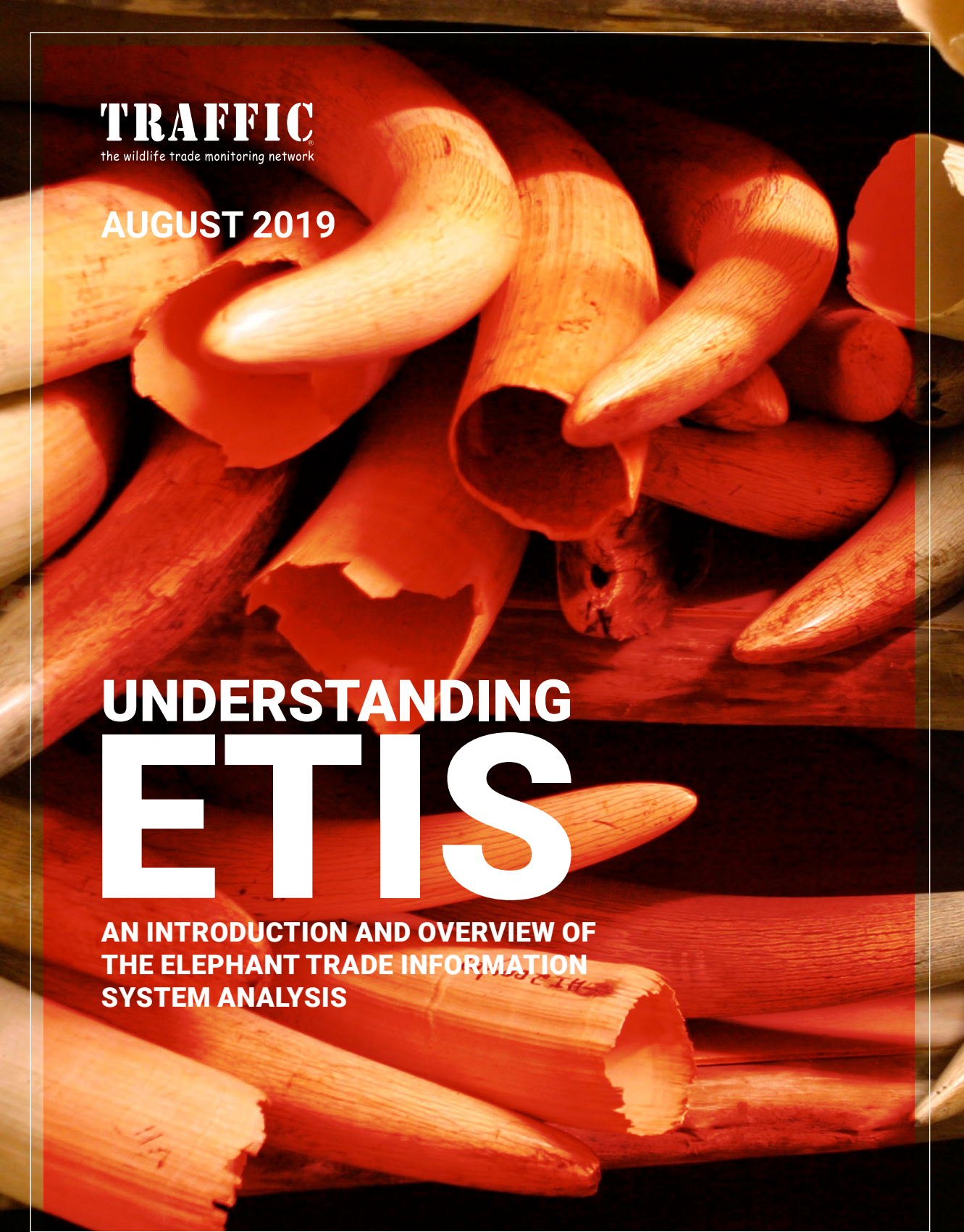


TRAFFIC
the wildlife trade monitoring network

AUGUST 2019

UNDERSTANDING ETIS

AN INTRODUCTION AND OVERVIEW OF THE ELEPHANT TRADE INFORMATION SYSTEM ANALYSIS

federal public service
HEALTH, FOOD CHAIN SAFETY AND ENVIRONMENT
.be
Ministry of Agriculture, Nature and Food Quality of the Netherlands

INTRODUCTION

WHAT IS ETIS?

BACKGROUND AND PURPOSE

The illegal ivory trade remains one of the most pressing threats to the conservation of elephant populations.

Ongoing demand for ivory continues to drive an ever-changing illegal trade that spans countries and continents, and whose covert nature poses serious challenges to understanding the true nature of illegal trade dynamics.

The Elephant Trade Information System (ETIS) was mandated by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) at the tenth Conference of the Parties (CoP10) in 1997 to monitor and analyse illegal ivory trade trends. Its sister program, Monitoring the Illegal Killing of Elephants (MIKE), was similarly mandated to track elephant poaching on the ground at selected sites across Africa and Asia.

Guiding international ivory trade policy and interventions to protect elephants from illicit trade and high-risk domestic markets is at the heart of why ETIS operates.

THE ETIS MANDATE AS PER RES. CONF. 10.10

Managed by TRAFFIC since its inception, and developed by statisticians Dr. Fiona M. Underwood and Mr. Robert E. Burn, ETIS uses elephant product seizure data to compile detailed analyses that help guide international policy decisions relating to illegal ivory trade.

Its core objectives, as specified in Resolution Conf. 10.10, are to:

1. ***Measure and record levels and trends, and changes in levels and trends, of illegal trade in ivory and other elephant specimens in elephant range States, ivory consumer States and ivory transit States***
2. ***Assess whether and to what extent observed trends are related to measures concerning elephants and trade in elephant specimens taken under the auspices of CITES; changes in the listing of elephant populations in the CITES Appendices; or the conduct of legal international trade in ivory***
3. ***Establish an information base to support the making of decisions on appropriate management, protection and enforcement needs***

Both ETIS and MIKE were designed to support decision-making for elephant conservation under the Convention by providing essential information and analysis on illegal killing of elephants and illegal trafficking in ivory to each meeting of the CITES Conference of the Parties. In addition to contributing to guidance behind decisions on global policy, ETIS also supports CITES Parties at the national level by allowing access to not only their own ivory seizure data, but also that from other countries that identified them as part of the trade chain of an illegal consignment.

Periodic ETIS Country Reports, which summarise all of the relevant data for each country, can be useful for informing national enforcement and policy action to combat illegal and unsustainable trade in elephant specimens and ivory.

ETIS DATA **STATISTICS**

THE LARGEST **1%** OF ALL SEIZURES REPRESENTS **58%** OF THE TOTAL ESTIMATED WEIGHT OF ALL IVORY SEIZED BETWEEN 2008–2017

29,000+
Elephant product seizure records are held in the database

9,124kg
the seizure case with the greatest weight, seized at the port of Da Nang, Viet Nam, in March 2019

104
countries/territories submitting data to the database

longest trade chain
tusks were seized from two containers in Malaysia, having moved through 9 countries

elephant range States
that have never reported an ivory seizure: Equatorial Guinea, Guinea-Bissau, Liberia, Somalia

USA
is the country with the largest dataset in ETIS

ETIS **DATA**

Illegal ivory trade flows are by their very nature largely unobservable and challenging to track and understand. But as the illegal trade unfolds, some consignments are detected and are seized. Some of these seizures get reported to ETIS.

The use of seizure data to provide information on the levels and trends in the illegal ivory trade is not straightforward. Simple summaries of seizure data will never create a reliable picture of the trade because of biases in the data (see "The Issue with Bias" for further explanation). On the other hand, with the right analytical approach, seizure data can provide unique insights into ivory trade dynamics, trends, and the evolution of illegal trade over time when other sources of information are simply not available. To meet the CITES mandate, ETIS has pioneered analytical methods that allow seizure data to track global trade trends in illegal ivory.

Resolution Conf. 10.10 recommends that Parties report seizures to ETIS within 90 days of their occurrence and a standardised data collection form has been in use since 1998.

In addition to the minimum requirements necessary for a seizure record (see "What Data are Reported to ETIS" below), ETIS also collects a range of contextual information to understand underlying trade dynamics, such as: the trade chain which describes other countries through which the consignment moved, or was moving to and their role as countries of origin, export/re-export, transit, or destination; the mode of transport; the method of concealment and detection; and other contraband in the consignment.

WHAT DATA ARE REPORTED TO ETIS?

ETIS seizure records are individually rated for accuracy and detail, with the minimum requirements for acceptance into the database consisting of:

- **Year** the seizure was made
- **Country** that made the seizure
- **Agency or authority** that made the seizure
- **Ivory Quantity** either in weight as kg, number of pieces, or preferably both
- **Ivory Type**, either raw, semi-worked, or worked

CLASSIFYING SEIZURES

Some countries make seizures and some countries don't. When reporting seizures to ETIS additional information might be provided on the countries through which the consignment was moved, or was moving to. This information describes the trade chain for that seizure. For each country in the trade chain, the seizure can be classified in one of two fundamental ways:

Seizures In: A seizure that is made in a particular country is counted as a "*Seizure In*" for that country – meaning it is the country of discovery, where the seizure occurred.

Seizures Out: The seizure is counted as a "*Seizure Out*" for all countries identified in the trade chain other than the country of discovery. But there are two ways of counting *Seizures Out* depending on what is being measured:

> When we want to understand intended **ivory trade flows** that capture the pathway of the illegal transaction from start to finish, the seizure is counted as a *Seizure Out* for all countries in the trade chain other than the country of discovery (which it is regarded as *Seizure In*).
>
> When we want to understand the trade chain from the standpoint of **law enforcement effectiveness** we only want to capture those countries which had an opportunity to make a seizure. Consequently, the seizure is counted as a *Seizure Out* only if the transaction had physically moved through a country undetected. For countries which were identified as part of the trade chain but fall after the point the seizure was made, the seizure is ignored and not counted as a *Seizure Out* because the country had no opportunity to take law enforcement action.

Similarly in ETIS, the same basic concept applies to not just the number of seizure cases, but also the weight of the ivory represented by each seizure.

Weights In: The total weight (kg) of a seizure that is made in a particular country is listed as "*Weight In*" for that country.

Weights Out: The total weight (kg) of a seizure is listed as "*Weight Out*" for all other countries identified in the trade chain that are not the country of discovery except in cases where there are multiple countries of origin which played no other role in the consignment. In such cases, only the proportion of the weight identified as coming from that country is recorded.

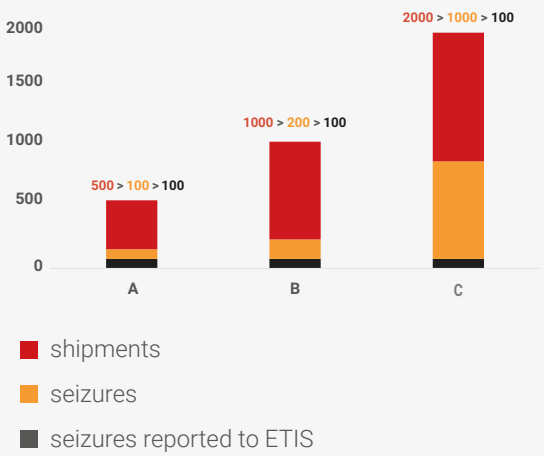
The *Weights In* and *Weights Out* values are typically used as a measure of the quantity of ivory associated with a particular country for assessing ivory trade flows. *Weights In* and *Weights Out* values are mostly used for reporting to countries and sometimes for analysing the scale of ivory trade that links to individual countries.

AN INTRODUCTION TO **THE ISSUE WITH BIAS**

ETIS data have inherent bias owing to the fact that random sampling is not possible and the selection of the data for inclusion in ETIS by those individuals who make reports is incomplete for many reasons. Equally, open source data suffers from bias selection and other factors. Because of the bias that this creates, great care needs to be taken in interpreting the ETIS data. To obtain better results a process of bias adjustment is an integral part of any ETIS analysis.

Bias Adjustment: The biases in the ETIS data arise because countries differ in their ability to make and report seizures. Not all illegal ivory transactions within a country are seized and the proportion that is seized by a country, the **seizure rate**, is unknown. Likewise, not all seizures that are made are reported to ETIS thus the proportion that is reported by a country, the **reporting rate**, is also unknown. This creates inherent bias in the ETIS data that needs to be accounted for to the extent possible in order to better understand what the ETIS data actually represents.

Just because countries report similar number of seizures does not mean that there are similar amounts of illegal activity in both countries because one country may have better law enforcement and reporting than the other.



*This example illustrates such discrepancies and the bias that can arise in seizure data. Three countries, A, B and C, each have different numbers of ivory **shipments** passing through them.*

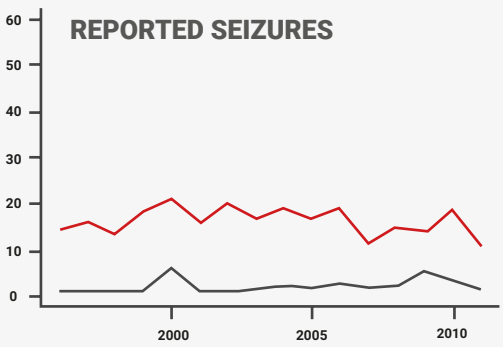
*Each country also has a different **seizure rate**, meaning they only intercept a percentage of said shipments, and each also reports a different proportion of those seizures to ETIS (**reporting rate**). Thus, despite very diffferent numbers of ivory flowing through each country, they all actually report the same numbers of ivory seizures **(100)** to ETIS.*

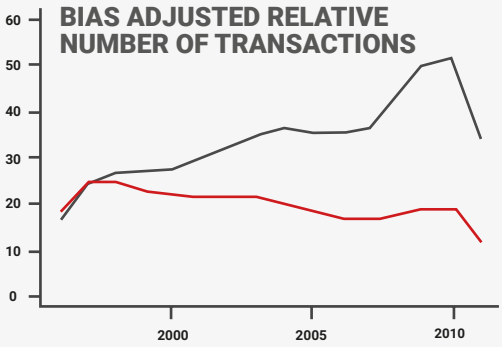
As such, given that countries may differ in the resources they allocate to law enforcement training, capacity and the degree of commitment towards interdicting contraband elephant products, two countries may make very different numbers of seizures even when there are similar amounts of illegal activity. Similarly, one country may have very good mechanisms for reporting seizures to ETIS whilst another does not. Thus two countries that make the same number of seizures may report very different numbers to ETIS. Therefore differences in simple summaries of the total number of seizures may reflect differences in countries abilities to make and report seizure rather than differences in the number of illegal ivory transactions.

ETIS **BIAS ADJUSTMENT METHODOLOGY**

The methodology for analysing the ETIS data includes ways to mitigate the biases in the data due to variable seizure and reporting rates so that more credible results in terms of illegal ivory trade patterns can be delivered to CITES.

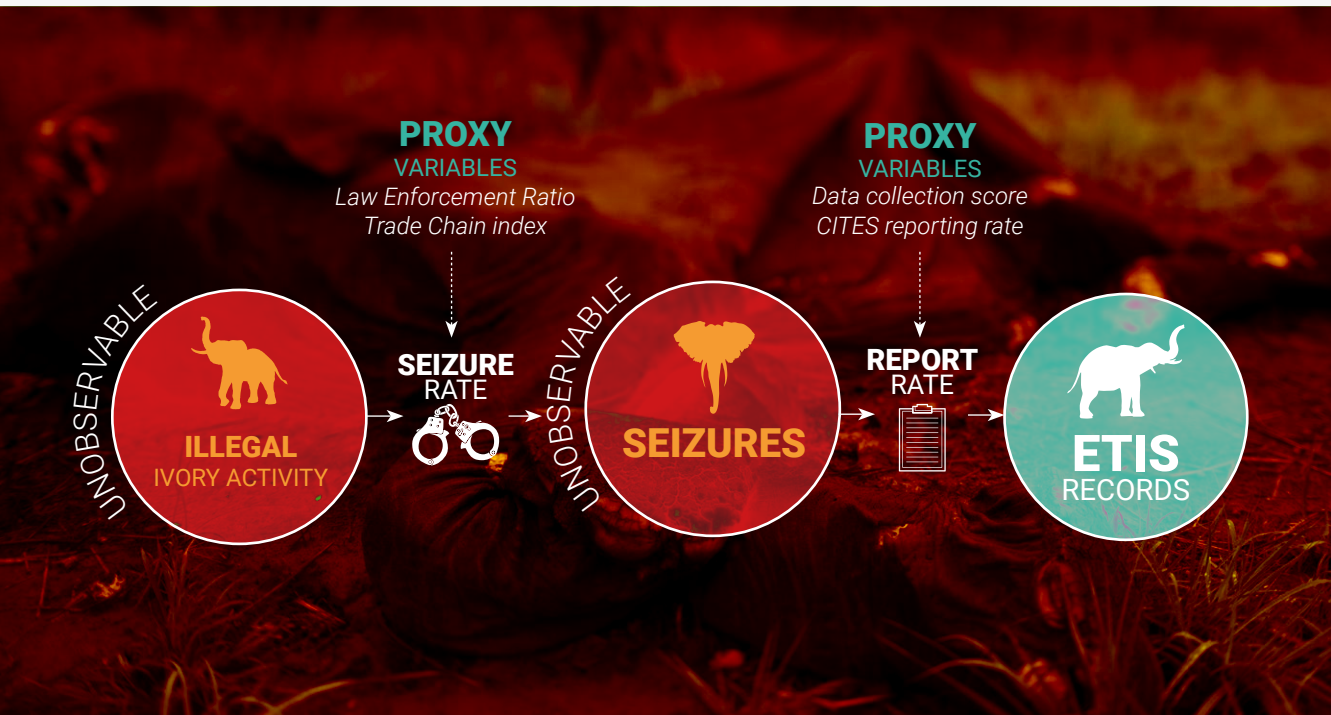
Specifically ETIS identifies possible reasons as to why countries differ in their ability to make and report seizures and then identifies data, or covariates, that might help describe these differences (see "Selecting Covariates for Bias Adjustment"" below). Our analytical framework uses these covariates to adjust ETIS records to account for different relative seizure and reporting rates. We can then obtain smoothed relative indicators of numbers and weights of illegal ivory shipments between countries over time.





*The example above compares reported seizures from **Country A** and **Country B** over a 15-year period, before and after bias adjustments are applied. Without any bias adjustment, data would otherwise indicate that the Country A is a consistently more significant actor within global ivory supply chains than Country B. However, the number of incidents by country changes significantly once bias adjustments are applied, giving a far more accurate representation of each country's position within global ivory trade.*

SOURCE: This graph is a simplified illustration taken from "Dissecting the Illegal Ivory Trade: An Analysis of Ivory Seizures Data"



OVERVIEW

DATA ANALYSIS

As previously discussed, the presentation of summaries of raw ETIS data will not serve to deliver the outputs mandated in Resolution Conf. 10.10 — data analysis is necessary to achieve that goal. The ETIS analysis consists of a series of progressive stages that can be best described as **data preparation, statistical modelling** and the **production of modelled outputs**.

1 DATA CLEANING AND CHECKING

There are minimum requirements for seizure records to be accepted into ETIS, and only validated seizure records are used in an ETIS analysis. The dataset for analysis is first subjected to some 19 separate automated data checks to ensure its integrity in all respects.

The statisticians then prepare graphical and numerical summaries of the seizures data and relevant covariates (which are described in subsequent sections). These are then compared to the data used in previous analyses, such as those submitted to CITES Standing Committee meetings. These comparisons are checked to ensure that any differences in records from past years can be identified and explained. If any problems are discovered, they are resolved before proceeding.

2 ESTIMATING WEIGHTS FROM PIECES

There is considerable uncertainty with respect to the weights of seizures reported to ETIS.

Approximately 50% of ETIS records provide the numbers of pieces rather than the exact weight of the ivory seizure. Other records that do specify a weight are often estimates rather than precise measurements.

Missing weights need to be estimated so that: (a) seizures can be assigned to a weight class; (b) total *Weight In* and *Weight Out* can be calculated for each country in the cluster analysis; and (c) the ETIS team can produce weight summaries where needed for reporting purposes outside of the CITES CoP cycle.

Missing weights are estimated by building models for raw and worked ivory separately using data from seizure records where both the number of pieces and seizure weight are recorded. This model is revised and updated every time an analysis is undertaken for a CoP.

Because illegal ivory activity is expected to vary by weight and by ivory type, each seizure is assigned to weight categories for raw and worked ivory. The weight categories are: small (less than 10 kg), medium (10 kg to less than 100 kg) and large (100 kg or more).

3 SELECTING THE **COUNTRIES FOR ANALYSIS**

Not all CITES Parties are included in each ETIS analysis because it is very difficult to model the data from countries which rarely make or are rarely implicated in ivory seizures.

Countries are included in the analysis if they scored at least 100 (see the formula to the right) in the time period of the analysis (usually at least ten years). All *Seizures In* and *Seizures Out* (irrespective of seizure opportunity) are included.

For example, a country that made a single large ivory transaction, or a country that was implicated in nine medium seizures and made ten small seizures, would become part of the analysis.

1x
number of small seizures
less than 10 kg

+10x
number of medium seizures
between 10 kg and 100 kg

+100x
number of large seizures
at least 100 kg

4 SELECTING **COVARIATES FOR BIAS ADJUSTMENT**

A "covariate" is an independent, yet directly relevant, variable used in statistical analysis to help improve the accuracy of results. In ETIS, a range of country-and year-specific covariates are considered for modelling the variable seizure and reporting rates, the two factors that produce bias in the raw unadjusted ETIS data.

Data for most covariates are extracted directly from ETIS subsidiary databases, but some of the covariates are derived from processing the ETIS data itself, for example the *Data Collection Score*. Covariates may change for each CoP analysis depending on their ability to account for variability in the data.

For the CoP18 analysis, the following covariates were included in the final model:

Seizure rate

In the ETIS analysis to CoP18, the seizure rate is based upon the one-year lagged Law Enforcement Ratio (LE1) and the Trade Chain Index.

Law Enforcement Ratio: As a relative measure of a country's ability to make seizures, the Law Enforcement Ratio is derived for each country from the calculation: **Seizures In/(Seizures In + Seizures Out)** using the law enforcement effectiveness definition of *Seizures Out* described previously.

Trade Chain Index (TCI): This assesses the number of times that a country is listed as a country of destination (i.e. *Destination Score*) as opposed to the number of times it is listed as country of origin, export or transit (i.e. *Non-Destination Score*) each year.

The TCI is combined with the Law Enforcement Ratio because a country which typically functions as a destination country can have a higher Law Enforcement Ratio than a country which typically occurs earlier in the trade chain even when there is the same level of law enforcement. This is because most seizures occur before the end of the trade chain.

In previous ETIS analyses, Worldwide Governance Indicators have also proved useful in accounting for variability in seizure rates between countries and over time.

Reporting rate

In the ETIS analysis to CoP18, the reporting rate is based upon the Data Collection Score and the CITES Reporting Score.

Data Collection Score: Seizure data comes to ETIS in a variety of different ways. It is important to understand the degree of effort expended by ETIS to obtain seizures data. In some cases, data will passively arrive to ETIS, whereas in others it will have to be prompted. There are additional cases where data submission is targeted in order to collect details on a specific incident. Passive, prompted, or targeted efforts will influence the overall completion of a country's dataset, which is relevant to their reporting rate.

CITES Reporting Score: CITES Parties have other reporting obligations as members of the Conventions. In every calendar year, each Party is required to submit an annual report on all trade in CITES listed species. ETIS tracks the number of annual reports a country has submitted against the number of years it has been a Party to the Convention. This provides a relative measure of its ability to meet a key CITES reporting requirement.

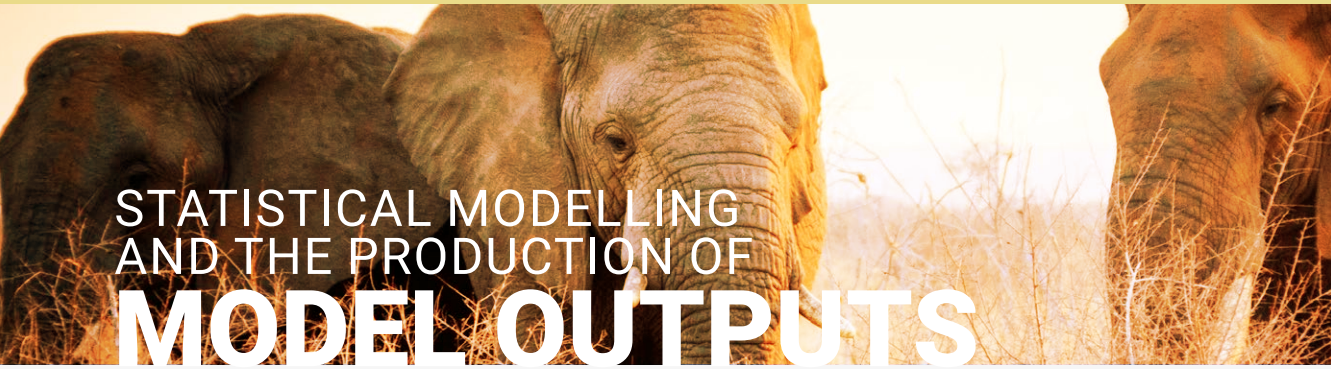
5 RESULTS OF THE **MODELLING**

Once the data preparation activities are completed, the ETIS analysis produces three different outputs. These are further described in subsequent sections.

Transaction Index
an estimation of illegal ivory trade activity

Weight Index
the relative quantity of ivory going into trade annually

Cluster Analysis
identifies countries which demonstrate similar behaviour with respect to the illegal ivory trade

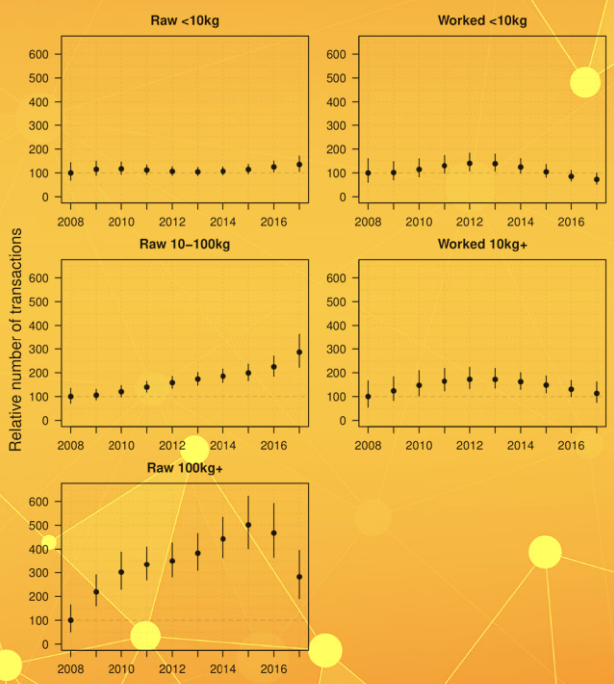


STATISTICAL MODELLING AND THE PRODUCTION OF MODEL OUTPUTS

Statistical modelling of bias-adjusted data is carried out to produce three specific model outputs:

Transaction Index

The Transaction Index depicts estimated relative numbers of illegal ivory trade transactions by year. In the CoP18 analysis the Transaction Index is expressed as two principle model outputs. Firstly, as a relative measure of the number of raw and worked ivory transactions occurring over the period in the five ivory weight classes, (three weight categories for raw ivory and two weight categories for worked ivory). Secondly, the Transaction Index is graphed as the aggregated totals of all five weight classes so that global annual comparisons of relative illegal ivory trade activity can be made.



Separate trends for raw and worked ivory seizures in the different weight categories are estimated because they represent different characteristics of illegal trade. Raw ivory transactions generally relate to the supply side of the equation, whilst worked ivory seizures reflect demand. In recent years the large raw ivory weight class has been driving high levels of illegal trade. Because worked ivory seizures of 100 kg or more are very rare, the large worked ivory weight class has been combined with the medium weight class in order to get more robust analytical results.

Weight Index

The Weight Index depicts the estimated relative quantity of illegal ivory in trade each year. It is created by modelling the estimated weight of the transactions in the five weight classes of the Transaction Index.

Cluster analysis

The Cluster Analysis is a statistical technique that is used to identify countries which share similar characteristics with respect to the illegal ivory trade. The data used to form the cluster analysis for CoP18 comprised the three-year totals (2015-2017) of eleven bias-adjusted variables. The variables assessed were designed to draw out the general characteristics of a country's involvement in illegal ivory trade, differentiate law enforcement performance, and consider total ivory trade flows, especially those representing the greatest trade volumes. The results of the cluster analysis contribute to the process by which groups of countries are identified that potentially warrant participation in the National Ivory Action Plans Process (NIAP) process under the Convention if recommended to do so by the CITES Secretariat and endorsed by the Standing Committee.

OTHER RESOURCES FOR UNDERSTANDING ETIS

This document is intended as an introduction to the basic concepts behind ETIS data collection and analysis.

For further information, general background, and details on how to request as an account as a National Data provider, please see the links and resources below:

ADDITIONAL **BACKGROUND**

ETIS and CITES:
www.cites.org/eng/prog/etis/index.php

Additional information on the analytical model:
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0076539
Underwood FM, Burn RW, Milliken T (2013) Dissecting the Illegal Ivory Trade: An Analysis of Ivory Seizures Data. *PLoS ONE 8(10): e76539.*

The ETIS code for the CITES CoP18 analytical report:
https://github.com/fmunderwood/ETIS_CITESReporting_RCode/blob/v.CoP18/Notes_CoP18.pdf

ACKNOWLEDGMENTS

The development of ETIS is an ongoing and successful collaboration between TRAFFIC and statisticians Mr. Robert E. Burn and Dr. Fiona M. Underwood, both previously at the University of Reading. In particular, the expert ivory analysis and development of the bias adjustment method were developed by Mr. Burn and Dr. Underwood in collaboration with TRAFFIC. Much of ETIS' recent development was conducted under a UK Government Darwin Initiative project, and the ETIS analyses for CITES CoPs and Standing Committee reports were originally carried out by Mr. Burn and are now led by Dr. Underwood.

The production of this document was made possible through the generous support of the European Union, the Government of Belgium and the Government of the Netherlands.

The contents of this document are the sole responsibility of TRAFFIC and do not necessarily reflect the views of the European Union or the governments of Belgium and the Netherlands. TRAFFIC is grateful to these donors for their support.

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AUGUST 2019

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