

# The complex policy issue of elephant ivory stockpile management

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## Abstract

Recent elephant poaching levels are a serious concern for conservationists. Opinions differ over how to deal with the upsurge and associated illegal ivory trade. Following the CITES-imposed international trade ban voted in 1989, limited legal trade has been permitted in two one-off sales. Opinions are divided on what effect this has had on poaching. Opinions are now also divided over whether trade in ivory products should be outlawed worldwide, both between and within countries. In the midst of this debate is the question of what government agencies should do with existing stockpiles of collected legal and confiscated illegal ivory. Governments of some countries have destroyed their stockpiles with the claimed intent of reducing poaching, and there are calls for others to follow suit. We review the academic literature and available relevant data and find that under current circumstances, stockpile destruction violates the precautionary principle because the outcome is unknown; it is therefore not recommended. Credible evidence suggests that speculation may drive the current high poaching rates more than consumer demand for carvings. Legal stockpiles provide an option to curtail speculative behaviour of criminals. We recommend that governments move closer towards consensus on a long-term vision for elephant and ivory management before undertaking measures such as large-scale stockpile destruction. In the meantime they should continue to retain existing ivory stockpiles securely to reduce incentives for criminal speculation with illegally accumulated stockpiles. We recommend that research be carried out to understand better the dynamics of the current legal and illegal ivory trade systems in order to formulate evidence-based policy.

**Additional keywords:** poaching, seizure, speculation

## Résumé

Les niveaux récents de braconnage des éléphants sont une préoccupation sérieuse pour les écologistes. Les opinions divergent sur la façon de faire face à la recrudescence du braconnage et le commerce illégal de l'ivoire y associé. Suite à l'interdiction du commerce international imposé par la CITES et voté en 1989, le commerce légal limité a été autorisé lors de deux ventes exceptionnelles. Les opinions sont divisées sur l'effet que cela a eu sur le braconnage. Les opinions sont actuellement divisées aussi quant à savoir si le commerce des produits en ivoire devrait être interdit dans le monde entier, entre et à l'intérieur des pays. Dans ce débat se trouve la question de savoir ce que les organismes gouvernementaux devraient faire avec les stocks existants d'ivoire légal collecté et d'ivoire illégal confisqué. Les gouvernements de certains pays ont détruit leurs stocks avec l'intention déclarée de réduire le braconnage, et il y a des appels pour que les autres suivent cet exemple. Nous passons en revue la littérature académique et les données disponibles pertinentes et nous trouvons que sous les circonstances actuelles, la destruction des stocks viole le principe de précaution puisque le résultat est inconnu; donc elle n'est pas recommandée. Des preuves crédibles suggèrent que la spéculation peut être la cause des taux actuels élevés de braconnage plus que la demande des consommateurs pour les sculptures. Les stocks légaux fournissent une possibilité de réduire le comportement spéculatif des criminels. Nous recommandons que les gouvernements se rapprochent d'un consensus sur une vision à long

terme pour la gestion de l'éléphant et de l'ivoire avant d'entreprendre des mesures telles que la destruction à grande échelle des stocks. En attendant, ils doivent continuer à conserver les stocks d'ivoire existants en toute sécurité pour réduire les incitations à la spéculation criminelle occasionnée par les stocks accumulés illégalement. Nous recommandons qu'une recherche soit effectuée pour mieux comprendre la dynamique des systèmes actuels du commerce légal et illégal de l'ivoire, afin de formuler des politiques basées sur des preuves.

**Mots clés supplémentaires:** braconnage, saisie, spéculation

## Introduction

In November 2013, the US Fish and Wildlife Service destroyed approximately 5.4 tonnes of confiscated ivory. In January 2014, China also destroyed some 6.1 tonnes; in February France followed suit with 3 tonnes and Chad with 1.1 tonnes; and in April Belgium destroyed 1.5 tonnes (CITES 2013a; Chan 2014; *Guardian* 2014a; Cronin 2014; Russo 2014). Hong Kong started destruction of almost 30 tonnes of its stockpile in May with the incineration of about 1 tonne of ivory (*Guardian* 2014b) and in late June the Thai government said it would decide by 8 July whether to destroy its more than 5 tonnes of illegal ivory (Thai PBS 2014). The decision has not been announced.

The material destroyed includes raw and carved whole tusks, smaller carvings, and other elephant ivory items amassed by government authorities as a result of enforcement efforts. The stated purpose of these events was to send a clear message to criminals that poaching and ivory trafficking will not be tolerated (USFWS 2013; Lau 2014). The US government has called on all countries to destroy stocks of illegal, confiscated ivory (IFAW 2013).

Previous stockpile destruction through burning or crushing took place in Kenya in 1989, in Zambia, Taiwan, Japan, the UAE and China in the 1990s, Kenya again in 2011, Gabon in 2012 and the Philippines in 2013 (Stiles 2013; Orenstein 2013). The total quantity of ivory destroyed so far is estimated to be over 65 tonnes. All of this stockpile destruction aims to deter consumer demand and illegal ivory trade and, by extension, elephant poaching.

As a result of an upsurge in elephant poaching beginning in the mid-2000s (UNEP et al. 2013; CITES 2014; Wittmeyer et al. 2014), calls have been increasing to destroy all ivory stockpiles and ban all trade in ivory worldwide, both between and within countries (Wasser et al. 2010; Burntheivory 2013; EIA 2013; Douglas-Hamilton 2013; Christy 2013; Bennett 2014). These actions would, in the

opinion of its proponents, save the elephant by making ivory valueless. There continues to be disagreement about this approach succeeding in reducing elephant poaching for ivory (Stiles 2009a, 2011a, 2013, 2014; Walker and Stiles 2010; Conrad 2012; Bandow 2013, 2014; MacMillan 2013; Challender and MacMillan 2014; Moyle and Stiles 2014).

The issue of ivory stockpiles was discussed at the 65th CITES Standing Committee meeting in July 2014. CITES Resolution Conf. 10.10 (Rev. CoP16) urges Parties involved with elephant ivory to 'maintain an inventory of government-held stockpiles of ivory and, where possible, of significant privately held stockpiles of ivory within their territory'. The resolution also directs the CITES Secretariat to 'support, where requested, the security and registration of government-held ivory stockpiles'. CITES does not recommend stockpile destruction.

However, Chad and the Philippines submitted SC65 Doc. 42.7 at the 65th Standing Committee meeting, which sought to have CITES endorse destroying ivory stockpiles and for it to encourage and assist Parties with such events. The proposal gained limited support, but some countries stated they opposed destroying legal ivory. The Standing Committee did not endorse the proposal, but the issue will be discussed further at CoP17 in South Africa in 2016 (IISD 2014).

We review the potential consequences on elephant poaching levels from policies to either maintain or destroy ivory stockpiles. This debate is not new. It was raised during the run-up to the first CITES-permitted experimental one-off sale of ivory from three southern African countries to Japan, which was held in 1999 (t Sas-Rolfes 1997). At that point the author concluded in part that 'the ivory trade ban is likely to prove unsustainable and even counterproductive in the longer term' and that 'it is important to deal with existing official ivory stockpiles in an appropriate way: destroying them probably makes little conservation sense'.

In the light of 17 years of experience since then and two CITES-approved experimental ivory sales from southern Africa, what, if anything, has been learned that would assist CITES and national governments in taking action on ivory stockpiles that will further elephant conservation?

### Trends in elephant numbers, poaching rates and ivory trafficking

Estimating elephant numbers is problematic. The IUCN/SSC African Elephant Specialist Group, which maintains the African Elephant Database, advises that comparisons of database figures should be made with great caution because of data deficiencies (CITES 2014). Given that caveat, Table 1 shows the estimates by African subregions since 1989, the year the ivory trade moratorium was voted.

The minimum number is made up of the *Definite* and *Probable* classes and the maximum is with the addition of the *Possible* and *Speculative* classes.

Notwithstanding the database figures, recent trends in poaching rates, as reported by the CITES programme of Monitoring the Illegal Killing of Elephants (MIKE), are disturbing. MIKE evaluates relative poaching levels based on the Proportion of Illegally Killed Elephants (PIKE), which is calculated as the number of illegally killed elephants found divided by the total number of elephant carcasses encountered by patrols or other means, aggregated by year for each of 60 monitoring sites in Africa. Coupled with estimates of population size and natural mortality rates, PIKE can be used to estimate numbers of elephants killed and absolute poaching rates (CITES et al. 2013). Figure 1 shows PIKE levels from 2002 through 2013. Figures 1 and 2 show that poaching rates accelerated after 2009, peaking in 2011. From 2010 to the present, 50% or more of elephant carcasses found are thought to have been illegally killed.

The Elephant Trade Information System (ETIS) implemented by TRAFFIC is the CITES programme for monitoring ivory trafficking that is the counterpart to MIKE. Figure 3 shows the estimate of the mean weight of illegal ivory trade combining all weight classes by ivory types, per year from 1996

through 2012. Figure 3 depicts relative (not absolute) values for the quantity of ivory being traded illegally, based on reported confiscations of smuggled ivory. Here, the pattern rather than the comparative weights is what is significant. There is relative stability in the quantity of ivory in illegal trade through 2007,

Table 1. African elephant population estimates, rounded to the nearest 10, 1989–2013

Year	Minimum	Maximum
1989	608,030	608,030
1995	387,520	581,180
2002	461,090	660,210
2007	554,970	689,670
2013	515,860	675,000

Source: Cobb (1989) and <http://www.elephantdatabase.org>

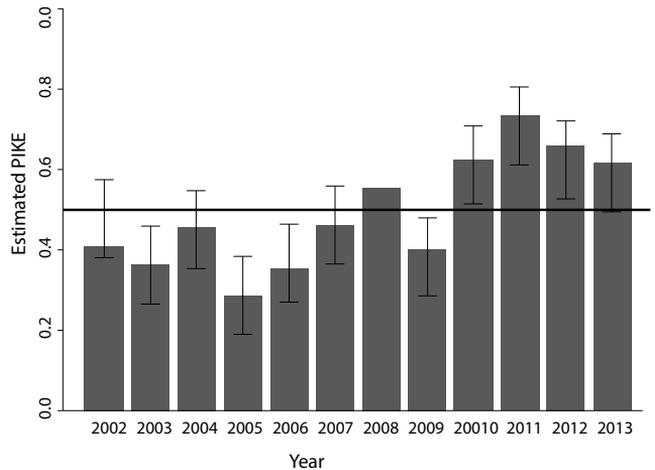


Figure 1. The estimated Proportion of Illegally Killed Elephants (PIKE) for all subregions of Africa combined. Source: CITES 2014.

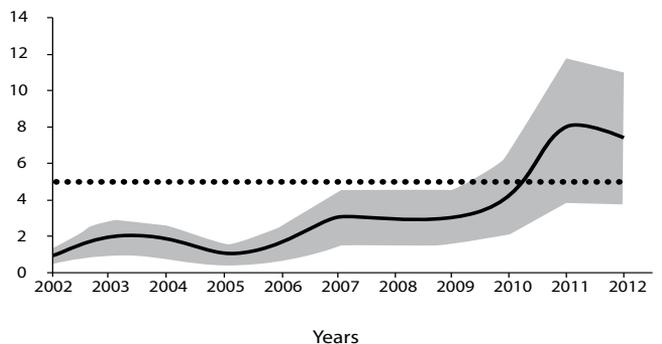


Figure 2. Estimated poaching rates. (The dotted line represents the normal average elephant population growth rate (5%).) Source: UNEP (2013).

but thereafter a fairly sharp upward climb is seen, despite a drop indicated in 2012. This pattern is similar to the MIKE poaching trend. The 100+ kg raw ivory class contributes the most to the weight index. This signifies that large-scale ivory seizures are driving the upward trend in the ivory trade. TRAFFIC interprets the trend for larger-scale ivory shipments as indicative of the presence of organized crime in the illicit ivory trade (CITES et al. 2013).

Larger shipments could also be evidence of increased demand for the purpose of speculative stockpiling. There is evidence that the larger shipments were not due to a requirement for larger raw ivory supply to meet increased production needs. One source of evidence is the legal market. It is reasonable to assume that the demand for legal carvings would follow similar (but not identical) trends as the illegal. Rising incomes in China should lead to demand in both markets increasing. This statement does not mean they will rise at the same rate or to the same levels. There are points of difference. The legal market appears to specialize in larger pieces while the illegal market handles smaller pieces (Moyle and Conrad 2014). This specialization, however, is not perfect. For instance, legal carving factories do make small carvings. About 80% of the carvings in 2013 weighed less than 100 g, but these carvings made up only 5% of the total by weight (Moyle and Conrad 2014).

Nonetheless, legal demand since 2009 appears relatively flat. First, only 13.78 tonnes of the 18 tonnes allocated by 2013 had been used by legal carvers (Yu 2013; Moyle 2014). This is supported by analysis of nearly 1,300 tusks that have gone through the legal factory system since the first allocation in 2009 (Figure 4). This suggests that retail consumer demand in general has been largely flat over this period. It also corroborates that the throughput of ivory is less than the government allocations in the legal ivory market sector.

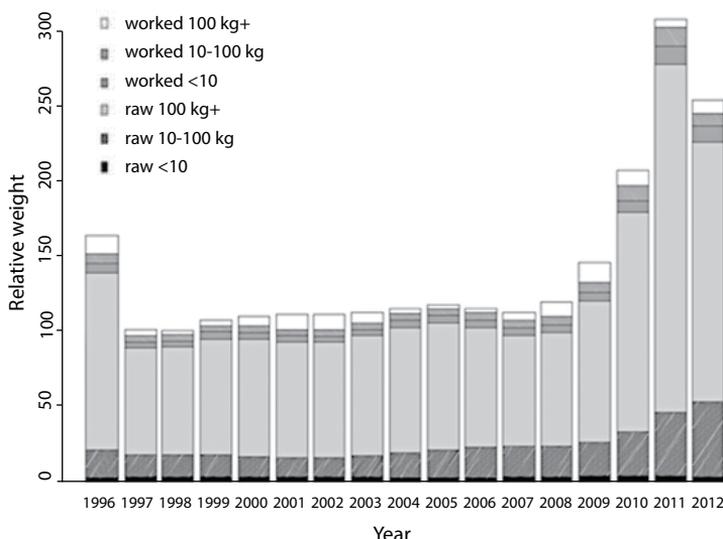


Figure 3. Estimate of the mean weight of illegal ivory trade combining all weight classes by raw or worked ivory, 1996–2012. Source: UNEP et al. 2013..

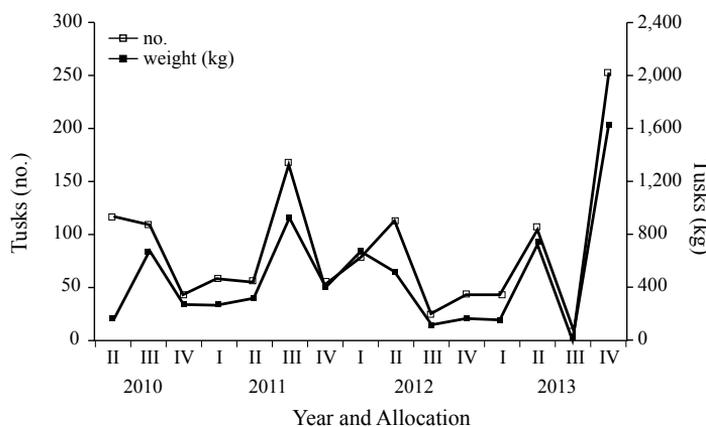


Figure 4. Throughput of tusks in Chinese factories, 2009–2013.

Production and consumption quantities of illegal ivory are unknown, but if the consumer demand pattern observed with legal ivory is similar, it would seem there has not been an increase large enough to account for the huge alleged increase in illegal raw ivory imports over the past five years or so.

Speculative stockpiling would be carried out by ivory dealers that supply ivory factories, some of whom probably have interests in ivory factories themselves. An example of this occurring is Hong Kong, where ivory dealers still have over 100 tonnes of ivory in stock 24 years after the CITES ivory trade ban (Hong Kong Government 2014). As long as ivory

rises in value sufficiently year-on-year, it remains profitable to stockpile and sell only small quantities, at great profit, as needed.

Clearly, something occurred in the 2008–2009 period that triggered the increased elephant killing and ivory seizure pattern seen since 2009. A widely held view is that the cause was the 2008 CITES-approved auctions of ivory stockpiles in four southern African countries to China and Japan (EIA 2012; Rice 2012; IFAW 2012). According to this line of thought, ‘the sale approved by CITES in 2008 spurred production and trade of ivory products in China and stimulated the demand for ivory from a growing class of wealthy consumers’ (IFAW 2012). This rise in demand, ‘combined with an uncontrollable legal ivory market which provides cover for illegal trade, makes a lethal combination that is decimating wild elephant populations.’ The claims by IFAW and EIA have been repeated by countless other NGOs, media outlets and prominent individuals. The same arguments were made regarding the first CITES-approved ivory sales to Japan held in 1999 (EIA 2002).

Stiles (2012) disagrees with the view that legal raw ivory sales in Africa stimulated consumer demand for worked ivory in China, even if the imported legal ivory did result in the availability of more worked ivory. First, the average consumer in China was totally unaware of the CITES one-off sales, so how could they have influenced consumer decisions to buy ivory? Second, to the extent that consumer demand for ivory increased after 2008, this coincided with a general and well-documented rise in Chinese consumer demand for all luxury products. Ivory, along with jade, works of art, gold, etc., became investment vehicles and prestige items of social display (Fischer 2011; IFAW 2012; Gao and Clark in review). Ivory consumption most likely rode the same wave. Third, consumer demand for ivory was stimulated by a Chinese government campaign to promote cultural heritage. Several government declarations and China’s adherence to UNESCO’s Convention for the Safeguarding of Intangible Cultural Heritage in 2005 publicized Chinese cultural arts. The ivory industry took advantage of the campaign to promote ivory carving in exhibitions, the media and on the internet. In May 2006, Beijing and Guangzhou ivory carving was included in the first National List of Intangible Cultural Heritages (Gao and Clark in review). This piqued interest in ivory as an aesthetic and culturally desirable commodity to acquire.

The MIKE and ETIS programmes were established

under CITES as a result of CITES Resolution Conf. 10.10, which included a call to assess to what extent observed trends of illegal elephant killing or ivory trading are a result of decisions taken by the Conference of the Parties to CITES, in particular CITES-approved sales of legal ivory.

ETIS (TRAFFIC International 2013) found that, after analysing ivory seizure data, ‘Over the 16-year period examined, an uninterrupted progression of Chinese involvement in illegal ivory trade is demonstrated. ... China’s involvement in illicit ivory trade transactions is 46 times greater in 2011 than it was in 1996. The increasing pattern of growth in illicit trade in ivory for China was well established long before the one-off sale under CITES commenced and certainly, for the period 1996–2008, was clearly driven by other factors ... independently of the CITES ivory sale event.’

MIKE (CITES 2013b) concluded after analysing the PIKE and associated data, ‘The MIKE analysis has therefore not found any evidence to suggest that illegal killing of elephants increased or decreased as a direct result of the CoP decisions. If the decisions had any effect on poaching levels, that effect was not discernible from the available data.’

Earlier analyses of available data, using different methods, could also find no causal relationship between the 1999 CITES one-off sales and ivory market activity or elephant mortality (Stiles 2004; Bulte et al. 2007).

Pro-ban supporters use the 1999 and 2008 sales to underpin the claim that a legal, regulated trade would stimulate ivory demand and drive elephant poaching to catastrophic proportions. The call for ivory stockpile destruction derives from this claim, based on the assumption that if there is no ivory to sell or otherwise leak onto the market, there would be no trade to stimulate elephant poaching. This simplistic argument has a superficial logic and emotional appeal, but it does not fit the empirical evidence or stand up to economic analysis, as we aim to demonstrate.

## **Raw ivory price trends**

Data on raw ivory prices in various parts of the world are confusing and conflicting. For a review of methodological issues affecting the collection of raw ivory prices and a sample of prices see Stiles et al. (2011). Raw ivory prices are rarely collected and reported accurately by researchers and the media. In spite of deficient data, it is safe to say that raw illegal

ivory prices have been rising between about 2000 to 2014 in Africa and eastern Asia. It is unclear since 2012 what direction prices have taken in China, the most significant market for ivory. Table 2 presents prices from 1999 to 2014 in selected countries.

Table 2 shows that the prices for smaller, 1–5 kg tusks in urban areas in Cameroon (Douala and Yaounde) and the Democratic Republic of Congo (DRC—Kinshasa and Kisangani) have not risen in real USD terms between 1999 and 2010. The prices for >5 kg tusks have risen, however, from an average of USD 56/kg in Cameroon in 1999 to USD 91/kg and in DRC from a minimum of USD 70/kg to an average of USD 112/kg. Martin and Vigne (2013) report raw ivory prices in smaller urban areas of Nigeria in 2012 for 1–5 kg tusks, obtained from a secondary source, of USD 110/kg and Vigne and Martin (in press) report the average price for tusks of 1–3 kg in Luanda, Angola, in 2014 as USD 150–250/kg, most of them originating in the DRC. This would imply the price in the DRC in 2014 would be less than USD 150–250/kg, because transport and markup costs would have been added to those in Luanda.

The available raw ivory African prices appear consistent and show a clear pattern of a steady rise in prices from 1999 to the present for the larger tusk weights, but not for smaller tusks.

Japan shows a modest rise in inflation-adjusted prices for >5 kg tusks for the period 2002–2009 while Thailand experienced a much larger price rise between 2002 and 2008 of average prices of less than USD 200/kg to USD 387/kg—approximately double (Martin and Stiles 2002, 2003; Vigne and Martin 2009; Stiles

2009b). TRAFFIC recently carried out an ivory survey in Bangkok but unfortunately did not collect price data (Doak 2014).

Prices in China are less well understood. There appear to be two different ivory markets and sets of prices: the legal market and the illegal (black) market. In 2002, the black market inflation-adjusted prices for >5 kg tusks in China ranged from USD 155 to 220/kg. There were no legal raw ivory prices in 2002 because legal ivory was not being traded due to scarcity (Martin and Stiles 2003). By early 2011, the inflation-adjusted price for 1–5 kg illegal tusks in Fuzhou had risen to USD 777/kg, 350–500% more expensive than larger tusks in 2002. The government, legal inflation-adjusted price for 1–5 kg tusks was an average of only USD 471/kg in 2011, 40% less than the black market price (Martin and Vigne 2011). Larger >5 kg illegal tusk prices had risen in southern China to an inflation-adjusted USD 930/kg (Martin and Vigne 2011), four to six times more expensive than in 2002 for that size.

The black market price appears to have skyrocketed in 2014 to an average of USD 2,100/kg for small <5 kg tusks in Beijing (AFP 2014a; E Martin, pers. comm. to D Stiles 2014), implying that larger tusks would be even more expensive. However, prices for black market carvings (necklaces and bracelets) do not show the same trend. Moyle and Conrad (2014) report that these black market pieces are systematically lower in Beijing and Fuzhou than the legal prices.

Legal government-owned raw ivory prices had risen much less from the 2011 USD 471/kg average, ranging USD 483–613/kg for >5 kg tusks in Fuzhou

Table 2. Middleman raw ivory prices<sup>a</sup> in USD, 1999–2014

Country	Year	Weight (kg)	Price/kg (USD)	Year	Weight (kg)	Price/kg (USD)
Cameroon	1999 <sup>b</sup>	1–5	38–53	2010 <sup>e</sup>	1–5	43
Cameroon	1999 <sup>b</sup>	>5	42–70	2010 <sup>e</sup>	>5	53–128
DRC	1999 <sup>b</sup>	1–5	42–70	2010 <sup>d</sup>	1–5	32–53
DRC	1999 <sup>b</sup>	>5	>70	2010 <sup>d</sup>	>5	64–160
China	2002 <sup>e</sup>	1–5	155–220	2014 <sup>f</sup>	1–4	2,100
China	2011 <sup>g</sup>	1–5	471–777	2014 <sup>h</sup>	>5	660–1100
China	2011 <sup>g</sup>	>5	930	2014 <sup>i</sup>	>5	484–613
Japan	2002 <sup>j</sup>	>5	181–311	2009 <sup>j</sup>	>5	302–362
Thailand	2002 <sup>k</sup>	1–5	30–236	2008 <sup>l</sup>	1–5	387

<sup>a</sup>Pre-2014 prices have been converted to 2013 USD prices to take into account inflation using the 'real price' conversion for a commodity available from <http://www.measuringworth.com/>; <sup>b</sup>Martin and Stiles (2000); <sup>c</sup>Randolph and Stiles (2011); <sup>d</sup>Stiles (2011b); <sup>e</sup>Martin and Stiles (2003); <sup>f</sup>AFP (2014a) and Esmond Martin, pers. comm. 2014; <sup>g</sup>Martin and Vigne (2011); <sup>h</sup>T Esmail, *in litt.* to D Stiles 2014; <sup>i</sup>B Moyle and K Conrad, field research 2014; <sup>j</sup>Vigne and Martin (2009); <sup>k</sup>Martin and Stiles (2002); <sup>l</sup>Stiles (2009b).

and Beijing (B Moyle, field research). In 2014, DaXin Ivory Carving Factory in Guangzhou offered USD 660/kg for three pairs of tusks weighing an average of 36 kg each (Figure 5). These were accompanied by CITES permits that would allow legal export from Canada and import to China. In response to a reference by the seller to a USD 1,300/pound (USD 2,860/kg) price purportedly paid in China in 2013 (Levin 2013), DaXin replied it was untrue. A private dealer in China offered USD 1,100/kg for the tusks (T Esmail *in litt.* to D Stiles).

It is difficult to explain the large difference between legal and illegal raw ivory prices. Chinese government prices for >5 kg tusks are in the USD 480–660/kg range. These prices are supported by a legal raw ivory auction in France in July 2014, in which 50 tusks of 20 kg average weight were sold for about USD 630/kg to Chinese buyers (AFP 2014b). Much smaller illegal tusks are reportedly selling for an average of USD 2,100/kg (AFP 2014a). The high illegal price receives support from Gao and Clark (in review), who report prices in 2014 for illegal ivory sold online between private parties ranging from USD 1,700/kg to USD 2,890/kg. These pieces were quite small (0.5–1.9 kg) tusk tips and cut tusk sections.

Further research is called for to understand the ivory market dynamics that explain these price indicators. However, it is simple to understand the incentives for elephant poaching when tusks can be purchased in Africa for less than USD 150/kg and sold in China for well over 10 times that amount.

## Theories of elephant conservation, ivory trade and stockpile management

Contemporary threats to wild elephant populations are essentially economic by nature; they include habitat loss, conflict with humans and poaching. The two essential drivers for these are competition with other forms of land use by humans (and their constituent species) and the demand for elephant products, principally ivory. Elephant poaching is undertaken because it is a profitable economic activity. Some of these economic aspects have been outlined in the economic literature from Barbier et al. (1990) through to Mason et al. (2012).

Major challenges to understanding the economics of the black market in ivory are two. The first is that the participants do not willingly reveal their business plans



Figure 5. Legal tusks ranging in weight from 5.5 to 55 kg (average 36 kg). Prices offered in China to purchase them in March 2014 were USD 660–1,100/kg.

and activity to authorities or researchers; the trade is mostly unobservable. For example, smugglers do not fill out compulsory statistical returns on trade and so the prices and quantities of ivory sold are unclear. Incomplete or inaccurate information is a hindrance to understanding the scale and organization of illegal activity.

The second challenge is that many factors influence black market activity. For instance, the steady growth in affluence in China has created an upward impetus in demand (Underwood et al. 2013; Gao and Clark in review). A milieu of interacting factors have short- or long-term effects on the market. For example, in a 2013 visit by Conrad and Moyle (2013) to factory owners in Guangzhou, they stated that the 1997 Asian financial crisis caused demand for carvings from Taiwan to drop coincident with a new system of ivory management in Taiwan that had prohibited ivory manufacture there (Phipps and Chen 1997). If demand for worked ivory destined for Taiwan from Guangzhou factories dropped at the same time that Taiwan stopped producing its own ivory carvings, the drop in consumer demand in 1997 must have been substantial.

Vigne and Martin (2011) reported that demand for worked ivory in South China was variable in 2010. It had risen in Guangzhou, where economic prosperity had grown, but remained low in Fuzhou, where economic growth was much less. It is difficult to identify all of the factors that drive this global black market. It is a dynamic system, changing over time, and it is a complex system, with many interactions not fully understood.

It is outside the scope of this paper to describe the global black market in ivory. The challenges stated

above mean that our understanding must adapt as new information is acquired, and that while general tendencies can be described, they should not be treated as emphatic predictions. In complex systems, confounding shocks generated by other variables are likely.

The focus of this paper is poaching and its interaction with stockpiles. In discussing stockpiles, we can distinguish between different categories. The most important distinction is between those held illegally and those held legally. Illegal stockpiles are privately held and clandestine—their location and extent is not known, but we assume that they consist mostly of raw ivory. This assumption is based on the dominance by weight observed of raw ivory being smuggled to Asia in seizures. Legally held stockpiles consist of both raw and worked ivory (carvings) and are mostly owned by governments, having been sourced from natural mortality and culls in range States or from confiscations of illegal ivory in range, transit or consumer countries.

The illegal trade in ivory has three important economic features. First, the major consumer markets in Asia and sources of ivory in Africa are separate. This makes it a trade mediated by many parties between poachers and consumers (Underwood et al. 2013; Bennett 2014). This also means that many strategic interactions occur along the supply chain. Participants in the illegal trade are not passive. They anticipate enforcement effort (by, for example, concealment strategies or bribing officials). Second, raw ivory is used mostly as input to produce carvings. It is usually not consumed in retail sales in its raw form. Third, ivory is durable and can be stored (Figure 6). This gives criminals the option of storing ivory for many years to be used later. Is it possible to identify the factors causing stockpiling to occur or not?

The following economic theory identifies two important motivations for acquiring raw ivory. The first is that ivory is poached and smuggled for immediate use as an input for carvings. The second motivation is speculation, i.e. stockpiling for anticipated future demand, either by carvers or by intermediaries (Kremer and Morcom 2000; Mason et al. 2012). The drivers for these two differ. When discussing the issue of stockpiles, therefore, it is important to be clear whether they relate to the immediate market for carvings or the future market as speculators perceive them. The economic theory also affirms that stockpiles are essentially a supply-side issue, and its effects on



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Figure 6. Tusks from an ivory factory in China. Ivory has little ongoing storage costs.

buyer's demand are uncertain.

Price elasticity for carvings will also influence the effectiveness of trade restrictions. If buyers are relatively insensitive to higher prices and tend to sustain their consumption, demand is price inelastic and trade bans face significant hurdles. Even a small reduction in supply will lead to correspondingly larger increases in price. Such market circumstances nurture the development of criminal cartels and present significant challenges for enforcement (Becker et al. 2006). Conversely, if demand is highly elastic, increasing legal supply may have little effect on prices or levels of illegal exploitation. The price elasticity of demand for carvings needs to be understood and not conflated with income increases that also affect demand.

We discuss several papers relevant to these issues. They are not intended to be full descriptions of the illegal market and all the factors at play but simply highlight the relationship between poachers and stockpiles. Their point is that they are abstractions of the real market. They are specific to wildlife with storable parts—in most cases, elephants.

Bergstrom (1990) specifically addresses the issue of ivory stockpiled from confiscations. These confiscations or seizures can have two negative effects on poaching levels. The first is that poachers kill additional animals to replace tusks lost in seizures to authorities or otherwise. The CITES Secretariat (2010, n24) observes that seizures are a plausible motivation for some of the recent poaching, as criminals attempt to recoup their losses to authorities. The second effect is that removing this ivory from the market can reduce the supply of ivory as an input. This in turn may cause higher prices for raw ivory that factories have to pay and, as a knock-on effect, higher prices in the consumer

market (all else being equal). These higher prices may offer a greater incentive for poaching effort.

Bergstrom (1990) affirms that changes to supply through confiscating and destroying ivory will affect the illegal market. This does not necessarily affect ivory demand, but it does reduce the potential supply and potentially generates a new condition with a combination of higher prices and lower quantity demanded in the market for carvings. Bergstrom thus concludes that destroying legally held stockpiles exacerbates rather than reduces poaching levels, all else being equal. The act of confiscating the ivory reduces the supply—destroying it then ‘seals the deal’.

In terms of poaching levels it makes no difference if the government sells ivory from the legally held stockpile or if criminals steal ivory from the stockpile to sell. This only affects who gets the revenue from the sales. While we prefer that criminals do not benefit from the sales, the conservation benefits are similar. Adding to raw ivory supply from whatever source should reduce incentive to poach, as long as demand levels remain constant.

Kremer and Morcom (2000) revisit the stockpile issue a decade after the CITES ban. A key element of this paper is that governments and criminals both have stockpiles. Criminal sellers accumulate their stockpiles both by poaching elephants and by theft or leakage from legal stockpiles. Their motive for doing so is their expectation of higher returns on ivory in the future. This point deserves emphasis. It is not the current market for carvings that is driving criminals to stockpile their own ivory. It is what they expect is going to happen in the future—up to many years hence.

Traders are willing to hold large stocks of ivory if storage costs are low and they expect the price of ivory to increase. Examples are ivory traders and owners in Hong Kong, Japan, the USA and France who have held on to raw tusks for many years, even decades, and have sold or plan to sell at great profit. As stated by Bergstrom (1990), legal stockpiles affect the ivory market by changing the behaviour of sellers. The effect now however is felt not only through the market for carvings. It is a longer-term interaction based on the value attributed by criminals to their illegal stockpiles. Kremer and Morcom (2000) thus argue that governments should ideally retain legally held stockpiles for the purpose of threatening to dump them on the market as a deterrent for illegal speculation.

Mason et al. (2012) revisit the issue of speculative

stockpiling as ‘banking on extinction’. They examine hypothetical instances of speculators with market power whose strategy is to drive certain species to extinction. Extinction would concentrate further market power in their hands as they hold most of the stock, enabling them to inflate prices and earn supernormal profits. Elephants are currently a poor fit to this model with a multitude of competing conspiracies, making it unlikely that a dominant seller will emerge.

Given that the wild population would likely still take decades to reach extinction (CITES et al. 2013; Wittmeyer et al. 2014), ‘banking on extinction’ does not yet appear to be an economic option. Nonetheless, Mason et al. (2012) again highlight that stockpile accumulation is a forward-looking strategic issue subject to manipulation by speculators. Furthermore, even competing illegal stockpilers will profit from reduced elephant numbers and ivory stocks as the relative scarcity and value of their own stock increases. They will therefore all benefit from maximum levels of poaching and work together in an inadvertent conspiracy to deplete elephant populations. The clear policy implication here is that it is risky to enable the concentration of market power in the illegal market.

The above analysis suggests that legally held stockpiles have two significant effects on poaching. The first is to influence the supply of ivory available as an input for carvings. The second is to influence sellers’ expectations of the future. Stockpile-holding policy can cause illegal agents to change poaching rates to manipulate criminal stocks of ivory. The demand curve of buyers is effectively stationary and buyers respond to changes in the supply curve.

The effect of legal stockpiles is predicated on legal sales potentially or actually occurring (although thefts are an unofficial transmission mechanism from such stockpiles to the black market). This introduces the issue of trade policy. The current regime consists of an international trade ban in ivory. Exceptions have been granted to a small number of parties as one-off sales. A literature survey shows that the ban is an ambiguous policy. It resolves some extinction risks but also creates other risks. Direct economic analysis of the first one-off sale (Bulte et al. 2007) indicates that it produced mixed results and does not resolve the issue of whether the ban is optimal.

The common risk associated with legal trade is laundering (Khanna and Harford 1996; Bulte and Van Kooten 1999). Illegal ivory has a long history of being laundered as legal and concealed within the legal trade.

Another conjecture is that legal trade results in lowered enforcement effort or makes enforcement less efficient (Bulte and van Kooten 1999). Proponents of a blanket ban advance this argument on all domestic ivory trade. Following this principle, the US president's Advisory Council on Wildlife Trafficking recommended a total domestic ban on ivory. The US White House has subsequently announced a trade ban on almost all types of elephant ivory (US White House 2014).

Fischer (2004) is the first to discuss the demand side effects of trade and notes a potential 'stigma effect'. She posits a consumer-type termed 'law-abiding' who drops out of the market if the product is illegal (or swamped by illegal products). This is because the commodity is stigmatized for that consumer. Other consumers stay in the market. If a ban (or other factors) stigmatizes ivory, demand falls. This effect has to be shown to be present in some markets, and if it dominates the adverse supply-related effects of the ban, it is an appropriate regime. However, it is also possible that an opposite effect exists in some Asian markets: if, for example, some consumers seek possession and consumption of illicit products as a means to acquire and demonstrate social status by being beyond the reach of the law.

Kremer and Morcom (2000) identify a number of variables that should affect stockpiling. One is interest rates. Stockpiling ought to increase with low interest rates, all else being equal, because of the higher potential for relative return on investment. For instance, if criminal speculators expect the price of ivory to increase 10% per year and interest rates decrease from 6% to 3%, then they would prefer to hold more ivory and less of the financial assets. Note that speculators typically hold assets with low returns when these assets also have lower risk. Figure 7 shows that global interest rates have collapsed since the global financial crisis. This is consistent with speculators wanting more raw ivory for stockpiling. The correlation statistic with raw ivory seizures is  $-0.455$ , which means when interest rates drop, seizures increase and vice-versa. We are assuming seizure levels are an indicator of illegal ivory trading scale.

A second factor is costs. Freight costs (air and shipping) matter for ivory, given

its weight and distance between range States and consumer countries. Note that this does not mean that these are the only relevant costs, rather that the preference for shipping containers is consistent with this. Figure 8 shows that shipping costs have also recently collapsed. Changes in freight costs and interest rates are consistent with the economic theory and of a magnitude that matches the surge in poaching (assuming that the hypothesis of ivory being mostly stockpiled by criminal speculators holds).

Rising Chinese consumer affluence appears to be driving increased demand for ivory carvings (IFAW 2012; Underwood et al. 2013). However, this demand has not kept up with the sudden changes seen in poaching rates, interest rates or transport costs. To illustrate, suppose there is a 20% seizure rate and 30–40 tonnes of raw ivory are being seized. This would mean an extra 150 to 200 tonnes of raw ivory being fed into the carving market every year. To see



Figure 7. Interest rates versus raw ivory seizures. Sources: ETIS (TRAFFIC International 2013) for ivory seizures, Bloomberg (2013a) for interest rates.

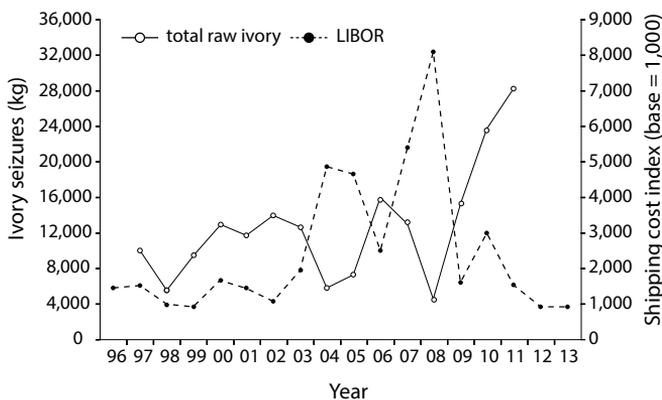


Figure 8. Freight costs versus raw ivory seizures.

price increases in ivory as seen in China and Thailand (Table 2) with the high volumes being smuggled in, at such low global transport costs, requires a massive offsetting increase in demand. However, there is little evidence to support this. The CITES Secretariat (2010) has highlighted that reported demand in Asia is not commensurate with the influx of ivory, verified by Wang Shan, secretary general of the China Arts and Crafts Association (Ma 2013) and supported by legal turnover of tusks shown in Figure 4. There appears to be a gap between estimated illegal raw ivory imports and worked ivory output. This gap is also supported by recent reports of a drop in demand in China for luxury goods (Baldwin 2014; Wendlandt 2014).

Converting the dramatic increase of poached raw ivory into carvings for rapid sale implies great flexibility in adjusting manufacturing volume. This would be evidenced by excess productive capacity and, in this industry, a very large number of under-employed or unemployed carvers to take up the extra carving requirements instigated by this ivory influx. This can be partly ameliorated by making smaller pieces, which require less time and skill. The trade-off is that the pieces are smaller, which puts downward pressure on throughput. To illustrate, the approximately 15,000 carvings of less than 100 g made in the legal factories in 2013 represented about 80% of the number of pieces made, but only about 5% of the weight of ivory used (Moyle and Conrad 2014).

The number of ivory carvers is also limited (Moyle and Conrad 2014), and to make carvings is time-consuming because production is largely artisanal (Stiles 2004). Indeed, Vigne and Martin (2011) report factories in South China closing because of lack of carvers. Many carvers left ivory to go into wood carving, which they found more profitable. Production evidence implies that illegal factories face a significant obstacle in trying to absorb the volumes of smuggled ivory. It does not appear that this obstacle has been overcome.

The evidence for black market stockpiling is still circumstantial. Nonetheless it aligns with many of the observations about the market while the explanation of increased worked ivory sales does not. Interest rates are low. Sales do not appear to have risen by a magnitude to absorb the influx of illegal raw ivory. Carving capacity is hindered by a lack of artisans. None of these explanations

explicitly rule out a large increase in illegal sales, but in combination they make the stockpiling explanation credible.

It is important to identify the destination of the smuggled ivory because this implies stockpile destruction will have an effect in different ways. If the ivory being smuggled into Asia is largely being stockpiled for speculation, destruction will have little immediate effect on the market for carvings. Any changes to the market observed in the wake of the announced intent to destroy ivory and its follow through will likely be the result of other factors. Measures of consumer demand in China have been softening through 2013 into 2014. One such measure is Chinese consumer confidence. This metric is apt as it homes in on Chinese households. This makes it a better measure than say, GDP, which includes non-household expenditures, such as those coming from industrial growth or exports. This measure has softened again. For instance, through 2013 Chinese consumer confidence has declined (Figure 9). A softening in demand for carvings thus appears plausible irrespective of the stockpile destruction.

## Discussion

The economic literature describes a complex system of interactions between stockpiles, poaching, prices and expectations. Poaching levels have multiple potential trajectories and can switch among them (Kremer and Morcom 2000). An important feature of ivory is that it can be stored for years. Illegal stockpiles accumulate (via increased poaching or leakage) to buffer black

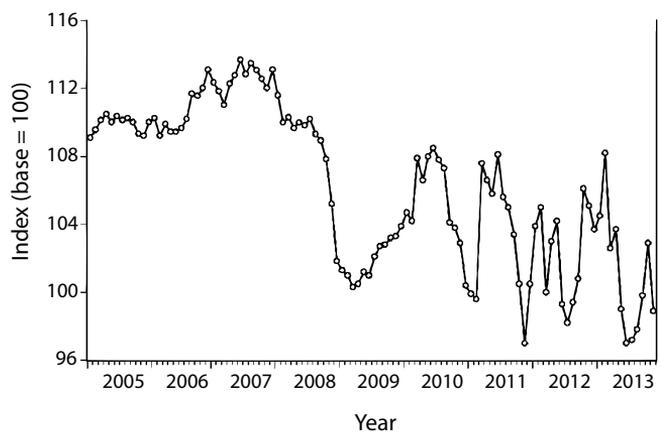


Figure 9. Chinese consumer confidence. Index from Bloomberg (2013b).

market sellers against volatile ivory supply, in expectation of future price increases and possibly to manipulate prices.

Poaching levels thus respond partly in anticipation of future market conditions. They are not merely a product of current conditions. The fact that CITES seems unlikely to approve further legal sales for the foreseeable future may create incentives for criminal speculators to accumulate stockpiles. Legal stockpiles act as a counterweight to these illegal stockpiles, and a threat of future legal sales (or even leakage by theft) may deter some poaching. There is no theoretical rationale for destroying legal stockpiles for conservation purposes. Indeed, destroying them concentrates market power with speculators holding illegal stocks and, if demand for ivory persists, makes extinction trajectories more likely (Bulte et al. 2003; Mason et al. 2012).

The future demand for ivory is a crucial issue that lacks proper analysis. With the exception of Fischer (2004), the literature assumes that demand for ivory will be maintained, if not accelerated. Trade bans and stockpile destructions are primarily supply oriented. Their demand effects are unclear.

There is also an important conflict in perceptions between speculators amassing ivory illegally and organizations supporting stockpile destruction. Such speculators must be confident that demand will persist and prices will keep rising (Kremer and Morcom 2000). They do not consider efforts to reduce ivory demand to be credible. By contrast, advocates of stockpile destruction are assuming that such actions will cause demand to decline. If the speculators are correct, demand for ivory will resist these measures.

Cultures with a long history of ivory use have a record of maintaining demand despite external pressure (Walker 2009). The conflict in perceptions extends to the diverse values elephants have for various peoples. Numerous cultures throughout Africa, the Middle East, Europe, North America and Asia have long-standing traditions of ivory use (Walker 2009). Some of these same cultures now have groups strongly opposed to any use of ivory. This conflict in values has wider dimensions. It motivates some parties favouring narrow conservation to adhere to a strict preservationist approach. A narrow policy can also generate a social justice dimension where some cultures' values are discounted completely or external economic costs are imposed upon them (Harris 2013).

The current dilemma is the conflict between demand and supply measures to reduce poaching. Existing attempts to change consumer behaviour (and therefore reduce ivory prices) employ both coercion (trade bans) and moral suasion (demand reduction campaigns). However, reducing supply via bans and stockpile destruction may exert upward pressure on prices, thereby offsetting gains from demand reduction. Attempting to reduce supply and demand at the same time is akin to simultaneously turning up the heating and turning on air-conditioning; it does not make good sense. Demand reduction alone may make short-term sense, but it ought to precede supply reduction to preempt the conflict.

Decisions to destroy confiscated and other legally held ivory stockpiles do not conform to policy aimed to deter illegal raw ivory hoarding. Instead, the economic literature supports the holding of legal stockpiles as an insurance policy that will lessen the benefits to hoarders of concentrating ivory stocks that gain in value from the decline in elephants. The claimed effect that stockpile destruction has on demand is based on rhetoric and assertions about ivory demand that lack coherence or empirical evidence.

The rapid increase in poaching and the scale of it in recent years defies a simple explanation and a simple solution. We postulate that criminal organizations and other speculators may have determined that stockpiling ivory is a viable investment. This is where research needs to be focused. It is also a warning that these speculators do not perceive ivory destruction to be a threat. It would be frightening to discover that concentrating market power in the hands of criminals through policies like ivory destruction is actually encouraging them further.

## **Conclusions**

The recent stockpile destructions in the USA, China, France and Hong Kong amounted to relatively small proportions of the known legally held stockpiles. Nonetheless, there are reports by ivory vendors in Beijing and Hong Kong, and by a non-government organization in Hong Kong, that the price of worked ivory did in fact increase after the China crush (Moore 2014; ITV 2014; NPR 2014). Table 2 and the section on price above demonstrate that illegal raw ivory prices have shot up since 2011, when the current round of stockpile destruction began with Kenya. The planned further destructions in Hong Kong and

possibly Tanzania and Thailand amount to a much higher proportion of legal stocks and consequently a greater potential risk of driving up the price of illegal ivory even more.

The decision to destroy legal stockpiles of ivory should be driven by sound policymaking, backed up by a robust economic rationale supported by compelling evidence. This evidence should include data on demand elasticities. Any stockpile destruction should be a credible signal to black market participants that ivory will become less valuable. Any rationale for destruction must address concerns that the signal will perversely increase the perceived value of illegal stockpiles. There should also be a monitoring system in place beforehand to assess whether these destructions are meeting their aims. Current moves to destroy stockpiles do not satisfy these conditions.

The economic literature on ivory trade, stockpile management and related issues provides no theoretical support for a policy of stockpile destruction. Trade legalization may have undesirable consequences, but the extent to which stigma is generated by bans is an unsettled empirical issue. The persistence of ivory demand in markets with long cultural traditions of use does suggest this type of market is not always readily or entirely amenable to stigmatization. It has not yet been convincingly demonstrated to what extent underlying demand is sensitive to stigma in the important markets of China and Thailand.

The argument that existing legally held ivory stockpiles pose a threat to elephants is supported neither by economic theory nor by empirical evidence. The only circumstance under which existing, securely held stockpiles would pose a threat is if they are primarily held by illegal speculators. Such agents benefit from large declines or extinction threats of elephants because they would drive up the rarity value of their stock. This is a further argument in support of governments retaining legal stockpiles, as a potential competitive buffer to such an outcome.

Ivory stockpiles are not a threat to wild elephant populations, but destroying them may be, as it reduces potential future supply; it may increase perception of scarcity value and thus drive up black market prices for ivory and therefore future levels of poaching. Ivory stockpile destruction does not meet the precautionary principle criteria, because the outcome is unknown. Having policy options in an uncertain environment is precautionary. Eliminating them is irresponsible.

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## References

- AFP. 2014a. Price of ivory in China triples. *The Guardian*, 3 July. Available from <http://www.theguardian.com/environment/2014/jul/03/price-ivory-china-triples-elfphant>. Accessed 4 July 2014.
- AFP. 2014b. France destroys illegal ivory stocks. *The Guardian*, 6 February. Available from <http://www.theguardian.com/environment/2014/feb/06/france-destroys-illegal-ivory-poaching>. Accessed 6 February 2014.
- Baldwin C. 2014. Luxury in China loses luster as wealthy flee. *Reuters*, 16 January. Available from <http://www.reuters.com/article/2014/01/16/us-china-luxury-hurun-idUSBREA0F0H320140116>. Accessed 2 February 2014.
- Bandow D. 2013. When you ban ivory, you ban elephants. *Forbes*, 21 January. Available from <http://www.forbes.com/sites/dougbandow/2013/01/21/when-you-ban-the-sale-of-ivory-you-ban-elephants/>. Accessed 2 February 2013.
- Bandow D. 2014. Obama administration treats antique collectors and dealers as criminals: new ivory rules put elephants at increased risk. *Forbes*, 17 February. Available from <http://www.forbes.com/sites/dougbandow/2014/02/17/obama-administration-treats-antique-collectors-and-dealers-as-criminals-new-ivory-rules-put-elephants-at-increased-risk/>. Accessed 20 February 2014.
- Barbier EB, Burgess JC, Swanson TM, Pearce DW. 1990. *Elephants, economics and ivory*. Earthscan, London.
- Becker G, Murphy K, Grossman M. 2006. The market for illegal goods: the case of drugs. *Journal of Political Economy* 114:1–38.
- Bennett E. 2014. Legal ivory trade in a corrupt world and its impact on African elephant populations. *Conservation Biology* DOI: 10.1111/cobi.12377.
- Bergstrom T. 1990. On the economics of crime and

- confiscation. *Journal of Economic Perspectives* 4(3):171–178.
- Bloomberg. 2013a. ‘LIBOR’, *Bloomberg Professional*. [Online]. Available at: Bloomberg Subscription Service. Accessed: 5 December 2013.
- Bloomberg. 2013b. ‘Chinese Consumer Confidence’, *Bloomberg Professional*. [Online]. Available at: Bloomberg Subscription Service. Accessed 5 December 2013.
- Bulte EH, Mason CF, Horan RH. 2003. Betting on extinction: endangered species and speculation. *Land Economics* 79(4):460–471.
- Bulte E, Damania R, van Kooten C. 2007. The effects of one-off sales on elephant mortality. *Journal of Wildlife Management* 71:613–618.
- Bulte EH, van Kooten GC. 1999. Economic efficiency, resource conservation and the ivory trade ban. *Ecological Economics* 28:171–181.
- Burntheivory. 2013. *Burn the ivory*. Available from <http://burntheivory.org/why-burn-the-ivory/>. Accessed 5 December 2013.
- Challender D, MacMillan D. 2014. Poaching is more than an enforcement problem. *Conservation Letters* DOI: 10.1111/conl.12082.
- Chan KM. 2014. China destroys six tons of ivory amid growing concern for illegal trafficking. *Huffington Post*, 6 January. Available from [http://www.huffingtonpost.com/2014/01/06/china-destroys-ivory\\_n\\_4547445.html](http://www.huffingtonpost.com/2014/01/06/china-destroys-ivory_n_4547445.html). Accessed 6 January 2014.
- Christy B. 2013. US ivory crush should be just a first step. *National Geographic Daily News*, 12 November. Available from <http://news.nationalgeographic.com/news/2013/11/131112-ivory-trafficking-crush-united-states/>. Accessed 12 November 2013.
- CITES. 2010. Control of trade in elephant specimens. SC61 Doc. 44. 1. Available from <http://www.cites.org/eng/com/sc/61/E61-44-01.pdf>. Accessed 3 December 2013.
- CITES. 2013a. *Notification to the Parties. United States of America. Destruction of ivory stockpile*. No. 2013/044. CITES, Geneva.
- CITES. 2013b. Monitoring the illegal killing of elephants. CITES 16th meeting of the Conference of the Parties, Bangkok (Thailand), 3–14 March 2013. Doc. 53. 1.
- CITES. 2014. *Elephant conservation, illegal killing and ivory trade*. SC65 Doc. 42. 1. CITES, Geneva, Switzerland.
- CITES Secretariat, IUCN/SSC African Elephant Specialist Group, TRAFFIC International. 2013. *Status of African elephant populations and levels of illegal and the illegal trade in ivory: A report to the African Elephant Summit*. IUCN/SSC African Elephant Specialist Group, Nairobi.
- Cobb S, editor. 1989. The ivory trade and the future of the African elephant. Unpublished report prepared for the 7th CITES Conference of the Parties. Ivory Trade Review Group, Oxford.
- Conrad K. 2012. Trade bans: a perfect storm for poaching? *Tropical Conservation Science* 5(3):245–254.
- Conrad K, Moyle B. 2013. The legal ivory market in China: part 2. *SULine*s 7. Available from [http://www.iucn.org/about/union/commissions/sustainable\\_use\\_and\\_livelihoods\\_specialist\\_group/sulinews/issue\\_7/sn7\\_ivory/](http://www.iucn.org/about/union/commissions/sustainable_use_and_livelihoods_specialist_group/sulinews/issue_7/sn7_ivory/). Accessed 13 December 2013.
- Cronin M. 2014. Chad destroys ivory stockpile as symbolic message to poachers. *The Dodo* 22 February. Available from <https://www.thedodo.com/chad-destroys-ivory-stockpile-438741778.html>.
- Doak N. 2014. *Polishing off the ivory trade: surveys of Thailand's ivory market*. TRAFFIC International, Cambridge, UK.
- Douglas-Hamilton I. 2013. Time running out to save elephants from ivory trade. *Swara* 36(1):20–26.
- [EIA] Environmental Investigation Agency. 2002. *Back in business: elephant poaching and the ivory black markets of Asia*. EIA, London, and Washington, DC.
- . 2012. *Blood ivory: exposing the myth of a regulated market*. Available from <http://www.eia-international.org/wp-content/uploads/EIA-Blood-Ivory.pdf>. Accessed 5 December 2013.
- . 2013. Crush the ivory trade. Available from <http://eia-global.org/campaigns/wildlife-in-crisis/crush-the-ivory-trade>. Accessed 22 November 2013.
- Fischer A. 2011. China to become the world's largest market for luxury goods over the next decade. CLSA, Hong Kong. Available from <https://www.clsa.com/about-clsa/media-centre/2011-media-releases/china-to-become-the-worlds-largest-market-for-luxury-goods.php>.
- Fischer C. 2004. The complex interactions of markets for endangered species products. *Journal of Environmental Economics and Management* 48:926–953.
- Gao Y, Clark S. In review. Elephant ivory trade in China: trends and drivers. *Biological Conservation*.
- The Guardian*. 2014a. France destroys illegal ivory stocks, 6 February. Available from <http://www.theguardian.com/environment/2014/feb/06/france-destroys-illegal-ivory-poaching>. Accessed 6 February 2014.
- . 2014b. Hong Kong burns ivory stockpile, 15 May. Available from <http://www.theguardian.com/>

- [environment/2014/may/15/hong-kong-burns-ivory-elephant-stockpile](#).
- Harris G. 2013. *Ivory's cultural importance: a White Paper*. International Ivory Society, Political Action Network, Los Angeles.
- Hong Kong Government. 2014. Ivory trade, Annex 2. Available from <http://www.info.gov.hk/gia/general/201406/04/P201406040449.htm>.
- [IFAW] International Fund for Animal Welfare. 2012. *Making a killing: a 2011 survey of ivory markets in China*. IFAW, Yarmouth Port.
- . 2013. US calls for global destruction of illegal ivory. Available from <http://www.ifaw.org/united-states/news/us-calls-global-destruction-illegal-ivory>. Accessed 6 December 2013.
- [IISD] International Institute for Sustainable Development. 2014. Summary of the 65th meeting of the CITES Standing Committee, 7–11 July 2014. *Earth Negotiations Bulletin* 21(84):1–18. Available from <http://www.iisd.ca/cites/sc65/>. Accessed 14 July 2014.
- ITV. 2014. Hong Kong the gateway for illegal ivory entering China. 13 February. Available from <http://www.itv.com/news/2014-02-11/hong-kong-port-the-gateway-for-illegal-ivory-entering-china/>. Accessed 14 February 2014.
- Khanna J, Harford J. 1996. The ivory trade ban: Is it effective? *Ecological Economics* 19:147–155.
- Kremer M, Morcom C. 2000. Elephants. *The American Economic Review* 90(1):212–234.
- Lau M. 2014. China destroys 6.1 tonnes of confiscated ivory in gesture reflecting major policy shift. *South China Morning Post*, 6 January. Available from <http://chinadigitaltimes.net/2014/01/chinas-six-ton-ivory-crush-debated/>. Accessed 7 January 2014.
- Levin D. 2013. From elephants' mouths, an illicit trail to China. *New York Times*, 1 March.
- Ma Y. 2013. Experts: preserve animals, traditions. *China Daily*. Available from [http://africa.chinadaily.com.cn/weekly/2013-11/29/content\\_17141063.htm](http://africa.chinadaily.com.cn/weekly/2013-11/29/content_17141063.htm). Accessed 11 February 2014.
- MacMillan D. 2013. Crushing billion-dollar ivory stockpile is an empty gesture. *The Conversation*, 21 November. Available from <https://theconversation.com/crushing-billion-dollar-ivory-stockpile-is-an-empty-gesture-20509>. Accessed 22 November 2013.
- Martin E, Stiles D. 2000. *The ivory markets of Africa*. Save the Elephants, Nairobi.
- . 2002. *The South and South East Asian ivory markets*. Save the Elephants, London and Nairobi.
- . 2003. *The ivory markets of East Asia*. Save the Elephants, Nairobi and London.
- Martin E, Vigne L. 2011. *The ivory dynasty: a report on the soaring demand for elephant and mammoth ivory in southern China*. Elephant Family, The Aspinall Foundation and Columbus Zoo and Aquarium, London.
- . 2014. Luanda—the largest illegal ivory market in southern Africa. *Pachyderm* 55:30–37.
- Mason CF, Bulte EH, Horan RD. 2012. Banking on extinction: endangered species and speculation. *Oxford Review of Economic Policy* 28(1):180–192.
- Moore M. 2014. Beijing's elephant graveyard: how China still drives world ivory market. *The Telegraph*, 10 February 2014. Available from <http://www.telegraph.co.uk/news/worldnews/asia/china/10628900/Beijings-elephant-graveyard-how-China-still-drives-world-ivory-market.html>. Accessed 11 February 2014.
- Moyle B. 2014. The raw and the carved: tusk throughput in an ivory industry. Available from <http://sciblogs.co.nz/chthonic-wildlife-ramblings/2014/05/02/the-raw-and-the-carved-tusk-throughput-in-an-ivory-industry/>. Accessed 2 May 2014.
- Moyle B, Conrad K. 2014. The Chinese illegal ivory market: a pilot study. Available at SSRN: <http://ssrn.com/abstract=2459207> or <http://dx.doi.org/10.2139/ssrn.2459207>. Accessed 25 June 2014.
- Moyle B, Stiles D. 2014. Destroying ivory may make illegal trade more lucrative. *South China Morning Post*, 3 February. Available from <http://www.scmp.com/comment/insight-opinion/article/1420001/destroying-ivory-may-make-illegal-trade-more-lucrative>. Accessed 3 February 2014.
- [NPR] National Public Radio. 2014. Hong Kong to destroy ivory stockpile. 17 February. Available from <http://www.npr.org/2014/02/17/278389285/hong-kong-to-destroy-ivory-stockpile>. Accessed 18 February 2014.
- Orenstein R. 2013. *Ivory, horn and blood: behind the elephant and rhinoceros poaching crisis*. Kindle edition. Firefly Books, Richman Hill.
- Phipps M, Chen V. 1997. The ivory trade in Taiwan. In: *Still in business: the ivory trade in Asia, seven years after the CITES ban*, editor, Nash S. TRAFFIC International, Cambridge.
- Randolph S, Stiles D. 2011. *Elephant meat trade in Central Africa: Cameroon case study*. IUCN, Gland, Switzerland.
- Rice M. 2012. Legal ivory trading severely undermines elephant conservation. *The Ecologist*, 8 November.

- Available from [http://www.theecologist.org/News/news\\_analysis/1669938/legal\\_ivory\\_trading\\_severely\\_undermines\\_elephant\\_conservation.html](http://www.theecologist.org/News/news_analysis/1669938/legal_ivory_trading_severely_undermines_elephant_conservation.html). Accessed 10 November 2013.
- Russo C. 2014. Belgium crushes its elephant ivory as Europe takes harder look at wildlife trafficking. *National Geographic Daily News*, 9 April. Available from <http://news.nationalgeographic.com/news/2014/04/140409-elephant-ivory-trafficking-eu-brussels-ifaw-ivory-crushes-world/>
- Stiles D. 2004. The ivory trade and elephant conservation. *Environmental Conservation* 34(1):309–321.
- . 2009a. CITES-approved ivory sales and elephant poaching. *Pachyderm* 45:150–153.
- . 2009b. *The elephant and ivory trade in Thailand*. TRAFFIC Southeast Asia.
- . 2011a. Burning ivory stockpiles: what message does this send? *Swara* 34(4):11–12.
- . 2011b. *Elephant meat trade in Central Africa: Democratic Republic of Congo case study*. IUCN, Gland, Switzerland.
- . 2012. The ‘inconvenient truth’ about the ivory trade. *The Ecologist*, 22 November. Available from [http://www.theecologist.org/News/news\\_analysis/1690689/the\\_inconvenient\\_truth\\_about\\_the\\_ivory\\_trade.html](http://www.theecologist.org/News/news_analysis/1690689/the_inconvenient_truth_about_the_ivory_trade.html). Accessed 22 November 2012.
- . 2013. US ivory crush sends the wrong message to elephant poachers. *Theguardian.com*, 4 November. Available from <http://www.theguardian.com/environment/2013/nov/13/us-ivory-crush-sends-the-wrong-message-to-elephant-poachers>. Accessed 4 November 2013.
- . 2014. Can elephants survive a continued ivory trade ban? *National Geographic A Voice for Elephants*, 15 September. Available from <http://newswatch.nationalgeographic.com/2014/09/15/opinion-can-elephants-survive-a-continued-ivory-trade-ban/>.
- Stiles D, Martin E, Vigne L. 2011. Exaggerated ivory prices can be harmful to elephants. *Swara* 34(4):16–20.
- Thai PBS. 2014. Thailand to destroy massive ivory stockpiles. 28 June 2014. Available from <http://englishnews.thaipbs.or.th/thailand-destroy-massive-ivory-stockpiles/>. Accessed 6 July 2014.
- TRAFFIC International. 2013. ETIS Report of TRAFFIC CITES 16th meeting of the Conference of the Parties, Bangkok (Thailand), 3–14 March 2013. Doc. 53. 2. 2 (Rev. 1).
- ‘t Sas-Rolfes M. 1997. Elephants, rhinos and the economics of the illegal trade. *Pachyderm* 24:23–29.
- Underwood FM, Burn RW, Milliken T. 2013. Dissecting the illegal ivory trade: an analysis of ivory seizures data. *PLoS ONE* 8(10):e76539. doi:10.1371/journal.pone.0076539
- UNEP, CITES, IUCN, TRAFFIC. 2013. *Elephants in the dust—the African elephant crisis: a rapid response assessment*. United Nations Environment Programme, GRID-Arendal.
- [USFWS] US Fish and Wildlife Service. 2013. *Destruction of US ivory stockpile: questions and answers*. Available from <http://www.fws.gov/international>. Accessed 4 November 2013.
- US White House. 2014. Fact sheet: national strategy for combating wildlife trafficking and commercial ban on trade in elephant ivory. Available from <http://www.whitehouse.gov/the-press-office/2014/02/11/fact-sheet-national-strategy-combating-wildlife-trafficking-commercial-b>. Accessed 12 February 2014.
- Vigne L, Martin E. 2009. Consumer demand for ivory in Japan declines. *Pachyderm* 47:45–54.
- . 2011. Consumption of elephant and mammoth ivory increases in southern China. *Pachyderm* 49:79–89.
- Walker JF. 2009. *Ivory’s ghosts: the white gold of history and the fate of elephants*. Grove Press, New York.
- Walker JF, Stiles D. 2010. Consequences of legal ivory trade. *Science* 328:1633–1634.
- Wasser S, Poole J, Lee P, Lindsay K, et al. 2010. Elephants, ivory, trade. *Science* 327:1331–1332.
- Wendlandt A. 2014. Chinese demand for luxury goods hits a major slump. *Business Insider*, 25 July. Available from <http://www.businessinsider.com/r-ivmh-results-send-chill-across-luxury-goods-sector-2014-25#ixzz3Aup2ALdY>.
- Wittmeyer G, Northrup J, Blanc J, et al. 2014. Illegal killing for ivory drives global decline in African elephants. *Proceedings of the National Academy of Sciences* doi/10.1073/pnas.1403984111.
- Yu J. 2013. Standardized management of raw materials of ivory and other endangered wildlife and the utilization of them in China. Paper presented at the International Workshop for Transboundary Conservation of Tigers and Other Endangered Species, the Strategy for Combating Illegal Wildlife Trade, Kunming, China, July 2013.

