegal logging also reduces government revenues, threatens local communities' income and livelihood, and actively destroys biodiversity and habitats (Hansen & Treue, 2008; Nellemann & UNEP, 2012; Tacconi, 2008).

Despite the concerns and efforts unhidden by some countries, the results are scarce since the decline in illegal logging in one particular country seems to increase demand elsewhere (Nellemann & UNEP, 2012).

#### **1.6.8.1 Rosewood**

Rosewood (genera *Dalbergia* and *Pterocarpus*) is a denomination for a vast range of hued hardwood tree species native to tropical areas of Africa, Central and South America, and Southeast Asia, often described as a precious wood (Dumenu & Bando, 2016; Patel, 2009; UNODC, 2020). African rosewood (*Pterocarpus Erinaceus*) is estimated to be the most traded tropical hardwood in the world, and it is listed as endangered on The IUCN Red List of Threatened Species™ (Barstow, 2018). Currently, all *Dalbergia* species are listed under CITES Appendices I and II (CITES, 2020). The illegal trade in rosewood is valued at billions of dollars annually (Margulies et al., 2019). The ongoing demand for rosewood furniture in Asia, primarily China, has placed a strain on rosewood tree populations and increased the illegal exploitation of this tree species

(Dumenu & Bando, 2016; Siriwat & Nijman, 2018; UNODC, 2020). In 2016, West Africa supplied 80% of the traded volume of rosewood to China, with 840 million US dollars of rosewood being imported into the country between 2015 and 2016 (Dumenu, 2019). According to Schuurman and Lowry II (2009), the vast majority of rosewood in Madagascar has also been illegally harvested from protected areas over the past decades.

#### 1.6.8.2 Agarwood

“The wood of the Gods” is the common name for the infected wood of the *Aquilaria* tree (Persoon, 2007). This is a valuable non-timber product that sporadically develops due to a defence mechanism against pathogens inside the tree (Persoon & van Beek, 2008). It has several applications that range from incenses used in religious ceremonies to perfumes, traditional medicines and ornamental utilities (Persoon, 2007). South and East Asia and the Middle East are the main markets for these products, where agarwood has been in high demand (Persoon & van Beek, 2008). High quality agarwood can sell for as much as 1,000 US dollars per kilogram (Persoon, 2007).

As the only way to know if an *Aquilaria* tree has produced the aromatic resin is by cutting the tree down, *Aquilaria* trees have been cut down indiscriminately (Persoon & van Beek, 2008; Persoon, 2007). Depletion of natural sources of agarwood has resulted in the deliberate wounding of these trees with knives or hammering nails into the tree trunks, or in some forests, trees are artificially inoculated with a microbe to induce the production of the aromatic resin (Persoon, 2007). As a result of unsustainable production and overharvesting, all varieties of *Aquilaria* trees are listed under CITES Appendix II (CITES, 2020; Z.-F. Wang et al., 2020; Yin et al., 2016).

#### 1.6.9 Trade in ornamental plants

For millenniums, plants have been cultivated for food, medicinal or ornamental purposes. However, the relatively recent strain put on the wild plant population by overharvesting and trading has been intrinsically connected to plant biodiversity loss and a motor for the proliferation of invasive plant species worldwide (Dehnen-Schmutz et al., 2007; Novoa et al., 2017).

Plants represent the vast majority of CITES-listed species experiencing over-exploitation (Fay, 2018; Liu et al., 2019). Although the botanical trade is not a recent matter, there is still minimal research and data on the dynamics of the commerce and the impacts of the harvest

(Phelps & Webb, 2015). In this context, ornamental plants are widely traded, the market value for plants and mushroom products in Europe being estimated at 1.6 billion euros (Charitonidou et al., 2019).

#### 1.6.9.1 Orchid

The *Orchidaceae* is the prime family being traded internationally (Hinsley et al., 2018; Phelps & Webb, 2015), wild orchids being harvested to be extensively used in traditional Asian medicine, for scientific and ornamental purposes, and more recently, in the fragrance and cosmetic industry (Charitonidou et al., 2019; Hinsley et al., 2018; Subedi et al., 2013). The CITES covers all species in the *Orchidaceae* family, the vast majority being listed on Appendix II, which allows international trade with permits (Fay, 2015). Nonetheless, some authors argue that there is still a paucity of awareness or concern among the CITES parties about the scope and scale of orchid trade that does not comply with the Convention's regulations (Hinsley et al., 2018).

*Salep* is a flour made from the dried tubers of terrestrial orchids, often served as a hot drink during winter or as a remedy for cold and cough in Turkey, Greece, Iran, Iraq and Albania. *Salep* is also a key ingredient in traditional Turkish ice cream – *dondurma*, and Greek ice cream – *kaimaki*, and is produced from over 35 different species of orchids. Its demand has increased orchid harvesting (Charitonidou et al., 2019). In addition, habitat destruction, climate change and non-compliance with trade regulations present a significant threat for orchids (Fay, 2018; Hinsley et al., 2018).

## II. Aims

Although concern over the declining of biodiversity and species loss has escalated over the years, the illegal global wildlife trade continues to grow, yielding billions of US dollars annually to criminal organisations while threatening vulnerable and endangered species as well as society safety. In this context, the analysis of wildlife trade dynamics in specific regions are of utmost importance to elucidate the extent and characteristics of the problem and accordingly establish local preventive measures and direct enforcement efforts.

In Portugal, studies on wildlife seizures and environmental law violations are virtually non-existent. As such, this research intended to provide a comprehensive assessment of the patterns of law infractions on wild-harvested fauna and flora. Specifically, this dissertation aimed to analyse the wildlife seizures and environmental law violations reported in Portugal from 2003 to 2019 to the National Institute for Nature Conservation and Forests, I. P. (ICNF), to ultimately allow enforcement authorities to identify priority areas for interventions and targeted strategies.



### III. Methods

#### 3.1 Study design

For this study, all cases of wildlife seizures and environmental law contraventions reported in Portugal between 2003 and 2019 were acquired through the ICNF database, after permission to access the anonymised files being granted by the Director of the Department of Nature Conservation and Biodiversity (DCNB). All retrieved cases were categorised and labelled as follows: i) cases falling under the Berne Convention on the Conservation of European Wildlife and Natural Habitats, ii) cases falling under the CITES listed species, iii) cases of violations regarding the cutting, sale and removal of wild holly (*Ilex aquifolium*), and/or iv) cases concerning exotic species, wolf, or falling under the Natura Network – i.e., the cases involving the network of natural habitat protection areas and core breeding and resting sites for valuable and threatened species in Europe (Natura 2000). Exclusion criterium was applied to all duplicates (i.e., case duplicates that fell within two or more different listed categories were eliminated). The anonymised data of the achieved cases were compiled in a Microsoft Excel® database and analysed to provide breadth knowledge on the patterns of wildlife crime, and their legal follow up. In specific, the following information was analysed: data on the seizure date, criminal police involved, commodities apprehended (e.g., species and/or related materials), limitation period – i.e., the time that the law determines as possible for the establishment/or continuation of a case, or the execution of the sanction applied; administrative decision and/or court decision, administrative fine value, the value of imputable fees, overall amount paid, preemptive measures – i.e., the proceedings designed to ensure effective results (e.g., seizure of specimens, seizure of objects or reinstatement of the situation to that prior to the infringement), and additional penalties – i.e., restriction of rights connected to the offence committed (e.g., loss of specimens or objects, publication of the sentence or reinstatement of the situation to that prior to the infringement).

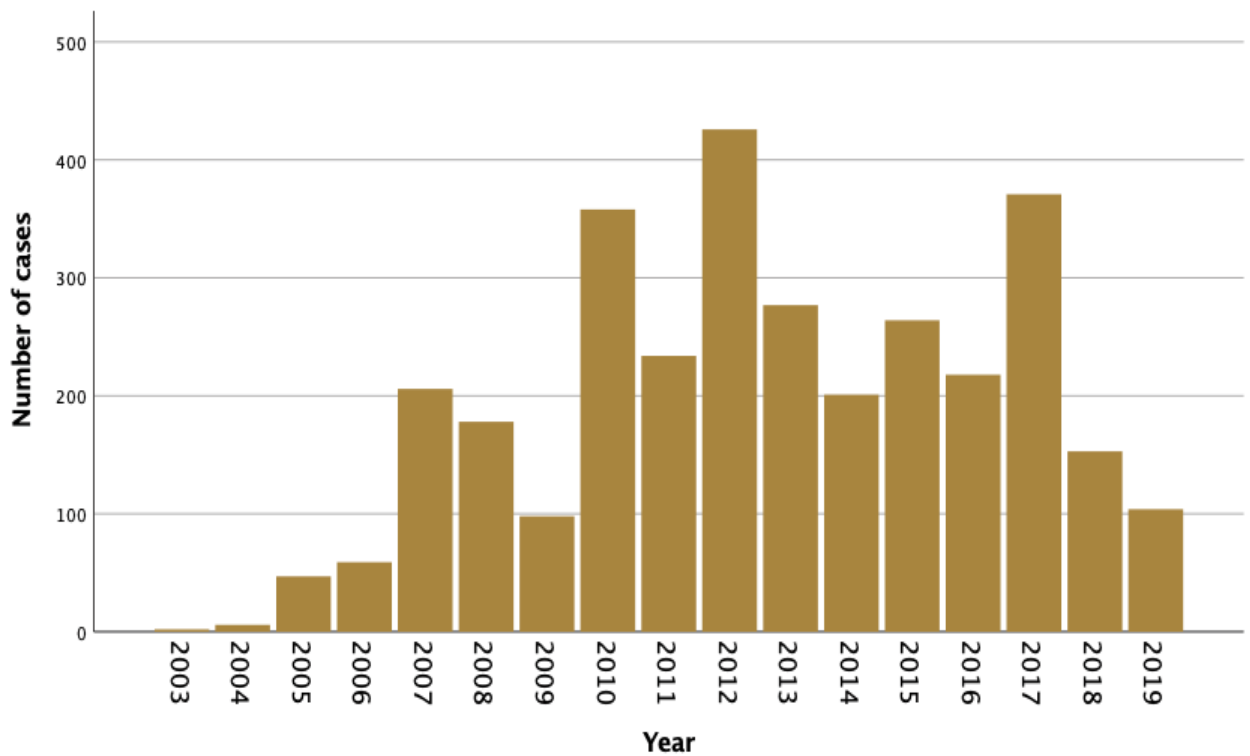
### 3.2 Statistical analysis

A descriptive statistical analysis of data was performed using the IBM Statistical Package for the Social Sciences (SPSS) Statistics 27® software.

For the sake of such statistical processing, those cases in which information concerning the seized commodity was not available, or cases related with environmental law violations were not considered (i.e., 1,539 cases in a total of 3,202). Similarly, for the calculation of the overall fine amount, the assignable administrative fees, the overall amount (i.e., the sum of both) and total value paid. For 17 cases in which a fine was applied but the amount was not available, along with 3 cases with contradictory information, were excluded.

## IV. Results and Discussion

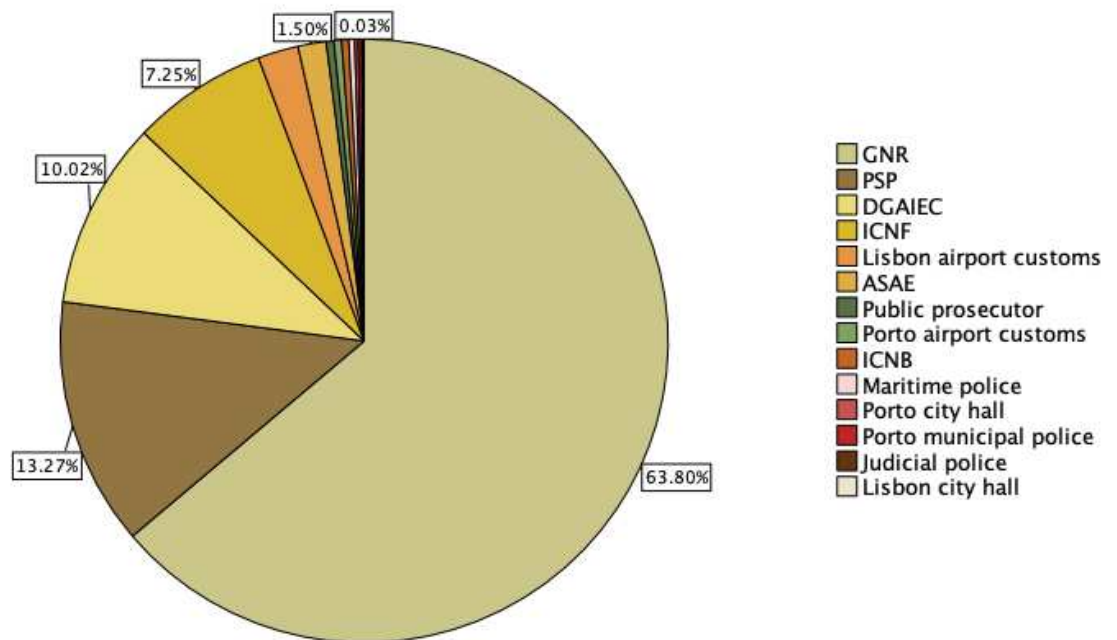
From the ICNF database, 3,380 cases concerning the wildlife seizures and environmental law violations reported in Portugal between 2003 and 2019 were initially obtained. Of these, 178 cases were excluded according to the exclusion criteria (i.e., duplicate cases). From the analysis of the remaining 3,202 cases (94.7%), it is evident that the annual reports peaked in 2012 (426 cases; 13.3%), while in 2003, it was only reported two (0.06%) occurrences (Figure 1) – this being probably explained by the low computerisation of data at that time.



**Figure 1.** Annual wildlife seizures and environmental law violations recorded in Portugal, between 2003 and 2019.

The enforcement authority which reported the vast majority of violations was the National Republican Guard (GNR) (2,043 cases; 63.8%). This could be justifiable with the absence of a fiscalizing authority capable of intervening across the entirety of the national territory. For this reason, GNR strengthened the development of specialized agents capable of dealing with the growing environmental violations, this culminated with the

establishment of the Nature and Environment Protection Service (SEPNA) in 2001, furthermore, the area under GNR responsibility covers 94% of the national territory, in which 54% of the Portuguese population inhabits (Amado, 2019; Guarda Nacional Republicana, 2020). The Public Security Police (PSP) reported 425 cases (13.3%), primarily in the urban areas due to territorial jurisdiction, the Institute for Nature Conservation and Forests (ICNF) was the fourth enforcement authority to report a substantial amount of cases (232; 7.2%), another significant place for seizures was the two most important airports in Portugal where 69 cases (2.2%) were reported by Lisbon airport customs, and 13 cases (0.4%) were reported by Porto airport customs, the entity with the lowest number of official police reports during the study period, was the Lisbon city hall (only 1 case) (Figure 2).



**Figure 2.** Enforcement authority which recorded the wildlife seizure and/or environmental law violation in Portugal, between 2003 and 2019. ASAE: Food and Economic Security Authority; DGAIEC: General Directorate of Customs and Special Consumption Taxes; GNR: National Republican Guard; ICNB: Institute of Nature Conservation and Biodiversity; ICNF: Institute for Nature Conservation and Forests; PSP: Public Security Police.

Regarding the taxonomic class of the specimen and/or commodities seized (Figure 3), 1,539 cases (48.1%) were not considered, as no information regarding commodities seized was available or were cases of environmental violations. These data highlight a significant gap in the recording system and the urge to educate criminal police authorities about the importance of correctly filling the infraction report, as these data will be of utmost relevance for the legal follow up. In the remaining 1,663 cases, birds were the most reported or seized taxonomic class (791 cases; 47.6%), followed by ivory (207 cases; 12.4%), reptile parts and derivatives (126 cases; 7.6%), reptiles (116 cases; 7%), mammals (93 cases; 5.6%), plants (93 cases; 5.6%), animal-derived medicines (77 cases; 4.6%), coral, shells, sand and molluscs (61 cases; 3.7%), plant-derived medicines (29 cases; 1.7%), mammal parts and derivatives (27 cases; 1.6%), fish (21 cases; 1.3%), invertebrates – i.e., insects, tarantulas, scorpions and starfish (9 cases; 0.5%), fish parts and derivatives (7 cases; 0.4%), timber (4 cases; 0.2%) and amphibians (only reported in 2 cases; 0.1%) (Figure 3).

The birds category (which also comprehends bird eggs and nests) comprised an assortment of exotic (e.g., *Psittacus Erithacus*, listed under CITES appendix I and assessed as endangered on the IUCN Red List of Threatened Species™; with 38 cases) and native species (e.g., *Carduelis carduelis*, assessed as least concern on the IUCN Red List of Threatened Species™ with 153 cases) (BirdLife International, 2015, 2018; CITES, 2020). The illegal removal and/or destruction of bird nests was observed in 44 cases (5.56%), but the illicit capture and possession of native birds of wild European fauna with the intent of selling was only reported in 14 cases (1.77%).

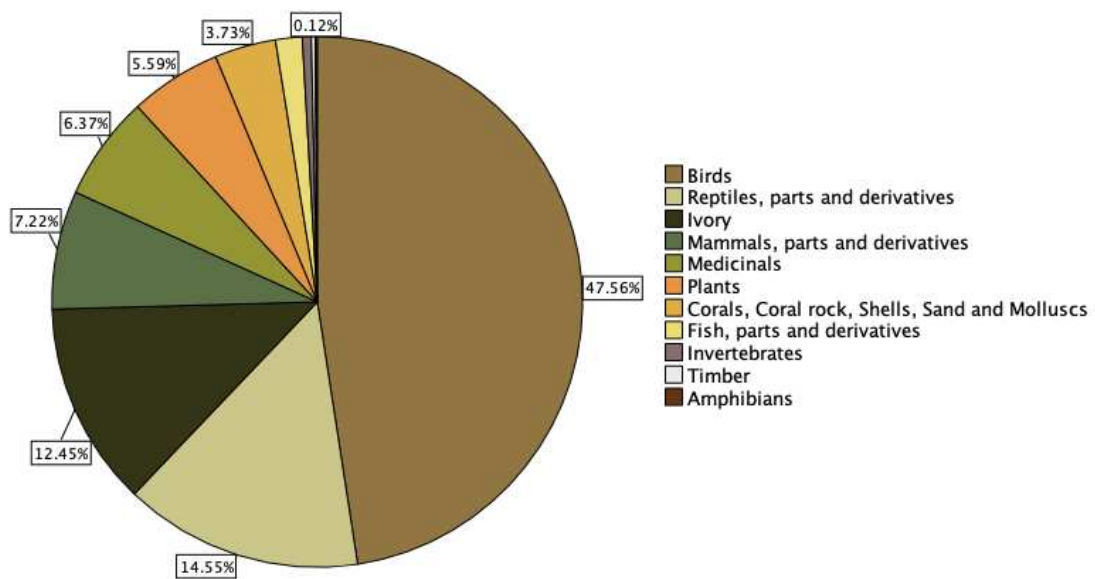
Although birds were the most reported or seized taxonomic class, these findings contrasted with reports on wildlife seizures, where, according to the World WISE database from 1999 to 2018, the primary taxonomic classes seized were mammals and as reported by TRAFFIC on seizures reported by the EU Member States submitted to the EU-TWIX database, both during the twelve-month period January to December 2018 and 2019 the primary taxonomic class seized were medicinals (i.e., medicinal products including health/food supplements), having said that, it was also stated that “in order of importance based on the number of reported seizure records” live birds were the main commodity seized within the EU (TRAFFIC, 2020, 2021; UNODC, 2016b, 2020).

Of note, the most relevant plant species apprehended was *I. aquifolium* (25 cases; 26.9%), which has been protected in Portugal since 1989 and legislated under the Decree-

Law No. 423/89, with fines varying from approximately 100 to 1,000 euros per private person (Assembleia da República, 1989), as a result of an overwhelming demand that resulted in the death of many specimens as a consequence of the systematic thinning of the plants, during the Christmas season.

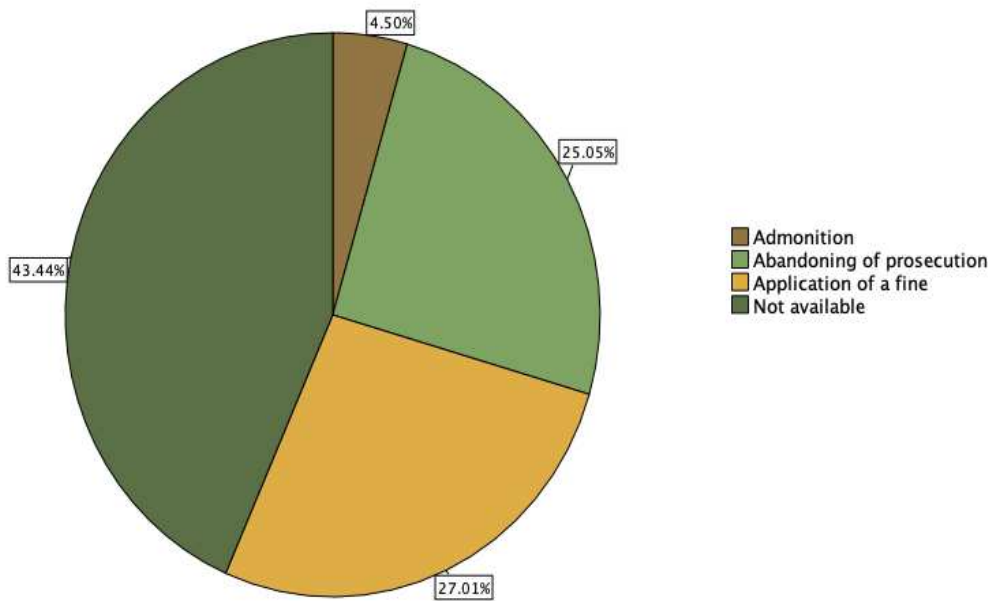
In the fish category, there were only 5 reports (23.8%) regarding the European eel (*A. Anguilla*). These data are not supported by the TRAFFIC report (2020, 2021), in which Portugal was considered one of the main exporters of European eel – in 2019, most of the seizures of live European eel occurred at an airport in Portugal. Furthermore, in 2018, 149 kilograms of live *Anguilla anguilla* on route to Vietnam were seized at airports in Portugal and Spain. Even though TRAFFIC reports were based on seizures reported by the EU Member States submitted to the EU-TWIX database, no mention of these facts was observed in the analysed ICNF database – only in one case the weight of the seized European eels was present (93.5 kilograms), and that case was reported in 2015 further corroborating an imprecise information entry. This absence of cases reported on the database could be owed to the fact that under the Portuguese framework law, CITES violations might be both classified as an administrative offence or as a crime. As a crime, it is regulated under article 278 of the Portuguese penal code. Consequently, the discrepancy observed between the actual number of cases regarding the European eel (as reported to EU-TWIX) and the number of cases described in the ICNF database could be explained by a difference in the infraction classification and the consequent assignment to a different database (e.g., crime).

Mammals (including their parts and derivatives) represented 7.2% of all apprehensions, the more significant being primates and felines. Reptiles (snakes, turtles, iguanas, and some crocodiles) were apprehended in 116 cases (7%), while their parts and derivatives in 126 cases (7.6%) mostly intended to taxidermy. In the category corals, coral rock, shells, sand and molluscs, there were 4 reports (6.6%) on the illegal extraction and removal of sand., even if the legal outcome of those cases is often minimal, the costs to human life could be tremendous, as it was observed in 2001 were 59 lives were lost with the collapse of the Hintze Ribeiro Bridge.



**Figure 3.** Seized wildlife commodities in Portugal, between 2003 and 2019. Cases for which no information on the commodities was available (n=1,539 cases; 48.1%) were excluded from this statistical analysis. Fish, mammal and reptile categories comprehend both the animal specimen and its parts and derivatives. The bird category comprehends birds, bird eggs and nests. The medicinals category comprehends medicinal products including health and food supplements.

Following the official police report, an administrative decision was made. From the cases with administrative decision (n=1,811 cases; 56.6%), a fine was applied in 865 cases (27%), the prosecution was abandoned in 802 cases (25%) as these were dismissed, and an admonition was issued in 144 cases (4.5%) (Figure 4). For the cases where a fine was applied, 22 cases (2.5%) requested a review of the administrative penalty or appealed to the court. However, to these cases, preemptive measures such as specimen seizure (2 cases; 9.1%) and additional penalties – e.g., loss of specimens and publication of the decision (3 cases; 13.6%), were applied. Furthermore, in 78 other cases (2.4% of the cases analysed), preemptive measures were also applied, with concurring additional penalties in 41 cases (52.6% of these).



**Figure 4.** Administrative decision on the cases of wildlife seizures and environmental law violations recorded in Portugal, between 2003 and 2019.

Of note, for 1,391 cases (43.4%), no information on the administrative decision was available (Figure 3). This concerned 1,229 cases (88.3%) that were in initial contravention procedural stages – i.e., no procedural decision was yet made; and 162 cases (11.7%) for which there was no information regarding the procedural stage.

The extensive number of dismissed cases (802 cases; 25%) that led to an abandoning of the prosecution (Table 1) further emphasises the importance of a standardised infraction report to be used by all of the criminal police authorities, where all of the relevant information should be explicit and well documented. On the other hand, it is manifest that continuous training should be provided to the enforcement authorities, especially to the authorities who registered a 100% rate of dismissed cases (Porto municipal police and Lisbon city hall), to produce an effective response at this level, contributing to eliminate the sense of impunity that surrounds these infractions, the hiatus between occurrence and decision that these offences entail – which is also well documented in the literature and attributed to the paucity of resources, the inadequate regulatory framework, and the shortage of law enforcement agents (Dinerstein et al., 2007; McCusker, 2006; UNODC, 2016b, 2016a; WWF, 2012). All these factors need to be tackled in order to ensure significant change and effective prosecution.

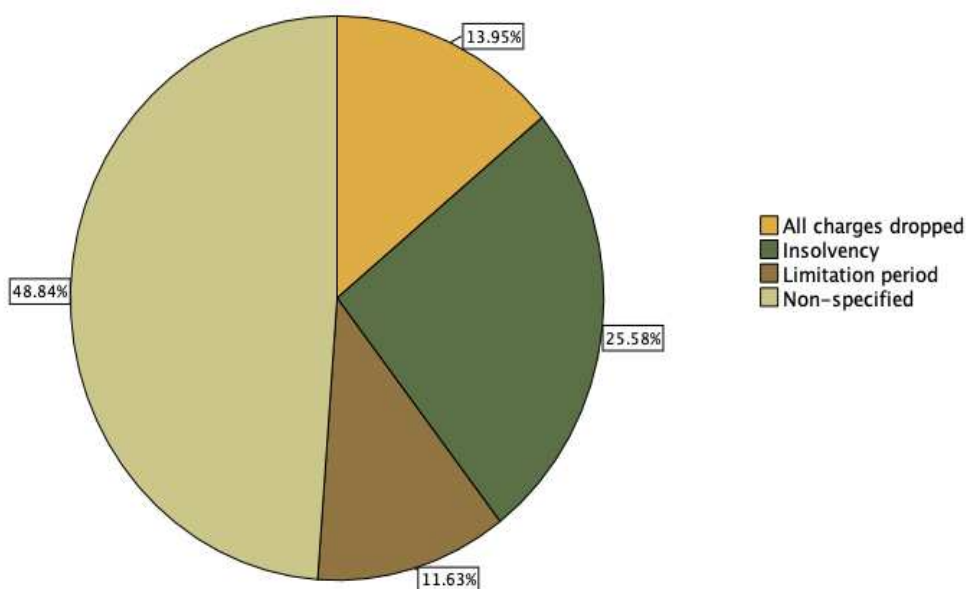


Moreover, upon the database analysis, it was possible to identify that the reason for the dismissal of the cases was not present. This could be crucial information to assist the understanding of why so many cases are being dismissed from the start (e.g., misapplication of the legislation, ill-conducted interlocutory stages of the proceedings), and consequently promote the development of strategies to improve these flaws.

**Table 1.** Number of cases of wildlife seizures and environmental law violations recorded in Portugal, between 2003 and 2019, with initial decision. ASAE: Food and Economic Security Authority; DGAIEC: General Directorate of Customs and Special Consumption Taxes; GNR: National Republican Guard; ICNB: Institute of Nature Conservation and Biodiversity; ICNF: Institute for Nature Conservation and Forests; PSP: Public Security Police.

Initial decision	Enforcement authority													
	GNR	PSP	DGAIEC	ICNF	Lisbon airport customs	ASAE	Public prosecutor	Porto airport customs	ICNB	Maritime police	Porto city hall	Porto municipal police	Judicial police	Lisbon city hall
Admonition	124 (6.1%)	13 (3.1%)	2 (0.6 %)	3 (1.3%)	1 (1.5%)	0	0	1 (7.7%)	0	0	0	0	0	0
Dismissed	505 (24.7%)	86 (20.2%)	108 (33.6%)	35 (15.1%)	5 (7.2%)	28 (58.3%)	5 (38.4%)	10 (76.9%)	7 (58.3%)	2 (20%)	3 (50%)	6 (100%)	1 (33.3%)	1 (100%)
Application of a fine	587 (28.7%)	71 (16.7%)	162 (50.5%)	31 (13.4%)	2 (2.9%)	5 (10.4%)	4 (30.8%)	1 (7.7%)	1 (8.33%)	0	1 (16.7%)	0	0	0
Not available	827 (40.5%)	255 (60%)	49 (15.3%)	163 (70.2%)	61 (88.4%)	15 (31.3%)	4 (30.8%)	1 (7.7%)	4 (33.3%)	8 (80%)	2 (33.3%)	0	2 (66.7%)	0

From the 1,811 cases (56.5%) with an administrative decision (i.e., cases with available information and not in the initial contravention procedural stages), 86 cases (4.7%) followed to a court trial, resulting in all charges dropped (12 cases; 14%), insolvency (22 cases; 25.6%), or limitation period (10 cases; 11.6%) (Figure 5). In 42 cases (48.8%), the decision was not specified – i.e., the decision was not accurately introduced into the database, but a mention of “court decision” confirms that it was made and the case closed. Once again, this result emphasises the importance of an accurate and thorough case report to allow the follow-up.



**Figure 5.** Court decision on the cases of wildlife seizures and environmental law violations recorded in Portugal, between 2003 and 2019.

In the 865 cases (27%) where a fine was applied (Figure 4), administrative fees were also due. However, for the calculation of the overall fine amount, the assignable administrative fees, the overall amount (i.e., the sum of both), and the total value paid. For 17 cases in which a fine was applied but the amount was not available, along with 3 cases with contradictory information, were excluded. As such, the total fine amount achieved for the remaining 845 cases was 967,670.34 euros, with a mean fine per case of 1,145.17 euros.

The total value for administrative fees was 58,368.41 euros, with a mean of administrative fees per case of 69.08 euros. The overall amount of fines and administrative fees applied was 1,026,038.75 euros. However, the amount paid was only 297,040.53 euros (28.9%). This expresses not only a financial loss but also an educational one, since the money that was not paid could be used to fund educational programs diffused across the communities as well as the training of the enforcement agents.

For 25 cases (3%), in which a fine was initially applied, the limitation period was over, and for that reason, there was an abandoning of prosecution (i.e., execution of the sanction applied was not carried out). However, there were 6 cases (24%) comprehended in the previous, even though the amount paid was present.

The limitation period is an important aspect to consider. When analysing the difference between the date of the official police report (date of the occurrence) and the date of computation of the case into the administrative system (two cases with conflicting information were not considered), it can be observed that for the majority of the cases (2,360; 73.7%), the year of the official police report and the year of computation into the administrative system was the same. However, for 11 cases (0.3%), it took 5 years for the data to be introduced into the administrative system, while for 7 cases (0.2%), it took 6 years, and for 3 cases (0.1%), it took 7 years. This presents a problem since, according to article 40 of the *Legal framework of environmental administrative offences 2019*, the limitation period for serious and very serious offences expires 5 years after the official police report. For light misdemeanours, the limitation period expires 3 years after the official police report, this presents a further challenge because it considerably reduces the possibility for these cases to be accurately persecuted (Assembleia da República, 2006). This evidence further supports a shortage of administrative personnel capable of managing the volume of cases.

## V. Conclusion and future perspectives

Illicit wildlife trade is a global issue. However, criminologists have long overlooked green crimes, making it difficult to find extensive relevant research on the numbers and patterns of the problem (Wyatt, 2009). Human-animal relationships are crucial and unavoidable. However, using those to generate profit through violent, forced, and exploitive encounters is appalling (Collard, 2013). In this context, Portugal is a source, transit and destination country for illegal wildlife trade (TRAFFIC, 2021), and as a CITES member, it has the responsibility to enforce and implement adequate legislation to address the problem in all of its aspects. This being said, the reality is entirely different, however very similar to other countries, in line with the findings of the state-of-the-art review conducted. As such, also the data herein presented supports the shortage of law enforcement agents and personnel dedicated to fight the issue. There is insufficient attention paid to the matter by the government and therefore limited funding.

From a total of 3,202 cases analysed between 2003 and 2019, we found that most seized commodities were birds, and for this reason, public awareness concerning protected bird species should be increased. Of note, there was a substantial difference between the fine amount that should have been paid (1,026,038.75 euros) and the amount effectively paid (297,040.53 euros). Not only denoting a financial loss but also an educational one, since the money that was not paid could be used to fund educational programs diffused across the communities and in the training of the enforcement agents.

Of greatest concern, there was a significant amount of unavailable and contradictory information as well as data gaps across multiple database categories. It was noticed that the different enforcement authorities did not use a standardised method for the data entry, further highlighting the need to educate police authorities for the correct and thorough recording of the infractions, which is paramount for the correct prosecution of the cases. For instance, all too often, it was observed that the infractions were erroneously categorized in what concerns the law to be applied, dictating an acquittal because the case was poorly drafted.

Portuguese legislation regarding the environment and wildlife protection is significant. However, this does not entail that its application is simple, unequivocal or even

sufficient. For instance, the same species is included in multiple legislative decrees, raising the question of which legislation should be applied. Depending on this, the fine amount and revenue distribution vary, so legal categorisation is determinant for the amounts involved. In this regard, legislation should be created and/or reviewed with a clear objective, which ultimately is the protection of wildlife. However, how can legislation be truthfully effective when it creates so many loopholes? How can these loopholes be counteracted when there are no resources available? To assist in these aspects, we highlight some key points that should be incorporated in the seizure reports and subsequently on the database: scientific name; conservation status; suitable/adequate legislation to be applied; ancestralism; country of origin; intent of the trade (e.g., hobbyists/collection, hunting, sale, personal use); the estimated value of the commodities on the legal or illegal markets; the location where the reports took place (e.g., airports, mail centres, private houses, markets and shops, maritime ports, roads or highways, fairs/exhibitions, zoological gardens, other locations); the destiny of the specimens. Understanding where and why the cases fall (i.e., the prosecution is abandoned) is paramount and urges improved, continuous training of the enforcement authorities to produce adequate interventions. In this sense, a specialised administrative team dedicated to data entry and analysis would be of uttermost importance to identify the existing gaps in the procedural composition and the reason(s) behind the early dismissing of such cases, enabling and providing an action plan to prevent such occurrences. Perhaps, going even further and advocating for establishing a task group comprised of elements from the different enforcement agencies focused on the investigation, inspection, and enforcement of environmental-related violations. Ultimately, these measures could contribute to an effective sanction of these offences (ensuring for capable legislation enforcement) and consequently eliminate the sense of impunity that surrounds these infractions.

## VI. Bibliography

- AFP. (2014). Cambodia seizes three tonnes of ivory in record haul. *The Guardian*.  
<http://www.theguardian.com/environment/2014/may/09/cambodia-seizes-three-tonnes-of-ivory-in-record-haul>
- Agnew, D. J., Pearce, J., Pramod, G., Peatman, T., Watson, R., Beddington, J. R., & Pitcher, T. J. (2009). Estimating the Worldwide Extent of Illegal Fishing. *PLoS ONE*, *4*(2), e4570. <https://doi.org/10.1371/journal.pone.0004570>
- Aguirre, A. A., Catherina, R., Frye, H., & Shelley, L. (2020). Illicit Wildlife Trade, Wet Markets, and COVID-19: Preventing Future Pandemics. *World Medical & Health Policy*, *12*(3), 256–265. <https://doi.org/10.1002/wmh3.348>
- Alemagi, D., & Kozak, R. A. (2010). Illegal logging in Cameroon: Causes and the path forward. *Forest Policy and Economics*, *12*(8), 554–561.  
<https://doi.org/10.1016/j.forpol.2010.07.008>
- Amado, M. (2019). *O papel da Guarda Nacional Republicana no combate à captura e comércio ilegal do meixão* [Academia Militar].  
[https://comum.rcaap.pt/bitstream/10400.26/30107/1/315\\_Amado\\_0%20papel%20da%20Guarda%20Nacional%20Republicana%20no%20combate%20%C3%A0%20captura%20e%20com%C3%A9rcio%20ilegal%20do%20meix%C3%A3o.pdf](https://comum.rcaap.pt/bitstream/10400.26/30107/1/315_Amado_0%20papel%20da%20Guarda%20Nacional%20Republicana%20no%20combate%20%C3%A0%20captura%20e%20com%C3%A9rcio%20ilegal%20do%20meix%C3%A3o.pdf)
- Anderson, L. (2017, February 15). Scotland has a hare coursing problem. Here's how we can stop it! *OneKind*. <https://www.onekind.scot/scotland-has-a-hare-coursing-problem-heres-how-to-stop-it/>

- Anderson, S. C., Flemming, J. M., Watson, R., & Lotze, H. K. (2011). Serial exploitation of global sea cucumber fisheries: Serial exploitation of sea cucumbers. *Fish and Fisheries*, 12(3), 317–339. <https://doi.org/10.1111/j.1467-2979.2010.00397.x>
- Assembleia da República. (1989). *Decreto-Lei 423/89, 1989-12-04*. Diário da República Eletrónico. <https://dre.pt/web/guest/pesquisa/-/search/550794/details/normal?q=Decreto-Lei+n.%C2%BA%20423%2F89>
- Assembleia da República. (2006). *Lei n.º 50/2006, de 29 de agosto*. [http://www.pgdlisboa.pt/leis/lei\\_mostra\\_articulado.php?nid=1356&tabela=leis&so\\_miolo=](http://www.pgdlisboa.pt/leis/lei_mostra_articulado.php?nid=1356&tabela=leis&so_miolo=)
- Barstow, M. (2018). *Pterocarpus erinaceus*. IUCN Red List of Threatened Species. <https://www.iucnredlist.org/species/62027797/62027800>
- Battista, W., Romero-Canyas, R., Smith, S. L., Fraire, J., Efron, M., Larson-Konar, D., & Fujita, R. (2018). Behavior Change Interventions to Reduce Illegal Fishing. *Frontiers in Marine Science*, 5, 403. <https://doi.org/10.3389/fmars.2018.00403>
- Biggs, D., Courchamp, F., Martin, R., & Possingham, H. P. (2013). Legal Trade of Africa's Rhino Horns. *Science*, 339(6123), 1038–1039. <https://doi.org/10.1126/science.1229998>
- BirdLife International. (2015, March 31). *Carduelis carduelis*. IUCN Red List of Threatened Species. <https://www.iucnredlist.org/species/103764950/60281782>
- BirdLife International. (2018, August 7). *IUCN Red List of Threatened Species: Psittacus erithacus*. IUCN Red List of Threatened Species. <https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22724813A129879439.en>
- Blanc, J. (2008). *Loxodonta africana*. IUCN Red List of Threatened Species. <https://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T12392A3339343.en>



- Boakye, M. K. (2018). Influence of ethnicity on cultural use of pangolins in Ghana and its implications on their conservation. *Ethnobiology and Conservation*.  
<https://doi.org/10.15451/ec2018-10-7.13-1-18>
- Borsig, L., Wang, L., Cavalcante, M. C. M., Cardilo-Reis, L., Ferreira, P. L., Mourão, P. A. S., Esko, J. D., & Pavão, M. S. G. (2007). Selectin Blocking Activity of a Fucosylated Chondroitin Sulfate Glycosaminoglycan from Sea Cucumber: EFFECT ON TUMOR METASTASIS AND NEUTROPHIL RECRUITMENT. *Journal of Biological Chemistry*, 282(20), 14984–14991. <https://doi.org/10.1074/jbc.M610560200>
- Bowcott, O. (2010, June 23). Northern Ireland bans hare coursing. *The Guardian*.  
<https://www.theguardian.com/uk/2010/jun/23/northern-ireland-bans-hare-coursing>
- Bowman, M., Davies, P., & Redgwell, C. (2010). The Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere. In *Lyster's International Wildlife Law* (2nd ed., pp. 241–261). Cambridge University Press.  
<https://doi.org/10.1017/CBO9780511975301>
- Brack, D. (2003). Illegal logging and the illegal trade in forest and timber products. *International Forestry Review*, 5(3), 195–198.  
<https://doi.org/10.1505/IFOR.5.3.195.19148>
- Brack, D., & Hayman, G. (2002). *The Nature and Control of Environmental Black Markets*. 21.
- Brandis, K. J., Meagher, P. J. B., Tong, L. J., Shaw, M., Mazumder, D., Gadd, P., & Ramp, D. (2018). Novel detection of provenance in the illegal wildlife trade using elemental data. *Scientific Reports*, 8(1), 15380. <https://doi.org/10.1038/s41598-018-33786-0>

- Bronner, S. J. (2007). Hare Coursing and the Ethics of Tradition. *Folk Life*, 46(1), 7–38.  
<https://doi.org/10.1179/flk.2007.46.1.7>
- Brown, A. A., Dean, A. J., Possingham, H., & Biggs, D. (2019). The role of animal welfare values in the rhino horn trade debate. *Conservation Science and Practice*, 1(11).  
<https://doi.org/10.1111/csp2.104>
- Burgess, G., & Broad, S. (2020). Evolving Evaluation: Exploring new measures to assess the impact of end-market interventions to address harmful wildlife trade. *TRAFFIC Bulletin*, 32(2). <https://www.traffic.org/site/assets/files/13362/evolving-evaluation.pdf>
- Canby, P. (2017). China and the Closing of the Ivory Trade. *The New Yorker*.  
<https://www.newyorker.com/news/news-desk/china-and-the-closing-of-the-ivory-trade>
- Cardador, L., Tella, J., Anadón, J., Abellán, P., & Carrete, M. (2019). The European trade ban on wild birds reduced invasion risks. *Conservation Letters*, 12.  
<https://doi.org/10.1111/conl.12631>
- Cardeñosa, D., Gollock, M. J., & Chapman, D. D. (2019). Development and application of a novel real-time polymerase chain reaction assay to detect illegal trade of the European eel ( *ANGUILLA ANGUILLA* ). *Conservation Science and Practice*, 1(5), e39.  
<https://doi.org/10.1111/csp2.39>
- Carleton, C., Hambrey, J., Govan, H., Medley, P., & Kinch, J. (2013). *Effective management of sea cucumber fisheries and the beche-de-mer trade in Melanesia*. 19.
- Carmona, R., Domezain, A., García-Gallego, M., Hernando, J. A., Rodríguez, F., & Ruiz-Rejón, M. (Eds.). (2009). *Biology, Conservation and Sustainable Development of Sturgeons*. Springer Netherlands. <https://doi.org/10.1007/978-1-4020-8437-9>

- Carr, L. A., Stier, A. C., Fietz, K., Montero, I., Gallagher, A. J., & Bruno, J. F. (2013). Illegal shark fishing in the Galápagos Marine Reserve. *Marine Policy, 39*, 317–321.  
<https://doi.org/10.1016/j.marpol.2012.12.005>
- Challender, D., & Waterman, C. (2017). *Implementation of CITES Decisions 17.239 b) and 17.240 on Pangolins (Manis spp.)*.  
<https://www.cites.org/sites/default/files/eng/com/sc/69/E-SC69-57-A.pdf>
- Chapsos, I., & Hamilton, S. (2019). Illegal fishing and fisheries crime as a transnational organized crime in Indonesia. *Trends in Organized Crime, 22*(3), 255–273.  
<https://doi.org/10.1007/s12117-018-9329-8>
- Charitonidou, M., Stara, K., Kougioumoutzis, K., & Halley, J. M. (2019). Implications of salep collection for the conservation of the Elder-flowered orchid (*Dactylorhiza sambucina*) in Epirus, Greece. *Journal of Biological Research-Thessaloniki, 26*(1), 18. <https://doi.org/10.1186/s40709-019-0110-1>
- Choo, P.-S. (2008). The Philippines: A hotspot of sea cucumber fisheries in Asia. *FAO Fisheries and Aquaculture Technical Paper*, 119–140.
- Choo, P.-S. (2018). *Fisheries, trade and utilization of sea cucumbers in Malaysia*. 11.
- Chou, H. W. (2018). *China's ivory auction market: A comprehensive analysis of legislation, historical data and market survey results*. TRAFFIC.  
[https://wwfeu.awsassets.panda.org/downloads/chinas\\_ivory\\_auction\\_market\\_9\\_25.pdf](https://wwfeu.awsassets.panda.org/downloads/chinas_ivory_auction_market_9_25.pdf)
- CITES. (2016). *Closure of domestic markets for elephant ivory*. Seventeenth meeting of the Conference of the Parties, Johannesburg.  
<https://cites.org/sites/default/files/eng/cop/17/WorkingDocs/E-CoP17-57-02.pdf>

CITES. (2020). *Appendices I, II and III*.

<https://cites.org/sites/default/files/eng/app/2020/E-Appendices-2020-08-28.pdf>

Collard, R.-C. M. S. (2013). *Animal traffic: Making, remaking and unmaking commodities in global live wildlife trade* [University of British Columbia].

<https://doi.org/10.14288/1.0165692>

Collis, M. (2019). *Significant conservation wins for key species at world's largest wildlife trade conference*. IFAW. <https://www.ifaw.org/eu/news/cites-conservation-wins>

Correia, M. J., Costa, J. L., Antunes, C., De Leo, G., & Domingos, I. (2018). The decline in recruitment of the European eel: New insights from a 40-year-long time-series in the Minho estuary (Portugal). *ICES Journal of Marine Science*, 75(6), 1975–1983.

<https://doi.org/10.1093/icesjms/fsy073>

Daut, E. F., Brightsmith, D. J., Mendoza, A. P., Puhakka, L., & Peterson, M. J. (2015). Illegal domestic bird trade and the role of export quotas in Peru. *Journal for Nature Conservation*, 27, 44–53. <https://doi.org/10.1016/j.jnc.2015.06.005>

de Klemm, C. (1993). Guidelines for Legislation to Implement CITES. *IUCN Environmental Policy and Law Paper*, 26, x + 107 pp.

Dehnen-Schmutz, K., Touza, J., Perrings, C., & Williamson, M. (2007). The Horticultural Trade and Ornamental Plant Invasions in Britain. *Conservation Biology*, 21(1), 224–231. <https://doi.org/10.1111/j.1523-1739.2006.00538.x>

Delegation to Thailand and to Myanmar / Burma (EU Delegations and Offices) & Directorate-General for International Cooperation and Development (European Commission). (2019). *Larger than tigerS Inputs for a strategic approach to biodiversity conservation in asia—Greater Mekong report*.

<https://op.europa.eu/en/publication-detail/-/publication/580e4392-0344-11e9-adde-01aa75ed71a1/language-en#>

- Delibes-Mateos, M., Ferreras, P., & Villafuerte, R. (2009). European rabbit population trends and associated factors: A review of the situation in the Iberian Peninsula. *Mammal Review*, 39(2), 124–140. <https://doi.org/10.1111/j.1365-2907.2009.00140.x>
- Dickson, B., Hutton, J., & Adams, W. M. (2009). *Recreational Hunting, Conservation and Rural Livelihoods: Science and Practice*. Blackwell Publishing Ltd.  
<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.456.6238&rep=rep1&type=pdf>
- Dinerstein, E., Loucks, C., Wikramanayake, E., Ginsberg, J., Sanderson, E., Seidensticker, J., Forrest, J., Bryja, G., Heydlauff, A., Klenzendorf, S., Leimgruber, P., Mills, J., O'Brien, T. G., Shrestha, M., Simons, R., & Songer, M. (2007). The Fate of Wild Tigers. *BioScience*, 57(6), 508–514. <https://doi.org/10.1641/B570608>
- Donlan, C. J., Wilcox, C., Luque, G. M., & Gelcich, S. (2020). Estimating illegal fishing from enforcement officers. *Scientific Reports*, 10(1), 12478.  
<https://doi.org/10.1038/s41598-020-69311-5>
- Doumbouya, A., Camara, O. T., Mamie, J., Intchama, J. F., Jarra, A., Ceesay, S., Guèye, A., Ndiaye, D., Beibou, E., Padilla, A., & Belhabib, D. (2017). Assessing the Effectiveness of Monitoring Control and Surveillance of Illegal Fishing: The Case of West Africa. *Frontiers in Marine Science*, 4. <https://doi.org/10.3389/fmars.2017.00050>
- Dumenu, W. K. (2019). Assessing the impact of felling/export ban and CITES designation on exploitation of African rosewood (*Pterocarpus erinaceus*). *Biological Conservation*, 236, 124–133. <https://doi.org/10.1016/j.biocon.2019.05.044>

- Dumenu, W. K., & Bandoh, W. N. (2016). *Exploitation of African rosewood (Pterocarpus erinaceus) in Ghana*. 32, 15.
- Ehrenfeld, D. (2003). *Globalisation: Effects on Biodiversity, Environment and Society*. 1(1), 99–111.
- EIA. (2019). *Illegal trade seizures: Large-scale elephant ivory seizures*. Environmental Investigation Agency. <https://eia-international.org/wildlife/wildlife-trade-maps/large-scale-elephant-ivory-seizures/>
- Eliason, S. (2012). From the King's deer to a capitalist commodity: A social historical analysis of the poaching law. *International Journal of Comparative and Applied Criminal Justice*, 36(2), 133–148. <https://doi.org/10.1080/01924036.2012.669912>
- Ellis, R. (2005). *Tiger bone & rhino horn: The destruction of wildlife for traditional Chinese medicine* (Vol. 43). Island Press.  
<http://choicereviews.org/review/10.5860/CHOICE.43-2835>
- Engler, M., & Parry-Jones, R. (2007). *Opportunity or threat: The role of the European Union in global wildlife trade*. TRAFFIC Europe.  
<https://d2ouvy59p0dg6k.cloudfront.net/downloads/opportunityorthreat.pdf>
- Fay, M. F. (2015). *Undocumented trade in species of Orchidaceae: Examples from Asia, the eastern Mediterranean region and Africa*. Twenty-second meeting of the Plants Committee, Tbilisi (Georgia).  
<https://cites.org/sites/default/files/eng/com/pc/22/Inf/E-PC22-Inf-06.pdf>
- Fay, M. F. (2018). Orchid conservation: How can we meet the challenges in the twenty-first century? *Botanical Studies*, 59(1), 16. <https://doi.org/10.1186/s40529-018-0232-z>

- Ferreira, C., Rodrigues, T., Leitão, M., Paupério, J., Gonçalves, D., & Alves, P. C. (2012). *Gestão de recursos cinegéticos no arquipélago dos Açores—O Coelho-bravo*. CIBIO-UP e Direção Regional dos Recursos Florestais. [http://drrf-sraa.azores.gov.pt/areas/cinegetica/Documents/Livro\\_O\\_Coelho\\_bravo\\_2012.pdf](http://drrf-sraa.azores.gov.pt/areas/cinegetica/Documents/Livro_O_Coelho_bravo_2012.pdf)
- Findley, L. (2010). *Totoaba macdonaldi*. The IUCN Red List of Threatened Species. <https://dx.doi.org/10.2305/IUCN.UK.2010-3.RLTS.T22003A9346099.en>
- Flothmann, S., von Kistowski, K., Dolan, E., Lee, E., Meere, F., & Album, G. (2010). Closing Loopholes: Getting Illegal Fishing Under Control. *Science*, *328*(5983), 1235–1236. <https://doi.org/10.1126/science.1190245>
- Frank, E. G., & Wilcove, D. S. (2019). Long delays in banning trade in threatened species. *Science*, *363*(6428), 686–688. <https://doi.org/10.1126/science.aav4013>
- Free, C. M., Jensen, O. P., & Mendsaikhan, B. (2015). A Mixed-Method Approach for Quantifying Illegal Fishing and Its Impact on an Endangered Fish Species. *PLOS ONE*, *10*(12), e0143960. <https://doi.org/10.1371/journal.pone.0143960>
- Gao, Y., Stoner, K. J., Lee, A. T. L., & Clark, S. G. (2016). Rhino horn trade in China: An analysis of the art and antiques market. *Biological Conservation*, *201*, 343–347. <https://doi.org/10.1016/j.biocon.2016.08.001>
- Global Canopy. (2019). *Annual report and accounts for the year to March 2019*. <https://globalcanopy.org/wp-content/uploads/2020/11/AnnualReportandAccounts2018-19.pdf>
- Globescan. (2018). *Consumer Demand for Rhino, Elephant, and Pangolin Products in Vietnam* (p. 149). <https://www.traffic.org/site/assets/files/11703/ussv-quant-report-saving-elephants-pangolins-and-rhinos-20181105.pdf>

- Guarda Nacional Republicana. (2020). *GNR STRATEGY 2025, a Strategy focusing on people*. [https://www.gnr.pt/InstrumentosGestao/estrategia\\_2025.pdf](https://www.gnr.pt/InstrumentosGestao/estrategia_2025.pdf)
- Hacklander, K., & Schai-Braun, S. (2019). *Lepus europaeus*. IUCN Red List of Threatened Species. <https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T41280A45187424.en>
- Haines, A. M., Elledge, D., Wilsing, L. K., Grabe, M., Barske, M. D., Burke, N., & Webb, S. L. (2012). Spatially explicit analysis of poaching activity as a conservation management tool. *Wildlife Society Bulletin*, *36*(4), 685–692. <https://doi.org/10.1002/wsb.194>
- Haken, J. (2011). *Transnational Crime In The Developing World* (p. 68). Global Financial Integrity. [https://www.gfintegrity.org/wp-content/uploads/2014/05/gfi\\_transnational\\_crime\\_high-res.pdf](https://www.gfintegrity.org/wp-content/uploads/2014/05/gfi_transnational_crime_high-res.pdf)
- Hansen, C. P., & Treue, T. (2008). Assessing illegal logging in Ghana. *International Forestry Review*, *10*(4), 573–590. <https://doi.org/10.1505/ifor.10.4.573>
- Hareide, N. R., Carlson, J., Clarke, M., Clarke, S., Ellis, J., Fordham, S., Fowler, S., Pinho, M., Raymakers, C., Serena, F., Seret, B., & Polti, S. (2007). *European shark fisheries: A preliminary investigation into fisheries, conversion factors, trade products, markets and management measures*. European Elasmobranch Association. [http://www.sasamaconsulting.com/jp/pdf/Hareide\\_2007.pdf](http://www.sasamaconsulting.com/jp/pdf/Hareide_2007.pdf)
- Harris, L., Gore, M., & Mills, M. (2019). Compliance with ivory trade regulations in the United Kingdom among traders. *Conservation Biology*, *33*(4), 906–916. <https://doi.org/10.1111/cobi.13277>
- Harris, R. (2016). *Moschus chrysogaster*. IUCN Red List of Threatened Species. <https://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T13895A61977139.en>



- Heinrich, S., Wittman, T. A., Ross, J. V., Shepherd, C. R., Challender, D. W. S., & Cassey, P. (2017). *A comprehensive summary of seizures and trafficking routes from 2010–2015*. 49.
- Hinsley, A., de Boer, H. J., Fay, M. F., Gale, S. W., Gardiner, L. M., Gunasekara, R. S., Kumar, P., Masters, S., Metusala, D., Roberts, D. L., Veldman, S., Wong, S., & Phelps, J. (2018). A review of the trade in orchids and its implications for conservation. *Botanical Journal of the Linnean Society*, *186*(4), 435–455.  
<https://doi.org/10.1093/botlinnean/box083>
- Homes, V. (Ed. ). (2004). *No Licence to Kill: The Population and Harvest of Musk Deer and Trade in Musk in the Russian Federation and Mongolia*. TRAFFIC Europe.  
[https://www.traffic.org/site/assets/files/4068/no\\_license\\_to\\_kill.pdf](https://www.traffic.org/site/assets/files/4068/no_license_to_kill.pdf)
- Ingram, D. J., Cronin, D. T., Challender, D. W. S., Venditti, D. M., & Gonder, M. K. (2019). Characterising trafficking and trade of pangolins in the Gulf of Guinea. *Global Ecology and Conservation*, *17*, e00576.  
<https://doi.org/10.1016/j.gecco.2019.e00576>
- Innes, J. (2010). Madagascar rosewood, illegal logging and the tropical timber trade. *Madagascar Conservation & Development*, *5*(1).  
<https://doi.org/10.4314/mcd.v5i1.57335>
- Iqbal, M. (2016). Predators become prey!, Can Indonesian raptors survive online bird trading? *BirdingASIA*, *25*, 30–35.
- Karesh, W. B., Cook, R. A., Bennett, E. L., & Newcomb, J. (2005). Wildlife Trade and Global Disease Emergence. *Emerging Infectious Diseases*, *11*(7), 3.

- Kelly, A. (2020). Welfare Implications for Hares, *Lepus timidus hibernicus*, Taken from the Wild for Licensed Hare Coursing in Ireland. *Animals*, *10*(1), 163.  
<https://doi.org/10.3390/ani10010163>
- Kerry, J. F., Boxer, B., Menendez, R., Cardin, B. L., Casey, R. P., Webb, J., Shaheen, J., Coons, C. A., Durbin, R. J., Udall, T., Lugar, R. G., Corker, B., Risch, J. E., Rubio, M., Inhofe, J. M., Demint, J., Carolina, S., Isakson, J., Barrasso, J., ... Danvers, W. C. (2012). *Ivory and insecurity: The global implications of poaching in Africa*. U.S. Government Printing Office. <https://www.govinfo.gov/content/pkg/CHRG-112shrg76689/html/CHRG-112shrg76689.htm>
- King, A. H. (2017). *Scent from the Garden of Paradise: Musk and the Medieval Islamic world*. Brill.
- Kiser, M. (2013, January 29). The Economics of Extinction: Africa's Elephants and Rhinos in Danger. *Newsweek*. <https://www.newsweek.com/economics-extinction-africas-elephants-and-rhinos-danger-63141>
- Koh, L. P., & Wilcove, D. S. (2007). Cashing in palm oil for conservation. *Nature*, *448*(7157), 993–994. <https://doi.org/10.1038/448993a>
- Kuemmerle, T., Chaskovskyy, O., Knorn, J., Radeloff, V. C., Kruhlov, I., Keeton, W. S., & Hostert, P. (2009). Forest cover change and illegal logging in the Ukrainian Carpathians in the transition period from 1988 to 2007. *Remote Sensing of Environment*, *113*(6), 1194–1207. <https://doi.org/10.1016/j.rse.2009.02.006>
- Lawson, S. (2010). *Illegal Logging and Related Trade: Indicators of the Global Response*. The Royal Institute of International Affairs.
- Li, X., Bleisch, W. V., & Jiang, X. (2016). Effects of Ethnic Settlements and Land Management Status on Species Distribution Patterns: A Case Study of Endangered

- Musk Deer (*Moschus spp.*) in Northwest Yunnan, China. *PLOS ONE*, *11*(5), e0155042. <https://doi.org/10.1371/journal.pone.0155042>
- Liu, H., Gale, S. W., Cheuk, M. L., & Fischer, G. A. (2019). Conservation impacts of commercial cultivation of endangered and overharvested plants. *Conservation Biology*, *33*(2), 288–299. <https://doi.org/10.1111/cobi.13216>
- Lo, C. (2020, September 24). Hong Kong customs seizes a tonne of pangolin scales in biggest haul of year so far. *South China Morning Post*. <https://www.scmp.com/news/hong-kong/law-and-crime/article/3102858/hong-kong-customs-seizes-tonne-pangolin-scales-biggest>
- Ludwig, A. (2008). Identification of Acipenseriformes species in trade. *Journal of Applied Ichthyology*, *24*(s1), 2–19. <https://doi.org/10.1111/j.1439-0426.2008.01085.x>
- Madden, K. K., Rozhon, G. C., & Dwyer, J. F. (2019). Conservation Letter: Raptor Persecution. *Journal of Raptor Research*, *53*(2), 230–233. <https://doi.org/10.3356/JRR-18-37>
- Margulies, J. D., Bullough, L., Hinsley, A., Ingram, D. J., Cowell, C., Goettsch, B., Klitgård, B., Lavorgna, A., Sinovas, P., & Phelps, J. (2019). Illegal wildlife trade and the persistence of “plant blindness”. *PLANTS, PEOPLE, PLANET*, *1*(3), 173–182. <https://doi.org/10.1002/ppp3.10053>
- Mayer, C.-H. (2019). *Combating Wildlife Crime in South Africa: Using Gelatine Lifters for Forensic Trace Recovery*. Springer International Publishing. <https://doi.org/10.1007/978-3-030-05891-3>
- McCusker, R. (2006). Transnational crime in the Pacific Islands: Real or apparent danger? *Australian Institute of Criminology*, *308*, 1–6.

Meijer, W., Bergin, D., Wu, D., Yang, C., & Kritski, E. (2019). *Demand under the Ban – China Ivory Consumption Research*. WWF; GlobeScan.

Menon, R. (2019). *What is REDD+?* The Forest Carbon Partnership Facility.

<https://www.forestcarbonpartnership.org/what-redd>

Milliken, T. (2004). *Domestic Ivory Markets: Where they are and how they work*. Thirteenth meeting of the Conference of the Parties. <https://www.traffic.org/about-us/working-with-cites/>

Milliken, T., & Shaw, J. (2012). *The South Africa-Viet Nam rhino horn trade nexus: A deadly combination of institutional lapses, corrupt wildlife industry professionals, and Asian crime syndicates*. TRAFFIC.

Mou, J., Li, Q., Qi, X., & Yang, J. (2018). Structural comparison, antioxidant and anti-inflammatory properties of fucosylated chondroitin sulfate of three edible sea cucumbers. *Carbohydrate Polymers*, 185, 41–47.

<https://doi.org/10.1016/j.carbpol.2018.01.017>

Musing, L., Harris, L., Williams, A., Parry-Jones, R., van Uhm, D., & Wyatt, T. (2019). *Corruption and wildlife crime: A focus on caviar trade*. A TRAFFIC, WWF, U4 ACRC, Utrecht University, and Northumbria University report.

Musing, L., Shiraishi, H., Crook, V., Gollock, M., Levy, E., & Kecse-Nagy, K. (2018).

*Implementation of the CITES Appendix II listing of European Eel *Anguilla anguilla**.

Mwale, M., Dalton, D. L., Jansen, R., De Bruyn, M., Pietersen, D., Mokgokong, P. S., & Kotzé, A. (2017). Forensic application of DNA barcoding for identification of illegally traded African pangolin scales. *Genome*, 60(3), 272–284.

<https://doi.org/10.1139/gen-2016-0144>

- Nellemann, C., Henriksen, R., Kreilhuber, A., Stewart, D., Kotsovou, M., Raxter, P., Mrema, E., & Barrat, S. (Eds.). (2016). *The rise of environmental crime: A growing threat to natural resources, peace, development and security*. United Nations Environment Programme.
- Nellemann, C. & UNEP. (2012). *Green carbon, black trade: Illegal logging, tax fraud and laundering in the world's tropical forests. A rapid response assessment*.
- Neo, H. M. (2009). *Smuggling wildlife: From eggs in a bra to geckos in underwear*. Phys.Org. <https://phys.org/news/2009-08-smuggling-wildlife-eggs-bra-geckos.html>
- Nielsen, E. E., Cariani, A., Aoidh, E. M., Maes, G. E., Milano, I., Ogden, R., Taylor, M., Hemmer-Hansen, J., Babbucci, M., Bargelloni, L., Bekkevold, D., Diopere, E., Grenfell, L., Helyar, S., Limborg, M. T., Martinsohn, J. T., McEwing, R., Panitz, F., Patarnello, T., ... FishPopTrace consortium. (2012). Gene-associated markers provide tools for tackling illegal fishing and false eco-certification. *Nature Communications*, 3(1), 851. <https://doi.org/10.1038/ncomms1845>
- Nielsen, E. E., Cariani, A., Aoidh, E. M., Maes, G. E., Milano, I., Ogden, R., Taylor, M., Hemmer-Hansen, J., Babbucci, M., Bargelloni, L., Bekkevold, D., Diopere, E., Grenfell, L., Helyar, S., Limborg, M. T., Martinsohn, J. T., McEwing, R., Panitz, F., Patarnello, T., ... FishPopTrace consortium. (2012). Gene-associated markers provide tools for tackling illegal fishing and false eco-certification. *Nature Communications*, 3(1), 851. <https://doi.org/10.1038/ncomms1845>
- Novoa, A., Le Roux, J. J., Richardson, D. M., & Wilson, J. R. U. (2017). Level of environmental threat posed by horticultural trade in Cactaceae: Horticultural cactus trade. *Conservation Biology*, 31(5), 1066–1075. <https://doi.org/10.1111/cobi.12892>

- Nuwer, R. L. (2020, February 11). *Illegal Trade in Pangolins Keeps Growing as Criminal Networks Expand*. <https://www.nationalgeographic.com/>.  
<https://www.nationalgeographic.com/animals/2020/02/pangolin-scale-trade-shipments-growing/>
- Nyambayar, B., Mix, H., & Tsytsulina, K. (2015). *Moschus moschiferus*. IUCN Red List of Threatened Species. <https://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T13897A61977573.en>
- OECD. (2012). *Illegal Trade in Environmentally Sensitive Goods*. OECD Publishing.  
[https://read.oecd-ilibrary.org/trade/illegal-trade-in-environmentally-sensitive-goods\\_9789264174238-en](https://read.oecd-ilibrary.org/trade/illegal-trade-in-environmentally-sensitive-goods_9789264174238-en)
- OJ. (2003). Council Regulation (EC) No 1185/2003 of 26 June 2003 on the removal of fins of sharks on board vessels. *Official Journal of the European Union*, L 167/1.  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003R1185&from=EN>
- Olsson, A. (2013). *An Action Plan to Save One of the World's Strangest Mammals*. [www.conservacion.org](http://www.conservacion.org). <https://www.conservacion.org/blog/an-action-plan-to-save-one-of-the-world-s-strangest-mammals>
- Österblom, H., Constable, A., & Fukumi, S. (2011). Illegal fishing and the organized crime analogy. *Trends in Ecology & Evolution*, 26(6), 261–262.  
<https://doi.org/10.1016/j.tree.2011.03.017>
- Panter, C., Atkinson, E., & White, R. (2019). Quantifying the global legal trade in live CITES-listed raptors and owls for commercial purposes over a 40-year period. *Avocetta*, 43(1), 23–36. <https://doi.org/10.30456/AVO.2019104>

Passas, N. (2003). Cross-border Crime and the Interface between Legal and Illegal Actors.

*Security Journal*, 16(1), 19–37. <https://doi.org/10.1057/palgrave.sj.8340123>

Patel, E. R. (2009). Logging of Rare Rosewood and Palisandre (*Dalbergia* spp.) within

Marojejy National Park, Madagascar. *Madagascar Conservation & Development*,

2(1). <https://doi.org/10.4314/mcd.v2i1.44124>

Pearl, M. C. (2004). Wildlife Trade: Threat to Global Health. *EcoHealth*, 1(2), 111–112.

<https://doi.org/10.1007/s10393-004-0081-y>

Persoon, G. A. (2007). *Agarwood: The life of a wounded tree*. 2.

Persoon, G. A., & van Beek, H. H. (2008). Growing 'The Wood of The Gods': Agarwood

Production in Southeast Asia. In D. J. Snelder & R. D. Lasco (Eds.), *Smallholder Tree Growing for Rural Development and Environmental Services* (Vol. 5, pp. 245–262).

Springer Netherlands. [https://doi.org/10.1007/978-1-4020-8261-0\\_12](https://doi.org/10.1007/978-1-4020-8261-0_12)

Phelps, J., & Webb, E. L. (2015). "Invisible" wildlife trades: Southeast Asia's undocumented

illegal trade in wild ornamental plants. *Biological Conservation*, 186, 296–305.

<https://doi.org/10.1016/j.biocon.2015.03.030>

Pike, C., Crook, V., & Gollock, M. (2020). *Anguilla anguilla*. IUCN Red List of Threatened

Species. <https://www.iucnredlist.org/en>

Pires, S. F. (2012). The illegal parrot trade: A literature review. *Global Crime*, 13(3), 176–

190. <https://doi.org/10.1080/17440572.2012.700180>

Pires, S. F., Schneider, J. L., & Herrera, M. (2016). Organized crime or crime that is

organized? The parrot trade in the neotropics. *Trends in Organized Crime*, 19(1),

4–20. <https://doi.org/10.1007/s12117-015-9259-7>

- Pramod, G., Nakamura, K., Pitcher, T. J., & Delagran, L. (2014). Estimates of illegal and unreported fish in seafood imports to the USA. *Marine Policy*, *48*, 102–113.  
<https://doi.org/10.1016/j.marpol.2014.03.019>
- Purcell, S. W. (2014). Value, Market Preferences and Trade of Beche-De-Mer from Pacific Island Sea Cucumbers. *PLoS ONE*, *9*(4), e95075.  
<https://doi.org/10.1371/journal.pone.0095075>
- Rao, M., Zaw, T., Htun, S., & Myint, T. (2011). Hunting for a Living: Wildlife Trade, Rural Livelihoods and Declining Wildlife in the Hkakaborazi National Park, North Myanmar. *Environmental Management*, *48*(1), 158–167.  
<https://doi.org/10.1007/s00267-011-9662-z>
- Requeira, R. F. S., & Bernard, E. (2012). Wildlife sinks: Quantifying the impact of illegal bird trade in street markets in Brazil. *Biological Conservation*, *149*(1), 16–22.  
<https://doi.org/10.1016/j.biocon.2012.02.009>
- Reid, N., Magee, C., & Montgomery, I. W. (2010). Integrating field sports, hare population management and conservation. *Acta Theriologica*, *55*(1), 61–71.  
<https://doi.org/10.4098/j.at.0001-7051.030.2009>
- Ribeiro, J., Reino, L., Schindler, S., Strubbe, D., Vall-Ilosera, M., Araújo, M. B., Capinha, C., Carrete, M., Mazzoni, S., Monteiro, M., Moreira, F., Rocha, R., Tella, J. L., Vaz, A. S., Vicente, J., & Nuno, A. (2019). Trends in legal and illegal trade of wild birds: A global assessment based on expert knowledge. *Biodiversity and Conservation*, *28*(12), 3343–3369. <https://doi.org/10.1007/s10531-019-01825-5>
- Richards, J. L., Sheng, V., Yi, C. W., Ying, C. L., Ting, N. S., Sadovy, Y., & Baker, D. (2020). Prevalence of critically endangered European eel ( *Anguilla anguilla* ) in Hong Kong



supermarkets. *Science Advances*, 6(10), eaay0317.

<https://doi.org/10.1126/sciadv.aay0317>

Ríos-Saldaña, C. A., Delibes-Mateos, M., Castro, F., Martínez, E., Vargas, J. M., Cooke, B. D., & Villafuerte, R. (2013). Control of the European rabbit in central Spain. *European Journal of Wildlife Research*, 59(4), 573–580. <https://doi.org/10.1007/s10344-013-0707-x>

Roe, D., Mulliken, T., Milledge, S., Mremi, J., Mosha, S., & Grieg-Gran, M. (2002). *Making a Killing or Making a Living: Wildlife Trade, Trade Controls and Rural Livelihoods*. IIED.

Rosen, G. E., & Smith, K. F. (2010). Summarizing the Evidence on the International Trade in Illegal Wildlife. *EcoHealth*, 7(1), 24–32. <https://doi.org/10.1007/s10393-010-0317-y>

Rosen, T. (2020). *The Evolving War on Illegal Wildlife Trade*. International Institute for Sustainable Development. <https://www.iisd.org/system/files/2020-10/still-one-earth-wildlife-trade.pdf>

Rubino, E. C., & Pienaar, E. F. (2020). Rhinoceros ownership and attitudes towards legalization of global horn trade within South Africa's private wildlife sector. *Oryx*, 54(2), 244–251. <https://doi.org/10.1017/S0030605318000030>

Sánchez-Mercado, A., Asmussen, M., Rodríguez, J. P., Moran, L., Cardozo-Urdaneta, A., & Morales, L. I. (2020). Illegal trade of the Psittacidae in Venezuela. *Oryx*, 54(1), 77–83. <https://doi.org/10.1017/S003060531700120X>

Santana-Garçon, J., Fordham, S., & Fowler, S. (2012). Blue shark *Prionace glauca* fin-to-carcass-mass ratios in Spain and implications for finning ban enforcement.

*Journal of Fish Biology*, 80(5), 1895–1903. <https://doi.org/10.1111/j.1095->

8649.2012.03233.x

Schneider, J. L. (2012). *Sold into Extinction: The Global Trade in Endangered Species*. ABC-CLIO, LLC.

Schuurman, D., & Lowry II, P. (2009). The Madagascar rosewood massacre. *Madagascar Conservation & Development*, 4(2). <https://doi.org/10.4314/mcd.v4i2.48649>

Shiffman, D. S., & Hueter, R. E. (2017). A United States shark fin ban would undermine sustainable shark fisheries. *Marine Policy*, 85, 138–140.

<https://doi.org/10.1016/j.marpol.2017.08.026>

Shrestha, M. N. (1998). Animal welfare in the musk deer. *Applied Animal Behaviour Science*, 59(1–3), 245–250. [https://doi.org/10.1016/S0168-1591\(98\)00139-7](https://doi.org/10.1016/S0168-1591(98)00139-7)

Shukla, M., Joshi, B. D., Kumar, V. P., Thakur, M., Mehta, A. K., Sathyakumar, S., & Goyal, S. P. (2019). Species dilemma of musk deer (*Moschus* spp) in India: Molecular data on cytochrome *c* oxidase I suggests distinct genetic lineage in Uttarakhand compared to other *Moschus* species. *Animal Biotechnology*, 30(3), 193–201.

<https://doi.org/10.1080/10495398.2018.1521822>

Siegel, L. J. (2010). *Criminology: The Core, Fourth Edition* (4th ed.). Wadsworth Publishing.

Siegel, L. J. (2016). *Criminology: The Core* (6th ed.). Cengage Learning.

Singh, P. B., Saud, P., Cram, D., Mainali, K., Thapa, A., Chhetri, N. B., Poudyal, L. P., Baral, H. S., & Jiang, Z. (2019). Ecological correlates of Himalayan musk deer *Moschus leucogaster*. *Ecology and Evolution*, 9(1), 4–18.

<https://doi.org/10.1002/ece3.4435>

- Siriwat, P., & Nijman, V. (2018). Online media seizure reports: A tool to monitor CITES implementation in regulating the international rosewood trade. *Forest Policy and Economics, 97*, 67–72. <https://doi.org/10.1016/j.forpol.2018.09.004>
- Siriwat, P., & Nijman, V. (2020). Wildlife trade shifts from brick-and-mortar markets to virtual marketplaces: A case study of birds of prey trade in Thailand. *Journal of Asia-Pacific Biodiversity, 13*(3), 454–461.  
<https://doi.org/10.1016/j.japb.2020.03.012>
- Smith, A. T., & Johnston, C. H. (2019). *Lepus timidus*. IUCN Red List of Threatened Species.  
<https://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T11791A45177198.en>
- Smith, J., Obidzinski, K., Subarudi, S., & Suramenggala, I. (2003). Illegal logging, collusive corruption and fragmented governments in Kalimantan, Indonesia. *International Forestry Review, 5*(3), 293–302. <https://doi.org/10.1505/IFOR.5.3.293.19138>
- Smith, K. F., Behrens, M., Schloegel, L. M., Marano, N., Burgiel, S., & Daszak, P. (2009). Reducing the Risks of the Wildlife Trade. *Science, 324*(5927), 594–595.  
<https://doi.org/10.1126/science.1174460>
- Sollund, R. (2017). Legal and Illegal Theriocide of Trafficked Animals. In J. Maher, H. Pierpoint, & P. Beirne (Eds.), *The Palgrave International Handbook of Animal Abuse Studies* (pp. 453–474). Palgrave Macmillan UK. [https://doi.org/10.1057/978-1-137-43183-7\\_21](https://doi.org/10.1057/978-1-137-43183-7_21)
- South, N., & Wyatt, T. (2011). *Comparing Illicit Trades in Wildlife and Drugs: An Exploratory Study*. 26. <https://doi.org/10.1080/01639625.2010.483162>
- Standard, T. (2020). *Customs seized HK\$18 million worth of fish air bladders*. The Standard. [http://www.thestandard.com.hk/breaking-news/section/4/158312/Customs-seized-HK\\$18-million-worth-of-fish-air-](http://www.thestandard.com.hk/breaking-news/section/4/158312/Customs-seized-HK$18-million-worth-of-fish-air-)

bladders?fbclid=IwAR16EZwAjAuqZOeZUeuS\_MnSPfQTOB40mXNKllas3zzWh1t2mQ  
lmiQHefDA

Subedi, A., Kunwar, B., Choi, Y., Dai, Y., van Andel, T., Chaudhary, R. P., de Boer, H. J., & Gravendeel, B. (2013). Collection and trade of wild-harvested orchids in Nepal. *Journal of Ethnobiology and Ethnomedicine*, 9(1), 64.

<https://doi.org/10.1186/1746-4269-9-64>

Swift, C. (2019). *Hare coursing gangs are terrorising the countryside* | *The Spectator*.

<https://www.spectator.co.uk/article/hare-coursing-gangs-are-terrorising-the-countryside>

Tacconi, L. (Ed.). (2008). *Illegal logging: Law enforcement, livelihoods, and the timber trade* (Pbk. ed). Earthscan.

Tan, K. T., Lee, K. T., Mohamed, A. R., & Bhatia, S. (2009). Palm oil: Addressing issues and towards sustainable development. *Renewable and Sustainable Energy Reviews*, 13(2), 420–427. <https://doi.org/10.1016/j.rser.2007.10.001>

Timmins, R. J., & Duckworth, J. W. (2015). *Moschus leucogaster*. IUCN Red List of Threatened Species. <https://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T13901A61977764.en>

Toral-Granda, V., Lovatelli, A., Vasconcellos, M., & Food and Agriculture Organization of the United Nations (Eds.). (2008). *Sea cucumbers: A global review of fisheries and trade*. Food and Agriculture Organization of the United Nations.

TRAFFIC. (2019). *Understanding ETI: An introduction and overview of the elephant trade information system analysis*.

<https://www.traffic.org/site/assets/files/3817/understanding-etis-vfinal-web.pdf>

- TRAFFIC. (2020). *An overview of seizures of CITES-listed wildlife in the European Union*.  
<https://www.traffic.org/site/assets/files/12745/eu-seizures-report-2020-final-web.pdf>
- TRAFFIC. (2021). *An overview of seizures of CITES-listed wildlife in the European Union*.  
<https://www.traffic.org/publications/reports/an-overview-of-seizures-of-cites-listed-wildlife-in-the-eu-in-2019/>
- UK Government. (2004). *Hunting Act 2004* [Text]. Statute Law Database.  
<http://www.legislation.gov.uk/ukpga/2004/37/contents>
- UK Government. (2020). *Prime Minister's speech at the UN High-Level summit on biodiversity: 30 September 2020*. GOV.UK.  
<https://www.gov.uk/government/speeches/preserving-global-biodiversity>
- Underwood, F. M., Burn, R. W., & Milliken, T. (2013). Dissecting the Illegal Ivory Trade: An Analysis of Ivory Seizures Data. *PLoS ONE*, 8(10), e76539.  
<https://doi.org/10.1371/journal.pone.0076539>
- UNEP-WCMC. (2018). *EU Wildlife Trade 2016: Analysis of the European Union and candidate countries' annual reports to CITES 2016*. European Commission.  
[https://ec.europa.eu/environment/cites/pdf/SRG%2083-10%20EU%20Wildlife%20Trade%202016\\_Analysis%20of%20European%20Union%20and%20candidate%20countries%20annual%20reports%20to%20CITES%202016\\_draft.pdf](https://ec.europa.eu/environment/cites/pdf/SRG%2083-10%20EU%20Wildlife%20Trade%202016_Analysis%20of%20European%20Union%20and%20candidate%20countries%20annual%20reports%20to%20CITES%202016_draft.pdf)
- United Nations. (2015). *Draft Doha Declaration on integrating crime prevention and criminal justice into the wider United Nations agenda to address social and economic challenges and to promote the rule of law at the national and international levels, and public participation*. 13.

[https://www.unodc.org/documents/congress/Documentation/ACONF222\\_L6\\_e\\_V1502120.pdf](https://www.unodc.org/documents/congress/Documentation/ACONF222_L6_e_V1502120.pdf)

UNODC. (2016a). *Transnational Organized Crime in the Pacific: A Threat Assessment*.

[https://www.unodc.org/documents/southeastasiaandpacific/Publications/2016/2016.09.16\\_TOCTA\\_Pacific\\_web.pdf](https://www.unodc.org/documents/southeastasiaandpacific/Publications/2016/2016.09.16_TOCTA_Pacific_web.pdf)

UNODC. (2016b). *World Wildlife Crime Report: Trafficking in protected species*. United Nations.

UNODC. (2020). *World Wildlife Crime Report 2020: Trafficking in Protected Species*.

[https://www.unodc.org/documents/data-and-analysis/wildlife/2020/World\\_Wildlife\\_Report\\_2020\\_9July.pdf](https://www.unodc.org/documents/data-and-analysis/wildlife/2020/World_Wildlife_Report_2020_9July.pdf)

van Uhm, D. P. (2016). *The Illegal Wildlife Trade: Inside the World of Poachers, Smugglers and Traders* (Vol. 15). Springer International Publishing.

<https://doi.org/10.1007/978-3-319-42129-2>

Vandergert, P., & Newell, J. (2003). Illegal logging in the Russian Far East and Siberia.

*International Forestry Review*, 5(3), 303–306.

<https://doi.org/10.1505/IFOR.5.3.303.19150>

Vijay, V., Pimm, S. L., Jenkins, C. N., & Smith, S. J. (2016). The Impacts of Oil Palm on Recent Deforestation and Biodiversity Loss. *PLOS ONE*, 11(7), e0159668.

<https://doi.org/10.1371/journal.pone.0159668>

Villafuerte, R., & Delibes-Mateos, M. (2019). *Oryctolagus cuniculus*. IUCN Red List of

Threatened Species. [https://dx.doi.org/10.2305/IUCN.UK.2019-](https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T41291A170619657.en)

[3.RLTS.T41291A170619657.en](https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T41291A170619657.en)

Wang, Y., & Harris, R. (2015a). *Moschus berezovskii*. IUCN Red List of Threatened Species.

<https://dx.doi.org/10.2305/IUCN.UK.2015-4.RLTS.T13894A61976926.en>

- Wang, Y., & Harris, R. (2015b). *Moschus fuscus*. IUCN Red List of Threatened Species.  
<https://dx.doi.org/10.2305/IUCN.UK.2015-4.RLTS.T13896A61977357.en>
- Wang, Z.-F., Cao, H.-L., Cai, C.-X., & Wang, Z.-M. (2020). Using genetic markers to identify the origin of illegally traded agarwood-producing *Aquilaria sinensis* trees. *Global Ecology and Conservation*, *22*, e00958.  
<https://doi.org/10.1016/j.gecco.2020.e00958>
- Wasser, S. K., Joseph Clark, W., Drori, O., Stephen Kisamo, E., Mailand, C., Mutayoba, B., & Stephens, M. (2008). Combating the Illegal Trade in African Elephant Ivory with DNA Forensics: *Tracking the Illegal Ivory Trade*. *Conservation Biology*, *22*(4), 1065–1071. <https://doi.org/10.1111/j.1523-1739.2008.01012.x>
- Wasser, S. K., Shedlock, A. M., Comstock, K., Ostrander, E. A., Mutayoba, B., & Stephens, M. (2004). Assigning African elephant DNA to geographic region of origin: Applications to the ivory trade. *Proceedings of the National Academy of Sciences*, *101*(41), 14847–14852. <https://doi.org/10.1073/pnas.0403170101>
- Williams, C., Tiwari, S. K., Goswami, V. R., de Silva, S., Kumar, A., Baskaran, N., Yoganand, K., & Menon, V. (2020). *Elephas maximus*. IUCN Red List of Threatened Species.  
<https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T7140A45818198.en>
- Wilson-Wilde, L. (2010). Wildlife crime: A global problem. *Forensic Science, Medicine, and Pathology*, *6*(3), 221–222. <https://doi.org/10.1007/s12024-010-9167-8>
- Wittig, T. (2016). IV. Poaching, Wildlife Trafficking and Organised Crime. *Whitehall Papers*, *86*(1), 77–101. <https://doi.org/10.1080/02681307.2016.1252127>
- World Bank Group. (2018). *Reducing Poaching, Reducing Trafficking, Reducing Demand* (p. 28). World Bank.

[https://www.thegef.org/sites/default/files/publications/GWPBrochureMay2018  
WEB.pdf](https://www.thegef.org/sites/default/files/publications/GWPBrochureMay2018WEB.pdf)

Wuertz, S., Gröper, B., Gessner, J., Krüger, T., Luckas, B., & Krüger, A. (2009). Identification of caviar from increasing global aquaculture production—Dietary capric acid as a labelling tool for CITES implementation in caviar trade. *Aquaculture*, *298*(1–2), 51–56. <https://doi.org/10.1016/j.aquaculture.2009.09.029>

WWF. (2012). *WWF Report: Fighting illicit wildlife trafficking: A consultation with governments*. WWF International.  
<https://www.traffic.org/site/assets/files/7455/dalberg-report-dec-2012.pdf>

WWF. (2018). *Stopping Elephant Ivory Demand*. World Wildlife Fund.  
<https://www.worldwildlife.org/initiatives/stopping-elephant-ivory-demand>

Wyatt, T. (2009). Exploring the organization of Russia Far East's illegal wildlife trade: Two case studies of the illegal fur and illegal falcon trades. *Global Crime*, *10*(1–2), 144–154. <https://doi.org/10.1080/17440570902783947>

Wyatt, T. (2014). The Russian Far East's illegal timber trade: An organized crime? *Crime, Law and Social Change*, *61*(1), 15–35. <https://doi.org/10.1007/s10611-013-9461-y>

Wyatt, T. (2016). Victimless venison? Deer poaching and black market meat in the UK. *Contemporary Justice Review*, *19*(2), 188–200.  
<https://doi.org/10.1080/10282580.2016.1169700>

Wylter, L. S., & Sheikh, P. A. (2013). *International Illegal Trade in Wildlife: Threats and U.S. Policy*. 26.

Xiao, Y. (2018). *China's Ivory Market after the Ivory Trade Ban in 2018*. TRAFFIC.  
<https://www.traffic.org/site/assets/files/11150/chinas-ivory-market-post-ban.pdf>



- Xu, L., Guan, J., Lau, W., & Xiao, Y. (2016). *An overview of pangolin trade in China* (p. 10).  
<https://www.traffic.org/site/assets/files/10569/pangolin-trade-in-china.pdf>
- Yin, Y., Jiao, L., Dong, M., Jiang, X., & Zhang, S. (2016). Wood Resources, Identification, and Utilization of Agarwood in China. In R. Mohamed (Ed.), *Agarwood* (pp. 21–38). Springer Singapore. [https://doi.org/10.1007/978-981-10-0833-7\\_2](https://doi.org/10.1007/978-981-10-0833-7_2)
- Yudha, D. S., Pratama, M. Z. M., & Eprilurahman, R. (2019). Antlers Characterization for Identification of Deer Species (Family Cervidae) in Indonesia. *Journal of Tropical Biodiversity and Biotechnology*, 4(3), 97. <https://doi.org/10.22146/jtbb.45667>
- Zhou, Y., Meng, X., Feng, J., Yang, Q., Feng, Z., Xia, L., & Bartoš, L. (2004). *Review of the distribution, status and conservation of musk deer in China*. 12.
- Zhou, Z.-M., Buesching, C. D., Macdonald, D. W., & Newman, C. (2020). China: Clamp down on violations of wildlife trade ban. *Nature*, 578(7794), 217–217.  
<https://doi.org/10.1038/d41586-020-00378-w>
- Zhou, Z.-M., Zhou, Y., Newman, C., & Macdonald, D. W. (2014). Scaling up pangolin protection in China. *Frontiers in Ecology and the Environment*, 12(2), 97–98.  
<https://doi.org/10.1890/14.WB.001>
- Zhu, A., & Zhu, G. (2020). Understanding China's wildlife markets: Trade and tradition in an age of pandemic. *World Development*, 136, 105108.  
<https://doi.org/10.1016/j.worlddev.2020.105108>