EFFACE

European Union Action to
Fight Environmental Crime

Qualitative and monetary analysis of the impacts of environmental crime: Overview

Deliverable 3.2a

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DISCLAIMER

ABSTRACT

The survey of data sources within earlier work within EFFACE showed that the data on environmental crime are usually highly dispersed with limited detailed data collations. The most likely sources of consolidated data are international institutions (such as Conventions and the EU). However, even here data are often limited. As a result it is not possible to provide a robust estimate of the overall impacts of environmental crime as a total figure. There are simply too many gaps for this to be done with any confidence. Therefore, it is important to focus on quantifying the impacts of environmental crime in areas where there are sufficient data for this to be done robustly and with confidence. As a result, the quantitative and monetary analysis has been undertaken for the following five subjects:

- The impacts of arson events
- The impacts of illegal wildlife trade in rhino and elephant
- The impacts of marine pollution
- The impacts of illegal WEEE shipments from the EU to China
- The impacts of illegal wildlife trade in Horsfieldii Tortoise

A common framework to guide data collection, analysis and presentation was agreed. This framework involved three analytical steps on the quantitative assessment of levels of illegal activity, the quantitative assessment of the impacts of that illegal activity and the economic valuation of the impacts of the illegal activity.

The results identified good examples of information that can be used to understand impacts of environmental crime. The most useful are good, coherent databases with information about the scale of illegal events (a fires database being a clear case). Another is the linking together of good data from different sources, such as that on illegal elephant and rhino poaching and that on population changes – thus enabling conclusions to be drawn on whether the criminal activity is affecting populations in the wild. Data from different types of sources can help paint a picture of different types of impacts (as seen with the waste shipment case).

The work had variable success in determining the quantitative impacts of environmental crime. Problems encountered in doing this have included:

- Barriers to determining what level of crime is occurring, where, trends, etc. In some cases there is poor recording of criminal events. However, in other cases it may be difficult to distinguish between legal and illegal activity.
- Information about impacts may prove difficult to move from anecdotal to quantitative.
- Where crime levels are known, the impacts from such crimes may be mixed with those from legal activities, so that distinguishing impacts is difficult.
- There is poor monitoring and recording of changes to environmental quality, health, etc., so that quantitative impacts of criminal activities are not known.

As a result, for much of the work here, assessments of quantitative impacts are limited to specific areas where there is sufficient data (or data of sufficient confidence) to provide those estimates.

The analyses in this study present different approaches to economic analysis. In some cases the quantitative information is insufficient to develop further economic assessments to any degree of confidence. Some used valuations of the natural environment (e.g. on natural capital loss due to poaching) or to health (e.g. for waste shipment). The fires case has sought to estimate the value of assets lost. Several cases have included information on the financial losses and benefits from those engaged in or affected by the illegal activity. In all cases, the economic analysis does not provide a total value for the impact of the type of environmental crime covered, but economic values for specific impacts.

ABBREVIATIONS

CITES	Convention on International Trade in Endangered Species
EA	Environment Agency
EFFACE	European Union Action to Fight Environmental Crime
EU	European Union
EUTR	European Union Timber Regulation
FTE	Full time equivalent
IQ	Intelligence quotient
IUU	Illegal, unreported and unregulated (fishing)
IWT	Illegal wildlife trade
MS	Member State
PAH	Polycyclic aromatic hydrocarbons
PBDE	Polybrominated diphenyl ethers
PCB	Polychlorinated Biphenol
PCDD/Fs	Polychlorinated dibenzo dioxins/furans
UNECE	United Nations Economic Commission for Europe
UNODC	United Nations Office on Drugs and Crime
WEEE	Waste Electrical and Electronic Equipment (Directive)
WP	Work Package

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1 Introduction

This deliverable is the conclusion of Tasks 2 and 3 of WP3 of EFFACE. The aim of WP3 is to understand the impacts (quantitative and monetary) of environmental crime. The purpose of the first task of WP3, Task 1, was to review and collect data on the extent and impact of different types of environmental crime. It did not produce estimates of the impact of environmental crime or otherwise quantify that impact. Rather it summarised the data sources available for different types of environmental crime and the type and extent of the data these sources contain. Task 2 was to draw on the available data and set out the quantitative impacts of environmental crime, while Task 3 was to set out the monetary impacts. This report describes the results of both the quantitative and monetary analysis. These are presented together as the monetary analysis often draws on the quantitative analysis.

The survey of data sources within Task 1 of WP3 of EFFACE showed that the data on environmental crime are usually highly dispersed with limited detailed data collations. The most likely sources of consolidated data are international institutions (such as Conventions and the EU). However, even here data are often limited. For many Conventions data collation is limited to those data reported by Parties and such data are often limited, of uncertain quality and with significant gaps. At EU level there has been limited data gathering on this issue (in contrast to other data sets on environmental quality and pressures).

While consolidated data sets are uncommon (e.g. that on fires is an exception), there are many examples of data on impacts in specific cases, such as for individual countries, individual instances, sites, etc. As a result it is not possible to provide a robust estimate of the overall impacts of environmental crime as a total figure. There are simply too many gaps for this to be done with any confidence. Even doing this for certain areas of environmental crime is problematic (particularly when the full range of potential impacts is considered). Therefore, it is important to focus on quantifying the impacts of environmental crime in areas where there are sufficient data for this to be done robustly and with confidence.

Following the examination of the data sets described in this deliverable, it was agreed that it would be most suitable for quantitative and economic analysis to be undertaken in selected areas given the availability of data. Thus the quantitative and monetary impact analysis of this WP should focus on those areas of environmental crime where there are likely to be sufficient data to perform such analysis and which could lead to robust conclusions. As a result, the quantitative and monetary analysis has been undertaken for the following five subjects:

- The impacts of arson events: D3.2b
- The impacts of Illegal wildlife trade in rhino and elephant: D3.2c
- The impacts of marine pollution: D3.2d
- The impacts of illegal WEEE shipments from the EU to China: D3.2e
- The impacts of illegal wildlife trade in Horsfieldii Tortoise: D3.2f

This overview report provides a short summary of the results of these analyses and some consolidating conclusions. The reader is referred to the more detailed analyses contained in these reports for further analysis.

2 Methodology

It was agreed that a common approach across the different subjects should be taken to help deliver results which were comparable. However, it is important to stress that the work undertaken in the project was neither the de novo collection of data on the impacts of specific types of environmental crime, nor the

collection of specific economic data. Were the work to have involved the collection of such raw data, a detailed common methodology for data collection may have been applicable. Instead, the research has involved the collation and analysis of data already collected for other purposes. Thus there is not a common method for data collection itself.

Instead, a common framework to guide data collection, analysis and presentation was agreed. This framework involved three analytical steps:

1. Quantitative assessment of levels of illegal activity: e.g.
    - Numbers of incidents
    - Different types of illegal activity
    - Timespan – changes over time
    - Variability between countries, etc.

2. Quantitative assessment of the impacts of that illegal activity: e.g.
    - Area impacted
    - Species/ecosystems impacted
    - Health impacts
    - Financial impacts

3. Economic valuation of the impacts of the illegal activity:
    - Monetisation of specific impacts from Step 2 (noting that not all impacts may be amenable to monetary analysis)

The research would conclude with conclusions including overall quantitative and economic assessments of the impacts of the illegal activity examined and comments on how good the link is between crime data and impact data.

Each of the sub-reports of this report contains sections providing details of the methodology used in the data collection and analysis. Most studies report issues with data availability or ability to interpret data. This is particularly so in separating illegal from legal activities, understanding specific impacts, including valuation of economic impacts of crime (i.e. the impact on economic activities such as economic growth, tourism, sales of particular products or destruction of goods and services that have a market value) and, in turn, having confidence to undertake economic valuation of impacts (i.e. the monetary valuation of all impacts related to environmental crime and not only at economic impacts or not only at monetary consequences).

3 Summary of the quantitative impacts of environmental crime

3.1 Introduction

This chapter provides a summary of the findings of the studies undertaken within this part of the EFFACE research. The findings are presented according to the three major sections of the analytical framework:

- Quantitative assessment of levels of illegal activity

- Quantitative assessment of the impacts of that illegal activity
- Economic valuation of the impacts of the illegal activity

3.1 Quantitative assessment of levels of illegal activity

Each of the analyses within the WP3 EFFACE research had a specific scope of illegal activity it examined. For some (such as that on illegal hunting of elephants and rhino), the scope of illegal activity is defined by the range of the species and the type of activity. For the study on illegal waste shipment between the EU and China, the particular geographic relationship limits the scope. In contrast, the study on marine pollution is more open-ended.

Arson events

The study of the impact of arsons noted that in order to understand the level of illegal activity, it is important not only to know the cause of individual fires, but their location, severity, etc.. Without this additional information, analysis of impacts is not possible. To improve the availability of information and to support the fire prevention activity in the EU, the Joint Research Centre (JRC) and Directorate General for the Environment (DG ENV) of the European Commission have developed and implemented the European Forest Fire Information System (EFFIS). This provides comparative data on the number, extent and causes of fires. This is summarised in Table 1 below, which focuses on five southern MS and shows considerable variability between MS and over time.

Therefore, **given the broad heterogeneity of the fire events, the existing literature on the impact evaluation of fires typically focuses on a case-study approach**. This seems to be the most effective strategy to gather detailed information regarding different level of damages in order to develop regional fire management measure to minimize negative economic, social and environmental impacts of fires.

Table 1. Number of arsons **in five Southern Member States over the last decade**

	ITALY	SPAIN	PORTUGAL	FRANCE	GREECE	**TOTAL**
Number of Arsons						
2003	6720	10123	8101	554		**25818**
2004	4823	8402	6657	355	290	**20527**
2005	3422	7867	5210	562	231	**17292**
2006	4238	8723	3212	455	180	**16808**
2007	8384	15168	2997	1345	724	**28618**
2008	4250	12123	9990	567	423	**27353**
2009	3251	5423	4234	352	196	**13456**
2010	2475	6702	6455	398	320	**16350**
2011	5296	7093	4478	575	312	**17754**
2012	5246	7656	5069	870	823	**19664**

Average	**4810.5**	**8928.2**	**5640,3**	**603,3**	**381,9**	**20364.2**
Total	**48105**	**89282**	**56403**	**6033**	**3819**	**203642**

Illegal poaching of elephant and rhino

The study of illegal poaching of elephant and rhino was able to use good data from CITES monitoring and a number of other specialist monitoring studies. These provide data for overall illegal activity and well as data by country and data over time. For example, there is the African Elephant Database, which is maintained by the IUCN/ Species Survival Commission (SSC) and the African Elephant Specialist Group (AfESG) which has produced five reports to date (i.e. 1995, 1998, 2002, 2007 and provisionally in 2015). For rhino, the relatively low number of rhino and their earlier near extinction has led to meticulous monitoring and statistics. It is important to note that here the data are on animals killed, which closely matches illegal events. The findings for elephant are **Africa lost a total of 100,000 elephants to poaching, that could have provided legal income for African countries**.

The trends have been very different in different regions of Africa. While in South Africa nearly no population loss occurred, the population losses were substantial in Central Africa. For Rhino, the data for four countries show:

- South Africa: For 2006-2014 3,827 Rhinos were poached which reduced the overall population growth but did not lead to a reduced population. Only in 2013 and 2014 (more than a 1.000 animals per year) the overall poaching was close to the level where a population decrease could be expected.
- Namibia: Only five animals were poached from 2006-2012 which did not lead to any reduction in population.
- Kenya: 101 animals were poached between 2006-2012 which reduced the increase in population but did not lead to a population decrease.
- Zimbabwe: between 2006-2012, 378 animals were poached. The population decreased during that time by 67 animals or 8% of the population.

Marine pollution

The study on marine pollution examined data on incidents in Europe's regional seas. There are data on oil incidents, discharges, shipping incidents, etc.. However, it is difficult to identify specific instances of environmental crime as opposed to legal activities or accidents. Therefore, the research on quantification of marine pollution has been limited. The work includes information from all of Europe's regional seas, but comparative analysis is problematic due to the diversity of data sources.

E-waste

The e-waste study found that quantifying the illegal export of e-waste from the EU (to China) is especially challenging as there is very little clear information upon which estimates can be based. There are data on the amounts of e-waste generated in the EU and on the amounts imported into China and also estimates of overall illegal e-waste exported from the EU. Overall, **the study estimated that that for 2005 and 2012 respectively around 0.74 and 1.16 million tonnes of e-waste have been imported in China from the EU**. However, because of uncertainties in the data, the study also proposed a 'minimum China import scenario' and a 'maximum China import scenario'.

The e-waste study, therefore, provides an overall estimate of the quantity of illegally moved waste. It was, however, unable to quantify the number of specific illegal activities or actors. **The data do suggest an increase over time and this would reflect huge increases in available EEE in recent years in the EU** (thus reflecting increased opportunity). The study did not examine variability across the EU Member

States. This is problematic in any case as much e-waste is moved within the EU to major ports before shipment, so determining particular roles is highly problematic.

Illegal wildlife trade in Horsfieldii Tortoise

The study on the impacts of illegal wildlife trade in Horsfieldii Tortoise found it difficult to have confidence in understanding the levels of illegal activity as importation of this species into the EU is legal from farmed sources (so simply looking at import figures is not appropriate). There are three potential avenues of illegal activity:

1. **It is likely that many more individuals are involved in the trade than are actually reported in CITES data**.

2. It is suspected that the improper use of CITES labels that differentiate between wild and captive bred specimens, results in a much higher number of wild caught specimens existing in trade than the data reported would suggest.

3. The vast geography in which the species exists is compounded by the fact that several range states are not Party to CITES which makes it likely that many individual tortoises are illegally transported and smuggled through non-Party countries or countries with less stringent environmental and enforcement standards.

However, the study concluded that it is possible to use available information to make estimates about the proportion of illegal trade as compared to the legal trade. For example, one source suggested in 2000 that the annual illegal export was around 7,000 tortoises from Uzbekistan, 25,000 from Kazakhstan and 40,000 in total from Central Asian Countries, but the Uzbek government gave a much higher figure in 2007 of 35,000 not accounted for in the trade statistics. The study concluded that in Uzbekistan at least 50-75% of the Horsfieldiis labelled as captive bred are actually illegally wild caught, equivalent to 20,000 to 30,000 animals per year.

3.2 Quantitative assessment of the impacts of that illegal activity

Introduction

Arson events

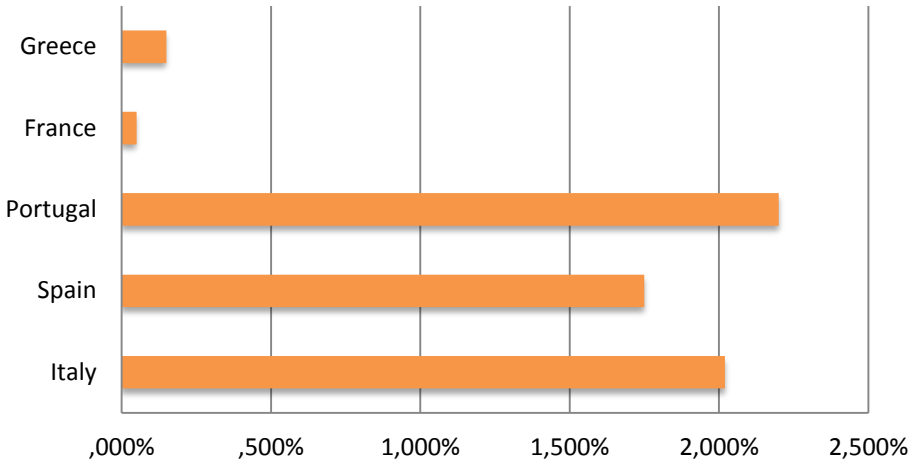
The extent of environmental, social, and economic impacts of arsons is a function of several factors such as the size, intensity, location and causes (deliberate and negligence) of the event. Thus the environmental impact was assessed using the following indicator:

$$\text{Environmental Impact (ha)} = \text{Average Burnt Area per fire (ha)} * \text{Number of arsons} \quad (1)$$

This was further combined with the land use type (for example, forest vs. non forest) and for forest characteristics (i.e. protected areas, national parks and so on).

The following Figure 1 shows how much of five MS total surface has been burnt due to arsons during the last decade. Overall, Portugal has been the most affected country considering the ratio (2.02%) between burnt area (201,210.9 ha) and total surface area (9,209,000 ha), followed by Italy (2.02%), Spain (1.75%) and, to a lesser extent, by Greece (0.15%) and France (0.05%).

Fig. 1. The evironmental impact by country total surface



	Italy	Spain	Portugal	France	Greece
Burnt Area/Total Surface	2,020%	1,750%	2,200%	,050%	,150%

Source: authors' elaboration from European Fire Database

The environmental impact of arsons is particularly problematic for protected areas. Impacts include those on biodiversity, tourism, those living in and near the areas (property and life) and others. In Italy, in 2012, there were a total of 696 arsons that have covered about 11826 hectares of protected areas. During 2012, the most affected regions in terms of protected area burnt by arsons were Campania and Puglia.

The loss of human lives is the worst impact arising from forest fires. However, other issues concerning health are related to injury and pathologies affecting fire-fighters and people with respiratory problems. However, data limitations were found which meant that only deaths could be determined and these only in Italy. Between 2003-2012 the loss of human lives amount to 55 people and 442 injured. The most dramatic season was in 2007 with 23 deaths and 26 injured.

Illegal poaching of elephant and rhino

The information given above on levels of illegal activities was presented in terms of animals killed. Therefore, there is no need to repeat the figures here as these demonstrate quantitative impacts on those animals. In some cases the levels of loss of individual have become unsustainable for population maintenance. For elephants, in 2012, the killing rate was 7.4% compared to an average annual population growth for elephants of 5% (in the absence of illegal killing), which means that more animals are being killed than are being born. Thus, the criminal activity is reducing populations.

For rhino, from 1990 to 2007 poaching was limited and populations recovered. However, illegal poaching is increasing. The total population of white and black rhino in Africa increased by 17.5% between 2007 and 2012 with an average rate of population growth of 4.9% per. This growth rate decreased from 2010 to 2012 to 0.9% per annum. Thus poaching is not yet reducing rhino populations, but it is slowing recovery.

E-waste

The e-waste study found the illegal export of e-waste from the EU to China has resulted in the release of large amounts of contaminants in the local environment, such as heavy metals, PBDEs, PCDD/Fs, PCBs, CFCs and PAHs. It has caused among others high concentrations of heavy metals such as lead, cadmium, mercury, copper and zinc in the surrounding air, dust, soils, sediments and plants. The potential annual emissions of some environmental contaminants were estimated, e.g. it was for instance estimated that respectively 10 and 16 tonnes of PCBs from EU e-waste were potentially released in the Chinese environment in 2005 and 2012. Given the complexity of the e-waste problem, the report presents only

select data as to the environmental impacts of the e-waste crime. The focus was mostly on the environmental impacts (i.e. pollution levels) related to heavy metals and lead and zinc in particular. And mostly studies investigating or results regarding adverse environmental impacts in Guiyi and Taizhou, as the most representative locations for informal e-waste recycling, are being referred to.

The environmental impacts lead to economic losses and additional costs. For example, due to local contamination of soils and water resources, drinking water needs to be brought in from other regions. It is estimated that in Guiyu, with a population of about 150,000 in the year 2013, establishing a piped water supply resulted in annual additional cost of around €1.6 million.

The e-waste study found that illegal exports from the EU are resulting in increasing incidences of chronic disease in China, threatening not just workers but also current residents of e-waste recycling areas and adjacent regions and future generations. Illegal exports from the EU result (through the informal recycling and dumping) in high prevalence of skin, gastric, respiratory, hematic, neurological, prenatal, natal and infant diseases in China. Select scientific studies (in China) show associations between exposure to e-waste and physical health outcomes such as:

- decreased lung function (i.e. lower forced vital capacity);
- decreased physical growth of children (i.e. lower weight, height and body-mass index);
- reduced reproductive health (i.e. increases in spontaneous abortions, stillbirths, and premature births, and reduced birth weights and birth lengths);
- changes in cellular expression and function (i.e. increased DNA damage).

Negative associations were also shown for blood lead levels and IQ in children. Studies of the impacts in these areas of China do not address local biodiversity impacts, if any.

For China as a whole it is conservatively estimated that around 81,300 children (58,000-93,000) born in the period 1995-2013 have been affected in their neurological development as a result of e-waste exposure. It was subsequently estimated that these children in China lost about 97,560 IQ points (69,600-111,600) as a result of informal e-waste recycling and dumping activities. This amounts to an average reduction of intelligence of 1.2 points per child.

Illegal wildlife trade in Horsfieldii Tortoise

The study on the impacts of illegal wildlife trade in Horsfieldii Tortoise noted that data limitations on population and replacement rate are a significant obstacle to calculate efforts the rate of extinction and sustainability of current trade levels. Horsfieldii mature slowly and have modest reproduction capacities and so are particularly susceptible to collapse in the presence of illegal trade. Moreover, it is estimated that 95% of Horsfieldiis that enter the pet trade die within a year, thus harvest rates may be significantly higher than those corresponding to that which is documented in CITES trade data. A further problem is that information on population density is limited and outdated, partly due the species' extensive range and reclusive habits and also to its perceived insignificance compared to a flagship or keystone species such as a panda, rhino or elephant. Having said this, the study did find evidence of significant declines in population levels in China, Kazakhstan and Uzbekistan and cases where the species had disappeared altogether. Illegal capture and trade is likely to be a major contributing factor, but other factors such as land-use change cannot be ruled out.

It is also worth noting that the value of the Horsfieldii tortoise for the overall ecosystem cannot be valued properly. It is not a keystone species and particular existence on the Central Asian steppes is not well understood in terms of its role within this ecosystem. The study did look into existing estimates for the value of the turtles and tortoises to ecosystems more generally but found there to be few studies and not applicable to the case.

3.3 Economic valuation of the impacts of the illegal activity

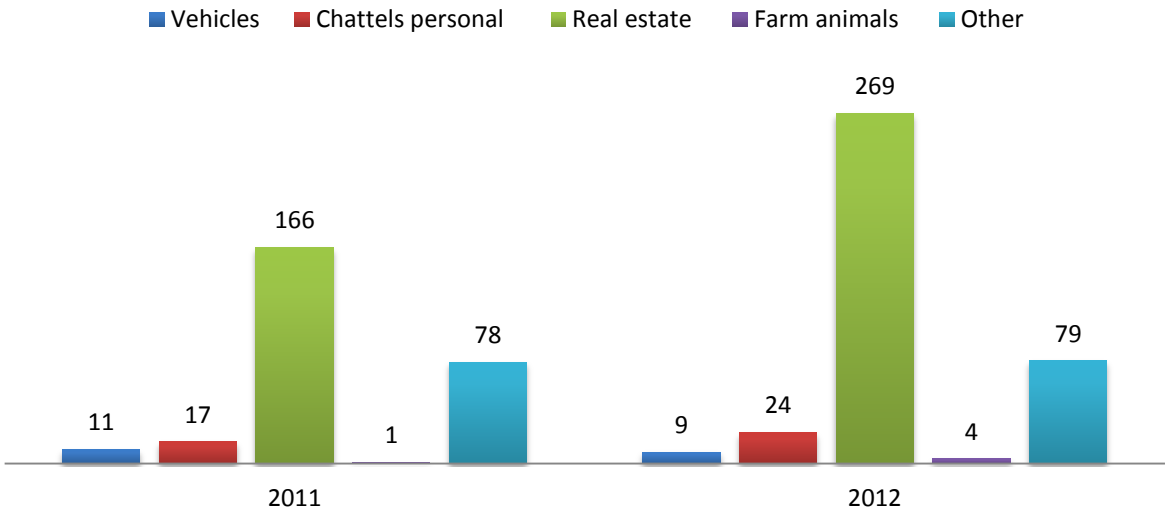
Introduction

This section summarises the findings on the economic valuation of the impacts of the illegal activities studied. It is important to note that for one study area (marine pollution), this proved problematic to determine and for the other areas there were issues for which there were insufficient data to perform an economic analysis. This was typically the case for biodiversity impacts, but also explains why some areas (e.g. tourism) could be analysed for some types of crime (e.g. poaching of elephants), but not others (e.g. arson events).

Arson events

The total impact of fires includes fire extinguishing costs, environmental damage and external damage to physical assets (e.g. infrastructures, building, etc.) in terms of reconstruction costs, etc. The study on arsons focused the economic analysis on direct costs associated with fire fighting and the loss of income due to the destruction of human physical assets in the surrounding areas. To quantify the material impact of fires based on the factors which have been recorded (e.g. there is not an estimated of losses to tourism, etc.), different categories of asset were considered: vehicles, material assets, real estate and farm animals. These economic impacts are summarised in figure 2 below (chattels being personal possessions).

Fig. 2. Economic and Material Impacts (2011-2012)



Illegal poaching of elephant and rhino

The study of the impacts of illegal poaching on elephant and rhino looked at the economic impact through two aspects of income provided by the ecosystem with elephants and rhinos:

- If the poaching does not lead to reduced numbers of the species, the societal loss is valued by estimating the alternative legal income that the host society could reap from the animals through tourism income, if they would not be poached.

- If the poaching reaches a level that leads to a reduction of the population, the loss is valued as a loss of natural capital. The wildlife is the wealth of the source countries on which basis they can attract wildlife tourism and the associated annual income from it.

The following tables 2-3 summarise these economic impacts for each type of animal. Overall the poaching of rhinos and elephants causes significant damage to African economies both by taking away legal present

income opportunities for African economies but also by reducing the natural capital on which all future income opportunities are based.

Table 2. Economic value lost due to elephant poaching

	Africa
Total population of Elephants in Africa 2010	500,000
Number of elephants poached 2010-2012	100,000
Lost potential legal income per Elephant	€22,331 - €31,264
Total loss of potential legal income 2010-2012	**€ 2.23 billion – € 3.12 billion**
Total loss of population 2010-2012	25.000 (5% of population)
Value of 1% population loss	€ 2,4 billion to € 3,6 billion
Total loss of natural capital 2010-2012	**€ 12 billion to € 18 billion**
Total economic loss per year	**€ 4,7 billion to € 7 billion**

Table 3. Economic value lost due to rhino poaching

	South Africa	**Namibia**	**Kenya**	**Zimbabwe**
Total population of rhinos 2012	20.954	2214 (2010)	914	792
Number of rhinos poached 2006-2014	3.827	5 (2006-2011)	101 (2006-2012)	378 (2006-2012)
Lost potential legal income per rhinos	€ 312.640	€ 312.640	€ 312.640	€ 312.640
Total loss of potential legal income per year	**€133 million**	**€0.26 million**	**€4.5 million**	**€16.9 million**
Total loss of population 2010-2012	0	0	0	67 (8%)
Value of 1% population loss	€790-1,180 million	€37- 56 million	€150 - 230 million	€45- 68 million
Total loss of natural capital 2006-2012	0	0	0	€360-544 million
Total loss of natural capital per year	**0**	**0**	**0**	**€51-76 million**
Total economic loss per year	**€133 million**	**€0.26 million**	**€4.5 million**	**€68 - 93 million**

The economic losses caused by rhino poaching are much smaller than the losses caused by elephants mainly due to the much higher occurrence of elephant poaching and, except for Zimbabwe, rhino poaching does not yet exceed the natural growth of population. The estimates only cover a small part of the overall societal costs of rhino and elephant poaching. The illegal trade does cause other costs which cannot be valued.

E-waste

The e-waste study estimated that the 2.98 million tonnes of illegally exported e-waste from the EU in 2012 correspond roughly with €31.2 million to €37.5 million loss in income to the EU e-waste recycling industry. If one looks at the e-waste exports to China only (1.16 million tonnes in 2012), the EU recycling industry is estimated to have lost €12.2 million to €14.6 million in profits in 2012. Assuming that the average intrinsic value of WEEE (i.e. income available to the recycling business) is about €300 per tonne, the economic value lost to the EU as a result of illegal exports to China is roughly estimated at €348 million for 2012 only. The economic value lost to the EU as a result of all illegal exports out of the EU is estimated at €892 million for 2012.

As to the impact on jobs, the illegal export of e-waste from the EU in 2012 is estimated to represent a potential loss of about 38,000 FTE recycling jobs in the EU. Assuming a typical multiplier of 2, these direct recycling jobs would result in another 38,000 indirect and induced jobs, for a total of 76,000 jobs. The illegal export to China in particular is estimated to represent a potential loss of circa 14,900 FTE jobs in the industry and another 14,900 indirect and induced jobs, for a total of 29,800 jobs. A loss of 14,900 FTE jobs goes along with an estimated loss of economic value added of around €780 million. Though this figure needs to be treated with caution due to data availability and quality issues, it is indicative of the significance of losses in economic terms. It should also be noted that the assessment of FTE jobs lost does not mean a total net loss of jobs in society as some people will have alternative jobs available.

Table 4 provides an overview of the estimated economic impacts for the EU.

Table 4: Overview of estimated economic impacts in the EU for 2012

Loss in profits for the EU recycling industry	Arising from illegal EU exports to China		€ 12.2m - € 14.6m	
	Arising from total illegal EU exports		€ 31.2m - € 37.5m	
Lost economic value to the EU	Arising from illegal EU exports to China		€ 348m	
	Arising from total illegal EU exports		€ 892m	
Potential job loss in the EU (FTE)	Arising from illegal EU exports to China	*Direct jobs*	14,900	29,800
		Indirect and induced jobs	14,900	
	Arising from total illegal EU exports	*Direct jobs*	38,000	76,000
		Indirect and induced jobs	38,000	

Some of the health impacts in China arising from illegal e-waste shipments (and informal recycling and dumping in particular) have direct economic costs and others can usefully be represented by economic or monetary values to help communicate the importance of preventive and remedial action. A monetary valuation of the impacts on children's IQ might include an assessment of: opportunity costs in terms of *lost productivity* (i.e. decreased current value of expected lifetime revenues); *direct resource educational costs* related with compensatory education; opportunity costs of *lost income during remedial compensatory education*; *medical treatment costs*; and, *disutility* resulting from human development disabilities. Given

time and resource constraints and limited availability of or access to Chinese data, it was not possible within the context of this project to estimate or calculate these direct costs and opportunity costs.

Illegal wildlife trade in Horsfieldii Tortoise

The study on the impacts of illegal wildlife trade in Horsfieldii Tortoise was unable to monetise impacts of illegal trade in wild population due to difficulties in determining changes to those populations, the cause of changes (i.e. the contributing factor of illegal trade) and the role of the species in the ecosystem (as noted above). There is certainly an economic value from the trade. However, while a *Horsfieldii* tortoise is sold as a pet for between $25 and $100 USD, the price paid to exporters/collectors in source countries was estimated in 1997 at €0.45 per individual. It is clear that the majority of the earnings stay with the importing country and pet dealership. Thus the overall value of the pet trade for the source countries is small. Overall countries are exporting around 80,000 live animals and this provides an overall value of less than € 40,000.

4 Conclusions

4.1 Introduction

The case studies make a series of conclusions and recommendations. Many of these are highly specific to the individual case study. However, others have wider consequences to addressing environmental crime and it is these which are summarised here. Given the focus of the case studies it is not surprising that many of recommendations are addressed to EU level institutions.

This conclusions section begins by examining some of the lessons learned from undertaking the work.

4.2 Limitations on assessing quantitative impacts

The work undertaken in this study has had variable success in determining the quantitative impacts of environmental crime. Problems encountered in doing this have included:

- Barriers to determining what level of crime is occurring, where, trends, etc. In some cases there is poor recording of criminal events. However, in other cases it may be difficult to distinguish between legal and illegal activity.
- Information about impacts may prove difficult to move from anecdotal to quantitative.
- Where crime levels are known, the impacts from such crimes may be mixed with those from legal activities, so that distinguishing impacts is difficult.
- There is poor monitoring and recording of changes to environmental quality, health, etc., so that quantitative impacts of criminal activities are not known.

As a result, for much of the work here, assessments of quantitative impacts are limited to specific areas where there is sufficient data (or data of sufficient confidence) to provide those estimates.

It is important to note, however, that the work has also identified good examples of information that can be used to understand impacts of environmental crime. The most useful are good, coherent databases with information about the scale of illegal events – the fires database being a clear case. Another is the linking together of good data from different sources, such as that on illegal elephant and rhino poaching and that on population changes – thus enabling conclusions to be drawn on whether the criminal activity is affecting populations in the wild. Data from different types of sources can help paint a picture of different types of impacts (as seen with the waste shipment case).

However, overall while the work has identified a wide range of different quantitative impacts of environmental crime, there are frustrations in working towards any systematic overview of such impacts.

4.3 Impacts are a pyramid

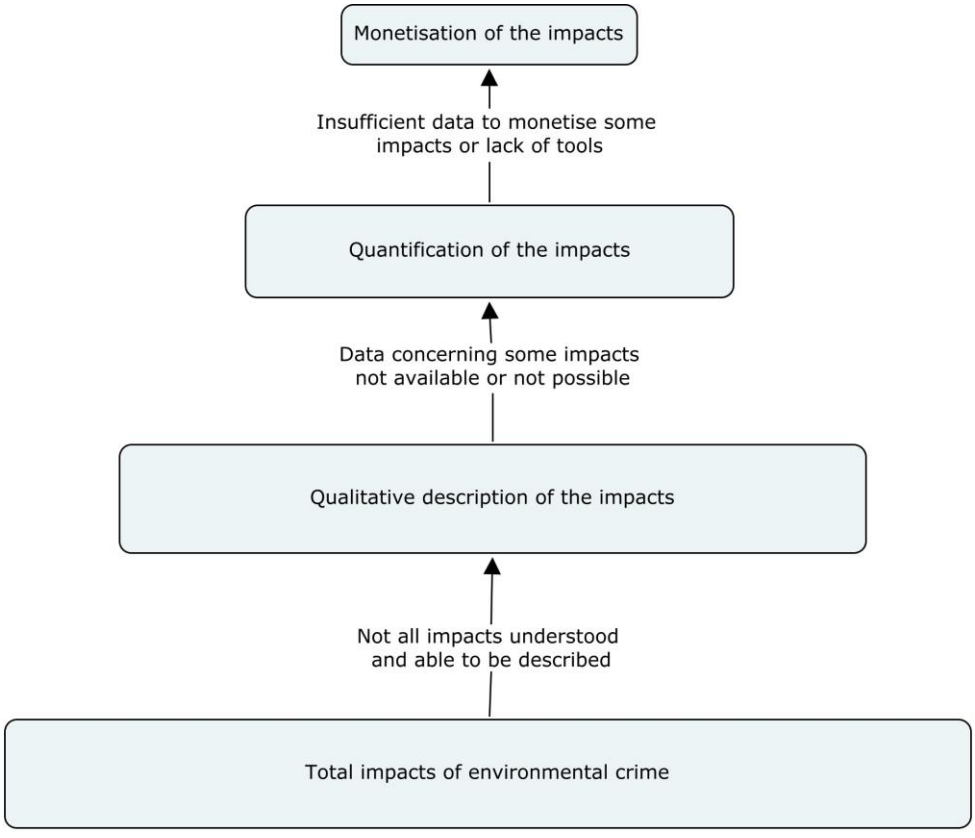
Environmental crime has many different impacts. The analysis supporting this overview report has examined quantitative and monetary impacts. However, an important lesson from the examination of the impacts of environmental crime is to recognise that there are different degrees to which impacts can be described and analysed and different ways in which these can be presented.

This is illustrated by the following figure. An environmental crime (individual or collective) has a range of different impacts. These are understood to different extents and it is likely that some will not be known. Therefore, only a proportion of these can be described in a qualitative way. Of those impacts that for which qualitative descriptions are possible, only a sub-set of these can be quantified. For the others there may be insufficient information (e.g. because of lack of monitoring, difficulty in collecting data in a criminal environment, problems in linking cause and effect, etc.) to provide numbers to impact events. Finally, only a sub-set of the quantified impacts will be able to be monetised, again due to data limitations as well as possible methodological limitations for specific types of impacts.

For environmental crime, there is even perhaps an additional lower layer to the pyramid – where total impacts are included, whether legal or illegal. For some of our work this is not an issue (e.g. elephant poaching is readily distinguished, or fires where causes are recorded), but for some areas such as marine impacts, identifying the illegal component is problematic.

This deliverable focuses on the quantitative and monetary impacts, but it is important that all impacts, even if they can only be qualitatively described, should be communicated to the public. Only in this way can a full picture be presented. Quantification is important, e.g. to communicate scale of impact, and monetisation enables the impacts to be considered within wider economic contexts. However, the biggest impact might be the one that has not been quantified and not monetised.

Figure 3. A schematic overview of understanding impacts as a pyramid



4.4 Scoping the impacts of environmental crime

An important lesson from the work on impacts on environmental crime in EFFACE has been the challenge of scoping those impacts. Most environmental crimes have an immediate focus for understanding the impact – that which is the crime itself. For example, the loss of animals protected under CITES can be determined, timber illegal felled can be estimated, quantities of waste illegally shipped can be analysed. However, these first order impacts are only the start of understanding the impacts of those crimes.

Figure 4 provides a generalised overview of the different types of impacts that might occur in considering a specific criminal activity. It is not meant to be comprehensive, but illustrative of the range of impacts that might occur.

The figure explores different types of direct environmental impacts. These includes impacts on environmental quality (which should be considered across air, water, soil quality) and direct impacts on biodiversity (e.g. hunting on protected species populations). However, it is also important to ensure indirect impacts are included, e.g. impacts on environmental quality through pollution causing impacts of biodiversity.

There may also be impacts on health (short and long term), caused by changes in environmental quality. Resources might be impacted (e.g. loss of useable soil, depletion of forest resources, etc.). Public administrations are also impacted, not least the diversion of funds to fight crime. Criminal activity may also negatively affect the financial interests of legitimate economic actors. Finally, the full scope of impacts should include positive impacts, such as economic benefits from the criminal business[1].

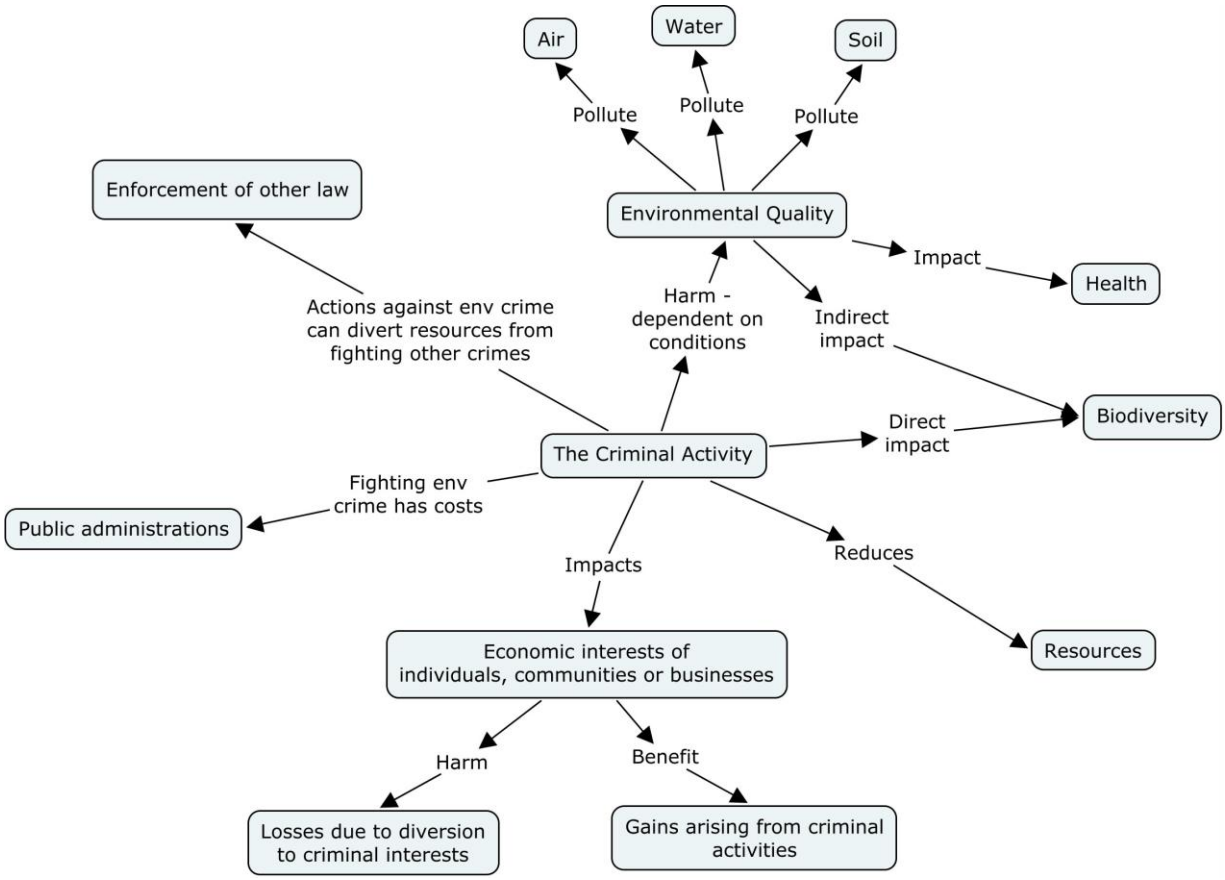
It is important to note that each of these elements of scoping can, themselves, contain many elements. It might be possible to identify a change in air quality causing a health impact, but other air pollution changes might cause further health impacts and these need to be acknowledged in any scoping to ensure a comprehensive picture is provided.

Overall, this scoping exercise is important to ensure all impacts are accounted for. It may not be possible to follow-up all impacts in further analysis, but the acknowledgement of a (potential) impact ensures they are not ignored, which can be important in communicating results to policy makers and the public.

The cases studied in this work present different approaches to the scoping of impacts. That for waste shipment, for example, has sought to identifying different types of impacts in order to then focus on those for which further analysis is appropriate. That for fires recognises the range of land-use, property and health impacts that occur, while that on illegal trade in Horsfieldii Tortoise notes the limited impacts that occur in that instance.

[1] This was noted in the scoping work within Task 1 of this WP, where studies have found waste electrical equipment illegal shipped to west Africa can have enter the local economy and have positive economic consequences.

Figure 4. A schematic illustration of scoping of the different types of impacts of environmental crime



4.5 Identifying an impact

The first scoping of impacts concerns the direct impacts on the environment. In the figure these are divided between environmental quality and impacts on biodiversity. Although biodiversity is an aspect of environmental quality, separating air, water and land quality is useful as these can also lead to health impacts. However, while these immediate environmental impacts may arise from an environmental crime, whether an change in air, water or soil quality causes harm will depend on a range of factors such as pre-existing conditions, nature of organisms dependent on the medium, etc. Further, where there are environmental quality thresholds of concern some degradation in quality resulting from a crime might not breach that threshold. However, care needs to be taken in understanding the nature of 'thresholds', particularly where these are in law. Some might be a real threshold beyond which an impact starts to appear. However, EU air limit values, for example, are not thresholds of impact and changes in air quality below these values has positive or negative health effects.

Even if one argues that change is quality is inherently undesirable, it is still necessary to scope the context of that change as this will certainly affect any attempt to quantify the impact after scoping is complete.

Impacts on biodiversity may be complex and may either be indirect (e.g. pollution affecting individuals and populations) or direct (e.g. from illegal hunting). The relationship for direct impacts on individuals may be relatively easy to conceptualise (not necessarily determine), but indirect impacts may be much harder to describe. A link between change in quality and biodiversity impact may be known, but that link may not be clear.

A second issue in scoping biodiversity impacts is the link between impacts on individuals and impacts on populations. Environment crimes might result in the death of individuals, but does this have any impact on populations[2]? This issue is explored in the analysis on hunting of elephants and rhinos, where it is clear that hunting levels are beyond those consistent with sustainable populations. Overall it would be expected that species that are slow reproducing would be at greatest risk from the removal of individuals from a population.

4.6 Relationships between drivers, pressures and impacts

Understanding the link between drivers, impacts and pressures is important in understanding impacts, particularly as a key driver for much environmental crime is economic. Therefore, these economic outcomes for the criminal may need to be included in an impact analysis. Understanding these interactions is also important in other contexts, such as in helping to direct more effective law enforcement, but that is a subject for other analyses.

The link between drivers, pressures and impacts might not always be clear. For many times of environmental crime this is often not an issue for immediate pressures. The loss of individual elephants due to hunting is relatively precisely documented. Similarly, local toxic contamination due to recycling activities from illegal imported electronic waste can be directly linked to that criminal activity. In other cases the exact relationship with a pressure is more difficult to determine, particularly if environmental crime is contributing to a problem, but is not the only cause. Illegal waste dumping in Europe removes the benefit of potential resources from the recycling system, but so do other activities.

4.7 Approaches to economic analysis

The analyses in this study present different approaches to economic analysis. In some cases the quantitative information is unsufficient to develop further economic assessments to any degree of confidence. Some have used valuations of the natural environment (e.g. on natural capital loss due to poaching) or to health (e.g. for waste shipment). The fires case has sought to estimate the value of assets lost. Several cases have included information on the financial losses and benefits from those engaged in or affected by the illegal activity.

It is important to note that this work did not include de novo collection of data and, therefore, could not be designed to fit into the most appropriate economic analysis tool for the issue being addressed. As a result, there is further work to be undertaken in this Work Package. This work will, therefore, continue by examining the range of different economic analysis tools available and determining which are most appropriate in examining different types of impact from environmental crime.

4.8 Use of data on impacts

Of course, the design of scoping for information on impacts and the effort into gathering such information is dependent on why such information is needed. Data on the impacts of environmental crime are needed for a variety of reasons, including the following:

- To help target actions, resources, etc., of enforcement bodies to target enforcement actions.
- To help understand impacts on victims and so guide attention to liability and restoration.
- To design welfare maximizing sanctions that internalize the external effects associated with environmental crime.
- To help guide policy review and policy development.

[2] Some might argue about the ethical issue of killing of individuals, but this would take us into the realm of animal rights and comparing the death of an elephant, for example, with millions of cattle every day. This is not part of this analysis.

Environmental enforcement bodies are usually resource constrained and, therefore, it is important that these resources are used most efficiently. One criterion to target those resources is to focus them on where the impacts of environmental crime are greatest or most severe. This might not be the same as numbers/levels of crime, which is also a legitimate criterion for targeting resources. However, understanding the extent of impacts and the limitations of such understanding is important in guiding enforcement strategies. Further, if data on impacts can be compared with the results of the application of different enforcement approaches, then such data can be important in guiding the development of enforcement strategies and the development of smart instrument mixes for tackling environmental crime.

Information on impacts is important for actions to be taken once those impacts have occurred. Where the offender is identifiable, then liability rules may apply and impact data can be used to determine the extent of liability. Such information, therefore, helps to empower victims (where these can be identified as some environmental crime can be viewed as 'victimless') by providing solid evidence. Information on impacts is also important to guide restoration initiatives, including helping to cost those initiatives.

The research within other areas of EFFACE has examined the suit of legislation and policies on environmental crime in different contexts (EU, Member State, International). There is much debate on whether these policies are well designed. However, in order to improve these policies, it is important to have evidence of their effectiveness and their efficiency. Information on impacts is an important part of this evidence (along with other types of evidence). Policies should be leading to reductions in impacts and these should, ideally, be focused where those impacts are most severe while taking into account the costs of the policy/enforcement measures. However, is there evidence that this is the case?

It can, therefore, be seen that there are many challenges in gathering qualitative, quantitative and economic data on the impacts of environmental crime. This is due to the wide range of many different types of impacts, the complexity of criminal activity and methodological challenges. However, the gathering of such information is important to help target enforcement activity and improve environmental legislation. Thus further effort is needed to improve the gathering of impact information. This should build on the strengths identified in this research and address the weaknesses. Identifying the strengths, weaknesses, opportunities and threats regarding data and information is undertaken in later work within the EFFACE project, which will lead to identification of specific policy recommendations on this issue.