

DOI: <https://dx.doi.org/10.4314/sinet.v44i1.5>

Trend, Challenges and Opportunities of Illegal Wildlife Trafficking and Trade Activities within and through Ethiopia

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ABSTRACT: Having improved knowledge on global, regional and/or national trends in illegal wildlife trade is required to develop effective combating strategies. In this paper, nine years (2011–2019) data on illegal wildlife trade and trafficking (IWT) seizure records were used to explore trends in IWT activities in Ethiopia and to identify countries involved most in the IWT. Trends of IWT activities were assessed in two indicators: as relative transaction index (TI), and as relative weight index (for ivory [WI]) or as relative number of items for ivory and other wildlife products [NI]. To account for potential yearly variations in seizure rates, proxy variables to law enforcement efforts and effectiveness were used and predictive models that produced bias-adjusted estimates of relative trends in IWT activities were built. To explore the underlying reasons for the trend observed, relevant national officers were also interviewed to assess how well has been wildlife law enforcement working in combatting IWT in the country. Linear or polynomial regressions, where appropriate, were fitted to the seizure data to establish trends in transaction index over the nine years. A total of 842 incidences of IWT seizure instance reports, involving 18 animal species, were recorded in the country during the nine years period. However, the highest seizure (94%) rate was ivory and ivory products. Our results generally showed declining trends in both TI and WI or NI. The observed trend was also supported by the experts' opinions and likely reflects the positive impacts of the country's implementation of its wildlife laws. Other interesting findings of this study were that China represented the single most important destination country and Chinese nationalities were the most traffickers. In conclusion, the results provide detailed evidence to inform national and international decision making on key species implicated in the illegal trade. Similar periodic assessment of the situation of IWT within the country is needed to evaluate effectiveness of the country's past and present measures and to revise its future combatting policies and strategies.

Key words/Phrases: CITES; conservation; elephant; Ethiopia; ivory; law enforcement; poaching; wildlife products trafficking

INTRODUCTION

Unregulated exploitation of wildlife resources for illegal trade has been highlighted as a key development challenge globally. This challenge and the need to address it have been reflected in a number of international development and crime prevention organizations and conventions (World Bank, 2014; INTERPOL-UNEP, 2016; Global Financial Integrity, 2017). Illegal wildlife trade and trafficking (IWT) involves cross border transactions and its ever-increasing trend is driven by

consumers' increasing demand, high profitability, gaps in protection, compromised security and the world's increasingly interconnected systems of finance, communication and transport (INTERPOL-UNEP, 2016; Global Financial Integrity 2017; INTERPOL General Secretariat, 2018; Fetene Hailu, 2019). Levels of exploitation of some animal and plant species are high and the trade in them, together with other factors, such as habitat loss, is thought to heavily depleting their populations (World Bank, 2014). In addition to causing political instability and fostering cross-border organized crimes, wildlife poaching and IWT also cause

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serious socio-ecological and economic impacts, especially in developing countries (Mackay *et al.*, 2018; Fetene Hailu, 2019). Thus, having improved knowledge on global, regional and/or national trends in IWT, and identification of major trade routes are required to develop effective combating strategies.

IWT is currently ranked the fourth (after drugs, human, and arms trafficking) most valuable type of international organized crime (INTERPOL General Secretariat, 2018) and the second biggest direct threat to species survival, after habitat destruction (World Bank, 2014). The consequence of IWT is particularly more pronounced in the cases associated with the demand for rare, highly endangered species, because such species are nationally or internationally legally protected and/or cost high duties through legal trade and thus need to be illegally poached and smuggled (World Bank, 2014; INTERPOL General Secretariat, 2018; Rossi, 2018). Many such rare species like tigers, rhinoceroses and elephants have been severely threatened due to past and present illegal over exploitation (CITES Secretariat, 2012; Maisels *et al.*, 2017). Unfortunately, such rare and threatened species that are subjected to poaching and IWT are mostly keystone species that play crucial roles in maintaining ecosystem processes, functions and services that are vital to the development of human well-beings (EWCA, 2014; World Bank, 2014). The implication is that if the present scale of wildlife poaching and trafficking continues unabated, regional ecosystems face not just species extinction, but also a complete collapse of ecosystem processes and functions and associated heightened crisis of human well beings.

In addition to its detrimental consequences, IWT is diverse in nature—involves live animals and plants and a vast array of wildlife products derived from them—and crosses borders between countries and across continents (Milliken *et al.*, 2012; World Bank, 2014; INTERPOL-UNEP, 2016). The effort to regulate it thus requires cooperation among conservation and law enforcement agencies at various levels, ranging from national to regional and international scales (TRAFFIC, 2019). In this regard, cooperation systems have been formally established by creating international conventions (e.g., The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES Secretariat, 2012) and regional multilateral agreements (e.g., African Elephant Coalition and

Horn of Africa Wildlife Enforcement Network) (EWCA, 2015; TRAFFIC, 2019). In some party countries, these collaborative systems and implementation of commitments articulated in the convention and agreements have enabled them strengthen their national level law enforcement agencies, establish regional and international collaborations, and tighten their wildlife conservation and trade policies (EWCA, 2015). This, in turn, has enabled them reduce poaching at protected areas, effective detection and persecution of criminals involved in poaching and IWT within and through the countries (EWCA, 2014, 2015; Weru, 2016). Despite this, IWT still remains a major conservation and socio-economic development concern, especially in African countries as they are the primary origin and/or source region for ivory, rhino horn and other mammals' products (Vira *et al.*, 2014; Weru, 2016). Some of these countries, such as Kenya, South Africa and Ethiopia, have been known to be prominent source and transit points due to their large international airports with varied flight routes (Mackay *et al.*, 2018; Weru, 2016). It is therefore apparent that countries should have up-to-date, reliable information on IWT activities to implement effective combatting strategies.

In this article, trends in IWT activities within and through Ethiopia were assessed. The specific objectives of this study were to: (1) explore trends in IWT activities (i.e., number and amount of transactions) in the country in the last nine years; (2) identify countries involved most in IWT and major trafficking routes; and (3) examine what the views of Ethiopian national wildlife conservation managers and government law enforcement agencies concerning the trend in IWT, effectiveness of wildlife law enforcement and future needs in combating IWT in the country.

MATERIALS AND METHODS

Data

Three data sets were used to assess trends in IWT activities within and through Ethiopia and examine underlying factors for the observed trends. First, the database of IWT seizure records kept at EWCA'S CITES Management Authority was used. However, it is assumed that this seizure data may not necessarily reflect the actual amount of

IWT transactions in the country because not all illegal trade activities within a given year are seized (Underwood *et al.*, 2013). Consequently, data on potential variables that have been shown to affect the country's ability to make seizures each year were obtained (Underwood *et al.*, 2013). Finally, a subsidiary qualitative data set was collected through interviews of national wildlife managers and other law enforcement officers and these data were used for explaining the trend observed.

Seizures Data

Reports of IWT seizures in the country mainly come from several national law enforcement agencies, including IWT controlling staff working at EWCA HQs, protected area managers, customs authority (working at Bole International Airport and national borders checkpoints), and Federal and regional police. Seizures have been made based on regularly undertaken monitoring by customs authority, in collaboration with EWCA, at Bole International Airport and at key border checkpoints. Furthermore, planned operations of inspections of suspected shops in Addis Ababa city and in the regional towns have also been made by EWCA and Federal or regional police. Opportunistic observations of illegally possessed wildlife products have also been confiscated by any of these law enforcement officers. All such data have been recorded for the last nine years (2011–2019), updated and reported to CITES every year by the IWT Controlling Directorate in EWCA. Each seizure reports the agency that made the seizure; the date and place of the seizure; trafficker's profile (name, passport ID, nationality and sex); if traveling, travel status (resident, departure, arrival or transit); species identity; species' specimen seized (live animal, horn, ivory/tusk, skin, nail, etc) and quantity of the specimens (number and/or weight of items); and legal actions taken. In case of ivory, specimen types were recorded as raw ivory [tusks or pieces of tusks], worked ivory [curved or semi-curved pieces of ivory] and ivory product types (e.g., bracelet, ring, necklace, etc), and quantity was recorded as number of pieces and/or weight of raw and worked ivories and number of each product type.

Variables affecting the seizure rate

Following Underwood *et al.* (2013), seizure rate was assumed to be a function of law enforcement effort and law enforcement effectiveness. Law enforcement effort can be measured using data on resources (e.g., budgets, personnel, time, etc) allocated to law enforcement activities in each year (Underwood *et al.*, 2013). Accordingly, data on five variables relevant to measure law enforcement efforts were obtained from EWCA archives: number of personnel; number of days spent on controlling illegal wildlife product activities at Bole international airport; number of field expeditions made outside Addis Ababa; number of organized (EWCA and Federal or Regional Police) operations conducted; and number of shops visited. High values, in all cases, were assumed to suggest that the country is seizing a large proportion of what originates from within and/or passes through the country in a specific year.

Effectiveness of law enforcement in a given country is assumed to vary according to, among others, the background level of corruption or governance in the country (Underwood *et al.*, 2013). Thus, as proxy estimate for law enforcement effectiveness, five indicators shown to be potential indicators of illegal ivory transaction (Underwood *et al.*, 2013; The World Bank, 2020) were obtained: political stability, government effectiveness, regulatory quality, rule of law, and control of corruption. These variables had missing values for the year 2019 in which case averages of the eight years were used. In addition, an indirect measure of law enforcement effectiveness was also derived, which was defined it as law enforcement ratio. This law enforcement ratio in a given year was defined as the proportion of all seizure instances in that year for which legal persecution was successfully accomplished in terms of service in prison and/or monetary fines.

Interview

To assess opinions of national wildlife and other law enforcement officers concerning how well wildlife law enforcement has been working in the country in the last decade, semi-structured interviews were conducted in November 2019 with (i) relevant experts working in EWCA HQs (5 persons), (ii) wildlife rangers, experts and managers working in five national parks where

elephant poaching has been known to be greatest (15 persons), and (iii) federal and regional law enforcement agents, including those working at Bole International Airport and key border points, such as customs authority, police, security agent, defense force and judiciaries (15 persons).

Questions addressed to officers of the different agencies slightly varied depending on the actual and potential roles they play in combatting IWT. However, the overall content of the questions covered concepts related to: perceptions of overall trend in IWT activities; extent of collaboration and flow of information between key actors involved in IWT controlling agencies in the country; adequacy of current technical capacity and legislations; challenges for persecuting, arresting and trailing of offenders; awareness, commitment and involvement of stakeholders, including local communities and government in fighting poaching and wildlife trafficking; availability and use of information technologies solutions; management system of seized wildlife products; mechanisms and extent of cross-border and international collaborations; and recommendations for future improvement.

Data analysis

Estimating ivory weight

Only a third of ivory seizures reported both number of pieces and weight of seizures, although number of pieces was recorded for each seizure instance. Thus, prior to estimating transaction and volume indexes, weights for the remaining records were estimated using equation of a regression model fitted to seizure records that reported both the number of pieces and weight of raw and worked ivory (Underwood *et al.*, 2013). As the numbers of raw and worked ivory seizures were too small to separately model, these data were combined for the regression modeling. To make comparable raw and worked ivory weights for the combined analysis, the Raw Ivory Equivalent was calculated by dividing worked ivory weights by 0.7 to account for an average 30% loss of ivory in the carving process (Milliken *et al.*, 2012; Underwood *et al.*, 2013). Both the response (weight of ivory per seizure) and the predictor (number of pieces) were log-transformed prior to analysis. These analyses were carried out using SPSS statistical software (IBM, 2011).

Estimating Relative Transaction and Trade Volume Indexes

IWT activity was described in two indicators: as Relative Transaction Index (TI), a measure of the frequency of illegal trade in wildlife products in and through the country in each year, and as Relative Quantity Index, a measure of the volume or amount of wildlife products in trade in each year (Underwood *et al.*, 2013). Relative quantity index was further defined as relative weight index of ivory [WI] and as relative number of items of ivory products or other species' specimens [NI]. To estimate year-specific seizure rate, the 11 candidate seizure rate proxy variables described above were first summarized using principal component analysis (PCA). This was conducted based on correlation matrix and Varimax rotation to account for the difference in variances among the variables (Quinn and Geough, 2002). The first four components with eigen values of greater than 1 explained 86 % of the variation in the dataset. These component scores were used as predictor variables to model the seizure data.

The negative binomial distribution with log-link function was used to build the models, which is more appropriate than Poisson distribution for count data with over dispersion like in the present dataset (Quinn and Keough, 2002). Model fit was evaluated using scaled deviance; in the present study it fell below 1 (in all cases = 0.165–0.760), suggesting better fit of the model including the predictors compared to the intercept only (Quinn and Keough, 2002). From this model, predicted number of seizures were obtained for each year, which represents bias-adjusted (i.e., variations in law enforcement over years were accounted for) relative number of seizures in each year. The predicted seizure was defined as Relative Transaction Index (TI). Then, the estimated TI values were regressed on year, using linear or polynomial regressions where appropriate, to establish trends in TI over the nine years. Model fit was examined using the regression coefficient determination (R^2), which measures the proportion of the total variations in the dependent variable that is explained by its relationship with the predictor (Quinn and Keough, 2002). All these analyses were conducted on overall seizure data, on ivory related seizures (raw/worked ivory and ivory products), ivory (raw and worked) only, ivory products only, and other species' products seizures.

To estimate bias-adjusted relative total WI and NI in each year, the total weight in each year was multiplied by the ratio of the predicted number of seizure (or TI) in a year to number of actual seizure records in each respective year. Each of these indexes was then regressed on year (using linear or polynomial regressions) to establish the trend in WI and NI. All these statistical analyses were carried out using SPSS statistical software (IBM, 2011).

Descriptive analysis (e.g., mean and percentage) was carried-out to characterize demographic features of traffickers and to identify countries that play a major role (i.e., implicated as an origin and/or destination) in the IWT within and through Ethiopia.

National law enforcement officers' opinions

A qualitative content analysis method was used to analyze the textual data obtained through experts interview (Neuendorf, 2019). First, each interviewee's responses were read and reread several times to better understand the concepts contained within the responses. Second, contents of each interviewee's responses were subjected to open coding process, during which descriptive codes were assigned to fragments of text on a variety of levels, including words, phrases, clauses, sentences, or paragraphs. Third, a selective coding procedure was applied to concepts that emerged from the open coding procedure where similar concepts were inductively grouped together into code main categories (themes) and subcategories. Finally, the emerged main categories and subcategories were examined in detail again to make sure the original data truly support these themes and categories (Corbin, 2008; Neuendorf, 2019). Then, findings of these analyses were presented to stakeholders who generated the data on a workshop held at Wabe Shebelle hotel in Addis Ababa on 20 May 2019 to validate the results and to obtain additional inputs. This process had helped us refine the main categories and subcategories identified from the interviews and describe them focusing on the strengths, weaknesses or limitations and existing opportunities on which to capitalize to reverse the weaknesses.

RESULTS

Summary of seizure data

Overall, 842 seizure reports were recorded in Ethiopia during the period of 2011–2019, representing 19 animal species (3 reptile, 4 bird and 12 mammal species). However, disproportionately the highest seizure (94%) was Elephant ivory and ivory products, followed by Leopard (skin and claws) and Hippopotamus tusks. Types of specimens seized ranged from eggs and live birds to horns of ungulates and to tusks (raw, worked and products) of Elephant, Hippo and Pigs. Fifty-four ivory (22 worked and 32 raw ivory) and 736 ivory products seizure instances were reported during the period (Table 1). This constituted 291 (38 worked and 253 raw) ivory pieces, with estimated total weight of ca. 1,055 kg (range = 250 g to 280 kg), and 3,879 items of various ivory product types (Table 2). Ivory product types included: hand bracelets, hair comb, chopstick, seal pad/stamp, finger ring, cigarette holder, animal or human figurine, and necklace. Hand bracelets contributed to almost half of the total items (Table 3). Specimens or products of other species accounted for only 7% (n = 59) of the total seizure reports and 299 items (Table 1 and 2). These products included 65 claws, 11 teeth and 38 skins of Leopard; 11 teeth and six bones of Lion; four teeth and three live cubs of Cheetah; and 50 raw and eight worked hippo tusks (Table 4).

Table 1. Number of instances of records of ivory (worked/raw), ivory products and other species products represented in the seizure database of EWCA during the nine years period.

Year	Worked Ivory	Raw Ivory	Total ivory	Ivory products	Others
2011	12	3	15	195	3
2012	5	6	11	107	5
2013		3	3	154	3
2014		1	1	101	5
2015	1	3	4	97	18
2016	3	7	10	33	9
2017		4	4	37	4
2018	1	2	3	10	6
2019		3	3	2	6
Sum	22	32	54	736	59

Table 2. Number of pieces and weight of worked and raw ivories, number of ivory products, and number of other species' products represented in the seizure database of EWCA during the nine years period (2011–2019).

	No. pieces (worked)	No. piece (raw)	Total no. piece*	Ivory weight*	Ivory products	Others
2011	23	3	26	40	1119	5
2012	6	8	14	22	493	13
2013		54	54	389	886	6
2014		1	1	0.25	298	95
2015	1	7	8	92	344	81
2016	4	158	162	431	334	22
2017		16	16	55	349	5
2018	4	4	8	13	53	59
2019		2	2	13	3	13
Sum	38	253	291	1055	3879	299

*represent the sum of raw and worked ivories.

Table 3. Number of items of the different ivory product types in the seizure database of EWCA during the nine years period.

Year	Cigarette holder	Earrings	Necklace	Bracelets	Bars	Ring	Sealpad/s tamp	Chopstick	Figurine	Comb	Others	Total
2011	52	21	249	545	13	75	33	89	21	13	8	1119
2012	11		43	297		12	46	76	3	4	1	493
2013	17	2	74	600	2	77	56	30	22	6		886
2014			74	189		10	7	2	6	4	6	298
2015	11	4	80	180		24	10	21	11	3		344
2016			23	295		10	2		3		1	334
2017	9		99	136		57	7	20	1	20		349
2018	1		23	19	4	5			1			53
2019			1	1	1							3
	101	27	666	2262	20	270	161	238	68	50	16	3879

Overall, 103 (12%), 62 (7%), and 677 (80%) of seizure incidences were made upon departure, from residents who possessed for sale or private use and on transit, respectively. Of the total seizure incidences, 96% of the total seizure incidences were made at Bole International Airport. Law enforcement agencies making seizures of illegal wildlife product trafficking included: EWCA HQs and PAs law enforcement departments; Regional Police (i.e., Addis Ababa Police Commission, Oromia; Amhara and Southern Regional police); customs authority (at Bole International Airport and at border checkpoints such as Methema, northern at Ethio-Sudan border, and Moyale in the south at Ethio-Kenya border, Togochale in the eastern at Ethio-Somali border); Defense Force; and Federal Police. Of the total seizure instances, 646(77%) IWT traffickers had appeared on court: 621 were fined financially ranging from 1,500–30,000 birr (mean $\pm$ SD = 9,783 $\pm$ 228 birr; equivalent to USD 42–833), 7 traffickers with

imprisonment service of 1–2years, and 18 released free for unclear reasons.

Seizure rate proxy variables

Results of the PCA on the proxy variables of seizure rate showed that the first four PCA axes explained 86% of the total variation in the seizure rate proxy variables. The first axis explained 29% of the total variation and was most correlated with two law enforcement effort proxy variables (number of days on control at BIA, component score = 0.931, and percent persecuted= 0.888), and two law enforcement effectiveness proxy variables—i.e., the World Bank's governance indicators—(regulatory quality = -0.669, and rule of law = 0.724). While the second component explained 21% of the total variation and was most correlated with corruption control (score = 0.975). The third and fourth components explained 19% and 18% of the total variation in the dataset,

respectively (Table 5). Component scores of these four axes were used to estimate relative transaction index.

Table 4. Number of seizures and items of animal species (excluding elephant) represented in the nine years (2011–2019) IWT seizures data.

Species	Body parts/items	No. seizures	No. items
Cheetah	Cubs, teeth	2	7
Crocodile	Skin, Bag made of skin	1	1
Duiker	Horn	1	1
Egyptian goose	Live	1	1
Gazelle	Poached (whole part)	6	6
Giant Hog	Tusk	2	3
Guinea fowl	Live	1	1
Hippo	Tusk (raw/worked), necklace	10	58
Klipspringer	Skull	1	1
Kudu	Poached (whole part)	1	1
Leopard	Claws, teeth, skins	16	114
Lion	Claws, teeth, Bones	5	17
Lovebird	Live	7	17
Ostrich	Eggs	2	3
Porcupine	Spikes	1	27
Python	Skin, Bag made of skin	2	2
Tortoise	Live	2	2
Warthog	Tusk, figurine, keyholder, candle holder	13	37
Total		59*	299

Trends of transaction and trade volume

Only the first two component axis had significant relationships with the seizure data. PCA 1 was positively and significantly correlated with overall, ivory and ivory products, and ivory products seizure rates (Parameter estimates [mean $\pm$ SE], overall = 0.966 ± 0.255 ; ivory and ivory products = 1.120 ± 0.312 , ivory products = 1.117 ± 0.350 , in all cases, Wald $\chi^2 = 10.202$ – 14.383 , df = 1, $P < 0.05$). This means seizure rates of these items were positively correlated with our two law enforcement effort proxy variables—number of days on control at BIA, and percent of traffickers persecuted—and with two law enforcement effectiveness proxy variables—regulatory quality and rule of law. PCA 2 was, however, negatively associated with seizures rate of ivory (Parameter estimates [mean $\pm$ SE], ivory: -0.458 ± 0.229 , Wald $\chi^2 = 3.977$, df = 1, $P < 0.05$) (Table 6), and positively with other: 0.395 ± 0.153 , Wald $\chi^2 = 6.662$, df = 1, $P < 0.05$).

Table 5. Rotated Component Matrix (based on Varimax rotation method) of the proxy variables for predictors of seizure rate.

Variable	Proxy for	Component			
		PCA 1	PCA 2	PCA 3	PCA 4
No. days on IWT control at BIA	LE effort	0.931	-	-	-
No. field expedition trips	LE effort	0.071	0.485	-	-
No. operations	LE effort	0.053	-	0.850	0.144
No. shops inspected	LE effort	0.166	-	0.923	-
No. staff	LE effort	-	0.652	-	-
Percent sentenced	LE effectiveness	0.888	-	0.309	0.177
Corruption Control	LE effectiveness	-	0.975	-	-
Regulatory Quality	LE effectiveness	-	-	0.199	0.011
Government effectiveness	LE effectiveness	0.668	0.473	0.087	0.074
Rule of Law	LE effectiveness	0.334	-	0.347	0.600
Political stability	LE effectiveness	0.037	0.272	-	0.915
Rule of Law	LE effectiveness	0.724	-	0.354	0.243

Table 6. Parameter estimates of Generalized Linear Model analysis of seizure data on the first two PCA for overall seizure, ivory and ivory products, ivory, and ivory products. (In all cases, df =1, and statistically significant values are shown in asterisk).

Parameter	Overall		Ivory and ivory products	
	B $\pm$ SE	Wald χ^2	B $\pm$ SE	Wald χ^2
Intercept	4.216 $\pm$ 0.222	361.178*	4.068 $\pm$ 0.263	239.385*
PCA 1	0.966 $\pm$ 0.255	14.383*	1.120 $\pm$ 0.312	12.922*
PCA 2	-0.191 $\pm$ 0.255	0.715	-0.223 $\pm$ 0.269	0.684

Parameter	Ivory		Ivory products	
	B $\pm$ SE	Wald χ^2	B $\pm$ SE	Wald χ^2
Intercept	1.602 $\pm$ 0.227	49.834*	3.997 $\pm$ 0.295	183.339*
PCA 1	0.232 $\pm$ 0.259	0.803	1.117 $\pm$ 0.350	10.202*
PCA 2	-0.458 $\pm$ 0.229	3.977*	-0.226 $\pm$ 0.303	0.556

The TI showed linear declining trend of illegal transactions in overall wildlife products ($R^2 = 0.80$), ivory and ivory products ($R^2 = 0.77$), and ivory products ($R^2 = 0.75$). However, TI of ivory, which was best fitted by cubic polynomial function ($R^2 =$

0.64), had bimodal trend: declining from 2011-2014, increasing up to 2017 and declining afterwards. No clear pattern was found for transaction in other species products (Figure 1a-e).

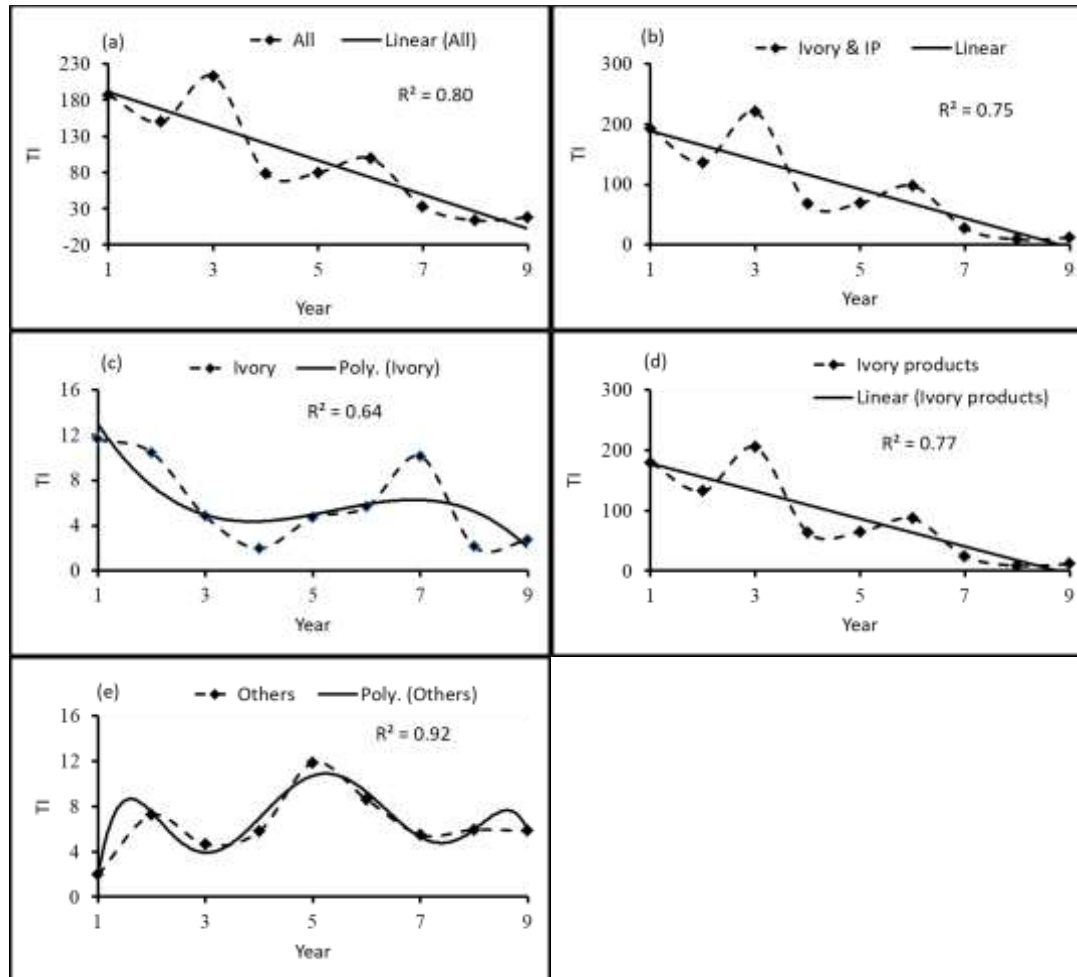


Figure 1. Trends in Transaction Index (TI) of illegal wildlife and wildlife products trade in and through Ethiopia during the period of 2011-2019: (a) all (all species and/or products) transaction, (b) ivory and IP (IP = ivory products), (c) ivory (raw and worked), (d) ivory products, and (e) others (transaction in other species rather than elephant). For each variable, broken lines are predicted transaction indexes (TI) and solid lines are trend line (linear or polynomial functions) fitted to the TI. R^2 values are the variance explained by the best trend line equation.

Relative ivory weight index showed a non-linear declining pattern: increasing from 2011 to 2013, followed by decline until 2015, and increasing from 2015 to 2017 and declining then

after (Figure 2a). While trade volume in ivory products was characterized by linear declining trend overtime, a unimodal trend was found for other species products (Figure 2b-c).

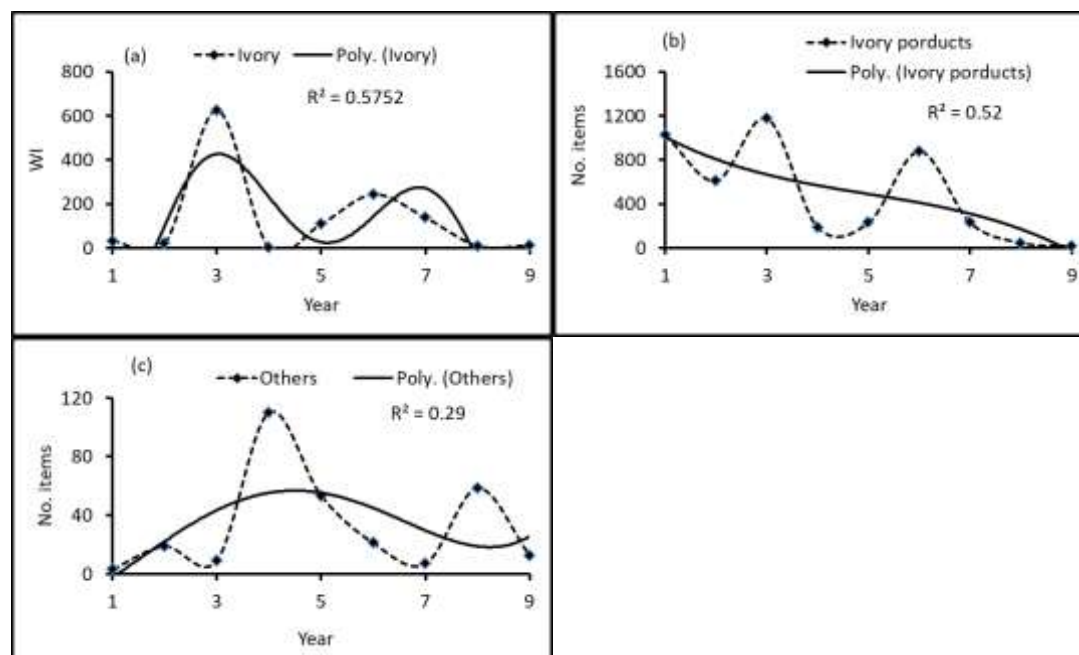


Figure 2. Trends in volume of illegal wildlife and wildlife products trade in and through Ethiopia during the period of 2011–2019: (a) weight index (WI) of ivory (raw and worked), (b) number of items of ivory products, and (c) number of items of other species. For each variable, broken lines are predicted trade volume indexes and solid lines are trend line (linear or polynomial functions) fitted to the predicted volume. R^2 values are the variance explained by the best trend line equation.

Traffickers' demography and trafficking routes

People involved in IWT within and through Ethiopia were nationalities of 41 countries. The majority of traffickers were Chinese nationalities (668 cases, or 79% of the total cases recorded), followed by Ethiopians (38, or 5%), Nigerians (14 cases, or 2%) and USA (2%). Of the total 833 seizure instances that recorded sex of trafficker, 133 (18%) and 800 (82%) of traffickers were females and males, respectively. Age of traffickers ranged between 15 to 88 years, with mean ($\pm 95\%$ CI) 40.41 (± 0.79) years.

Overall, 58 countries were implicated in the seizures data record, with 24 and 18 countries serving as origin and destination of IWT, respectively, with 17 countries serving both as origin and destination (Appendix 1). The six countries with most frequently implicated as origin of wildlife products for international illegal trade were Nigeria (129 seizure incidences; or 16% of total seizures), Angola (118; 15%), Ethiopia (103; 12%), Equatorial Guinea (54; 9%), DRC (42; 5%) and Ghana (39; 5%). However, China represented the single most important destination country for IWT from and through Ethiopia, accounted for 94% (697

seizures) of the total seizure instances across the period. Other countries implicated as destination country included USA (12; 2%), Vietnam (6; 0.8%), Saud Arabia (6, 0.8%), UAE (5; 0.7%) and UK (5, 0.7%) (Appendix 1). As the result shows that major trafficking route (linking origin, transit and destination countries) is from Africa to middle-east and European countries.

Considering ivory separately, origin of ivories (raw and worked) in trade were from 13 countries (Table 7). China was implicated as the intended destination country for all or most of these seizures originating from each country, both in terms of frequency of seizure and volume (total number of pieces or weight) of ivory transactions. Of the total 23 seizures (92 pieces) of 952 kg of ivory seized in Ethiopia, 10 (44%) and 462 (49%) were intended to China (Table 7) and the remaining was seized either from shops and poachers. Analysis of the correspondence of illegal wildlife products traffickers' nationality and the origin or destination countries of the products showed that only 10% (84 of the 842 total seizure instances) of the traffickers were nationalities of

the products origin countries while 90% (758) were nationalities of the destination countries.

Table 7. Origin, number of seizures, number of pieces and weight of ivory (raw and worked) intended to all destination countries (Total) and China.

Origin country	No. seizures		No. pieces		Weight (kg)	
	Tot al	Chi na	Tot al	Chi na	Tot al	Chi na
Angola	7	5	35	5	91	10
Congo Brazzaville	1	1	1	1	3	3
Congo Kinshasa	4	4	6	6	20	20
DRC	4	4	3	3	29	29
E. Guinea	3	3	9	9	24	24
Ethiopia	10	10	92	92	462	462
Nigeria	4	4	29	29	117	117
Rwanda	2	1	26	1	106	3
South Africa	1	1	17	17	37	37
Sudan	1	1	2	2	6	6
Uganda	1	0	13	0	33	0
Zambia	1	1	4	4	13	13
Zimbabwe	1	1	9	9	32	32
Grand Total	40	36	246	178	973	756

Opinions of national law enforcement officers on the status of wildlife law enforcement

Three major themes and seven categories were identified from the interview conducted with national wildlife experts and law enforcement officers concerning effectiveness of wildlife law enforcement: (i) law enforcement with four categories (i.e., policy and legislation, capacity, methods and tools for IWT intelligence and investigations, and partnership and collaboration); (ii) seizures stock and information management, with two categories (seizure wildlife product stock management, and seizure data management and information sharing); and (iii) education and awareness. The situation of each of these themes and categories in the last decade (i.e., strengths and weaknesses/limitations) and present initiatives on which to capitalize to turn the weaknesses into strengths were summarized and described in the following subsections.

Law enforcement

Wildlife policy and legislation was the most frequently cited issue/category under this theme. According to the informants' opinion, Ethiopia has a long history of enacting wildlife conservation

and utilization legislation, dated back to 1900s. The current legislation is assumed to be comprehensive and articulates strict regulatory frameworks. However, the legal framework concerning wildlife crime has been reported by the officers to have some gaps that hinder effective implementation. In particular, sentences provided in the current wildlife regulation do not serve as deterrents. Furthermore, standard operational procedures for prosecuting and sentencing wildlife criminals have not been in place. Nonetheless, these gaps were identified in 2018 and draft amendments are now submitted to the House Peoples of Representatives Parliament for endorsement. EWCA has also played a pivotal role in the establishment of an environmental crime unit for the first time. The environmental crime unit is part of the federal serious crime court whose members are drawn from EWCA, federal police, Attorney General. This establishment is thought to accelerate the speed of investigation and trails for crimes related to wildlife smuggling. Standard operational procedures for prosecuting and sentencing criminals are also developed for the unit. However, building internal capacity across relevant law enforcement agencies, such as strengthening EWCA capacity in the intelligence section, improving capacity for prosecution, litigation and judiciary are required to effectively combat IWT in the country.

Other bottlenecks stated by the officers for combatting IWT in the country have been lack of technical capacity of EWCA staff and other relevant stakeholders and lack of methods and tools needed to identify, seize, arrest and prosecute criminals. Conservation managers and experts stated that there has been lack of capacity needed for effective law enforcement at the protected areas. This capacity lack revolves around resource constraints, such as the low number and competence of law enforcement personnel, and financial and equipment constraints. Similarly, inadequate capacity across other relevant local and national law enforcement agencies were reported, which has led to poor capacity of in detecting wildlife poaching, prosecution, litigation and judiciary processes. They recommended, stating the fact that although initiatives are undergoing, that these challenges need to be resolved to minimize risk of poaching wildlife and also to effectively work with local collaborators, including local communities, district administrators and law enforcement

agencies. Furthermore, the officers have also indicated that IWT prosecution methods and tools are still the traditional ways. The use of forensic techniques for prosecutions and detection of origin of seized ivory has been lacking. Despite these constraints, with the aid of EMPA project, some promising progress is recently undergoing. For example, initiatives to establish intelligence networks of EWCA up to site levels (five sites known to be vulnerable to poaching) to curb illegal wildlife trade and trafficking has been started. This may involve improving detection and seizure probabilities and information sharing using modern technologies, such as SMART technique and introducing the use of sniffer dog at Bole International Airport.

Given the seriousness and complexity of IWT activities, combating these activities requires forging strong partnership and collaboration with key actors ranging from local communities and government agencies to national government law enforcement agencies, and to regional and international law enforcement agencies. In this regard, wildlife officers at the EWCA HQs stated that Ethiopia has relatively achieved a good success at establishing regional and international collaborative and coordination systems to fight IWT. For example, the country has signed conventions/agreements such as CITES and INTERPOL at international level, and IGAD, AECI and HAWEN at regional (transboundary) level. However, as stated by the officers, although in pipeline at present, establishing effective partnership and collaboration with local communities, national regional states and national law enforcement agencies has been remained challenging. Accordingly, they recommended that the currently established National, Regional and Local taskforces should be formalized and capacitated.

Management of IWT seizures stock and data

EWCA wildlife officers have disclosed their thought that current Ethiopia's ivory stock management and security is insecure. They quoted, as an evidence to support their claim, the theft of about 1700 kg of ivory from EWCA store in 2003. In addition, officers working both EWCA HQs and protected areas stated that currently ivory stock is present only at EWCA's HQs, in Addis Ababa, but several ivories confiscated from

poachers by protected area or local law enforcement agencies or discovered from dead elephants (due to natural mortality) are usually kept at protected areas and in the regional customs' stocks until transported to Addis Ababa. This obviously poses a serious security risk and theft.

Another major issue raised by the officers under this theme was lack of central database and poor mechanisms for sharing, dissemination and obtaining feedback of data and information about IWT seizures among law enforcement agencies. Current data collection and recording protocols are even unstandardized and do not allow consistency and record of detail information on IWT seizures. EMEPA project has incorporated in its plan the establishment of a central database at EWCA HQs and mechanisms to share among key law enforcement actors.

Education and awareness

Inadequate education campaign at all levels (local community to national authorities) has led the public to have low level of awareness of the social, ecological, cultural and economic importance of Ethiopia's wildlife and the negative consequences of wildlife crime (poaching and IWT) on this natural capital. While this lack of awareness has resulted in increased human-wildlife conflicts and poaching at local level, it has resulted to poor support from government officials, particularly at parliamentary and cabinet level, in passing tight law enforcement provisions. This challenge has been in operation until very recently, but currently seems to be improved. For instance, mass environmental education campaigns have been conducted in the last three years, using national TV and radio channels in five local languages. This campaign is believed to increase the public awareness/knowledge and support of stakeholders at all levels (local community to national authorities). EWCA has posted posters at all domestic and international airports, instructing people not to buy ivory and on penalties that many people may be unaware of. Furthermore, all currently relevant laws and policies in effective have been disseminated to all stakeholders.

DISCUSSION

Our assessment of trends in IWT in and through Ethiopia during the period of nine years (2011–2019) showed a declining trend in overall illegal transactions. However, trade in ivory was non-linear trend: declining from 2011–2014, increasing up to 2017 and declining afterwards. The relative ivory weight and number of ivory products also exhibited an increasing trend patterns from 2011 to 2014 and declining then after. In addition to establishing the trend, this study has also highlighted the likely reasons underlying the observed trend and countries involved in illicit wildlife trade and major trafficking routes, particularly the trade in ivory and ivory products, in and through Ethiopia.

Analysis and description of trends in IWT activity, including ivory and ivory products trade, is an important step for an eventual analysis of the drivers of these trends. A particular concern to EWCA is whether implementation of national and multilateral international policies and plans have had an impact on the trade. In this regard, the overall decline in IWT in the present analysis, including the recent decrease in illegal ivory trade activity, may therefore reflect the level of efforts and effectiveness of the country in implementing such policies and other initiatives, such as implementation of the national ivory management and elephant action plans (EWCA, 2014, 2105) and other associated projects. In addition, commitment of other source and destination countries in implementing international and national agreements may also be contributing factors to the observed trend. As was also commented by the national wildlife and law enforcement officers, all such national and international efforts might have resulted in reduced poaching, trafficking, and/or demands globally and nationally within Ethiopia (Milledge and Abdi, 2005).

Although many countries are involved in IWT, some are found to be key players of origin and destination of IWT. China, a country known to be the single most important destination country for IWT globally (Burn and Underwood, 2011), is also revealed in the present study. Similarly, countries such as Angola, Equatorial Guinea, Nigeria, DRC and Ghana (Milliken *et al.*, 2012; Weru, 2016; Mekbeb Tessema, 2017) that have been implicated as major origins of ivory appear to be key origin of ivory trade through Ethiopia. Furthermore, our

results demonstrate that 80% of the total seizure instances have been seized from traffickers in transit at Bole International Airport and the remaining on departure and confiscated from shops and illegally possessed persons. As also reported by Mekbeb Tessema (2017), our findings suggest that Ethiopia's key role in IWT has been serving as a pivotal hub point between source and end-use countries, but also serves as a source of wildlife products for both international and domestic markets. Vigne and Martin (2008) have reported that Addis Ababa is the fifth cities in Africa with high volume of illegal trade where retailer shops sale ivory and ivory products solely to foreigners, including diplomats and project workers. Although Martin and Vigne (2011) stated that ivory trade in the city had declined over the period between 2008 and 2011, due to government's increased law enforcement efforts, it was difficult to explore this as the seizure data used for this study were collected on *ad hoc* basis, instead of following standard research approaches applied by the previous authors. Thus, systematic inventory of ivory and ivory products in all potential retail shops in the city and comparing that with previous reports would help assess the trend of ivory transaction in Addis Ababa. Furthermore, the source of ivories seized within Ethiopia (on departure or from shops) is unclear, but it could be from elephants poached in the country and/or from neighboring countries, mainly from Kenya, Sudan and South Sudan (see also Martin and Vigne, 2011). Future works should focus on identifying such sources, for example by tracing elephant poaching incidences and ivory seizures and applying forensic analysis.

Although it is difficult to deduce absolute quantities of ivory and other product types in circulation within and through Ethiopia, our analysis demonstrated about the trend in IWT activity in Ethiopia. The methodology used in this paper has enabled major sources of bias in seizures data to be reduced by using key predictors of variation in the seizure over time. Thus, future similar analyses should adopt our approach to overcome the pitfalls of using simple summaries of illegal seizures data that do not account for these biases and that can be misleading in recognizing both countries of most concern and trends over time. Furthermore, most of the species involved in illegal trade are those known to be globally threatened, including the elephant (vulnerable),

hippopotamus, lion, leopard and cheetah (IUCN, 2020). These species, in addition to habitat loss and fragmentation, are known to be adversely affected by poaching (Yirmed Demeke and Afework Bekele, 2000; EWCA, 2014, 2015). Thus, analysis of trends in poaching and trade data would enable conservation managers and policy makers device effective strategies that would help reduce illegal poaching and trade and ensure their perpetuity and maintain the ecological functions they play and ecosystem services they provide to humans.

In conclusion, our analysis demonstrates that IWT activity in Ethiopia is on declining, probably reflecting the impacts of government policies and interventions. However, as also commented by national wildlife and other law enforcement officers, there are some critical issues in fighting poaching and IWT in the country. This includes, *inter alia*, low level of law enforcement capacity, inadequate collaboration and coordination between wildlife and other law enforcement agencies at all levels, poor detection and seizure rates, and lack of central database and systems of information sharing among stakeholders. Despite this, there are opportunities which Ethiopia can capitalize on to overcome these challenges. Ethiopia has currently received funding supports from some international organizations such as FZS, GIZ, and GEF-UNDP to implement wildlife conservation projects. Some of such projects, particularly the GEF-UNDP project, are directly targeting to contribute to halt the challenges to contain wildlife crime (poaching and IWT). Therefore, the following actions should be taken by EWCA and these projects to significantly reduce poaching and IWT in the country. Capacity building trainings should be provided to EWCA staff and other relevant local and national law enforcement officers and other stakeholders on wildlife laws, seizure, arresting, reporting, information sharing and technology use procedures. Maintenance of the established local, national and international collaboration systems should be seen as a major opportunity to fight IWT. Endorsement and proper implementation of the proposed draft amendment of wildlife law and ensuring the functionality of the newly established Environmental Crime Unit are also of paramount importance to reduce IWT. Given the use of sophisticated techniques for transporting illegal wildlife products, the use of sniffer dog for detection at Bole International Airport is crucial to

improve detection and seizure probabilities. Finally, establishment of a central database and systems of information sharing among stakeholders and increasing the spatial coverage of current public awareness campaign are key tasks of EWCA and its partner NGOs.

ACKNOWLEDGMENTS

We are thankful to all the officers and experts for their willingness and time to provide us information during the interview. Financial support for data collection was received from the GEF 6/UNDP project "Enhanced Management and Effectiveness of Ethiopia's Protected Area Estate".

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Appendix 1. Countries implicated in the seizures data record serving as origin, destination and both of wildlife products.

Countries	Origin: No. (%)	Destination: No. (%)	Countries	Origin: No. (%)	Destination: No. (%)
Angola	118 (14.0)		Mozambique	20 (2.4)	
Australia		1 (0.1)	Niger	3 (0.4)	
Belgium	1 (0.1)	2 (0.2)	Nigeria	129 (15.3)	1 (0.1)
Benin	14 (1.7)	1 (0.1)	North Korea		1 (0.1)
Burkina Faso	5 (0.6)		Norway		1 (0.1)
Burundi	4 (0.5)	1 (0.1)	Philippines		1 (0.1)
Cameroon	12 (1.4)		Qatar		2 (0.2)
Canada		1 (0.1)	Rwanda	14 (1.7)	
Chad	8 (1.0)		Saudi Arabian	6 (0.7)	6 (0.7)
China	3 (0.4)	698 (82.9)	Senegal	16 (1.9)	
Congo	37 (4.4)	1 (0.1)	Sierra Leone	1 (0.1)	
Cote D'ivoire	6 (0.7)		Somali Land	1 (0.1)	
Djibouti	2 (0.2)		South Africa	4 (0.5)	
DR Congo	51 (6.1)		South Sudan	9 (1.1)	
Egypt		2 (0.2)	Sudan	23 (2.7)	4 (0.5)
Equatorial Guinea	62 (7.4)		Sweden		1 (0.1)
Ethiopia	103 (12)	62 (7.4)	Tanzania		4 (0.5)
France		3 (0.4)	Thailand	1 (0.1)	2 (0.2)
Gabon	17 (2.0)		Togo	11 (1.3)	1 (0.1)
Germany		1 (0.1)	Turkey		1 (0.1)
Ghana	39 (4.6)		Uganda	4 (0.5)	1 (0.1)
Guinea Bissau	1 (0.1)		Britain		5 (0.6)
India	5 (0.6)	1 (0.1)	UAE	1 (0.1)	
Israel		1 (0.1)	USA	1 (0.1)	12 (1.4)
Italy	1 (0.1)	1 (0.1)	Vietnam		11 (1.3)
Kenya	2 (0.2)	3 (0.4)	Zambia		3 (0.4)
Liberia	4 (0.5)		Zambia	6 (0.7)	
Malaysia		1 (0.1)	Zimbabwe	17 (0.2)	
Malawi	8 (1.0)				
Mali	10 (1.2)	1 (0.1)			
			Total	842	842