Impact case study (REF3b)

Institution: University of Reading

Unit of Assessment: 10 Mathematical Sciences

Title of case study: Informing international decision making on the protection of elephants

1. Summary of the impact

The research at the University of Reading has developed statistical methods and information systems for two global monitoring systems for elephants: MIKE (Monitoring the Illegal Killing of Elephants) and ETIS (Elephant Trade Information System). The systems provide quantitative evidence, via bias-adjusted indicators, on global and regional trends in the illegal killing of elephants and the illicit ivory trade. This evidence forms the substance of reports discussed at the Convention for International Trade in Endangered Species of Wild Fauna and Flora (CITES). Based on this information, CITES has adopted decisions to introduce interventions targeting over 20 countries in Africa, Asia and the Middle East aimed at curbing the illegal ivory trade. As well as providing the underpinning data that has informed international policy on illicit trading of this threatened species, the evidence has also helped raise public awareness of the threats to elephants as well as improving monitoring systems and increasing their reach.

2. Underpinning research

Background

CITES, a United Nations convention administered by the United Nations Environment Program (UNEP), is the global regulatory body for international wildlife trade. In 1989 CITES banned all trade in elephant products, but in 1997, at the 10th meeting of the CITES Conference of the Parties (CoP) agreed to a tightly regulated one-off sale of ivory from three Southern African countries to Japan. This was a controversial decision but it led the CITES Parties to mandate two global monitoring systems for elephants, MIKE and ETIS. Part of the remit of these systems was to provide evidence on levels and trends in the illegal killing of elephants (MIKE) and the illegal trade in ivory (ETIS) and, as far as possible, relate these results to decisions taken about protecting elephants under the Convention. Both programmes are required to provide comprehensive analyses to meetings of the Conference of the Parties (CoPs) every two to three years and update reports to the annual Standing Committee meetings to support decision-making for elephants under the Convention.

The MIKE programme was designed as a site-based initiative to collect elephant mortality data, especially the number of illegally killed elephants, at selected sites throughout elephant range in Africa and Asia. The focus of ETIS was on seizures of illegal ivory trade made by law enforcement agencies across the world. However, when these programmes were first set up, the statistical methods required to analyse the data were not in place.

Involvement of the University of Reading in MIKE and ETIS

ETIS was to be based on an earlier system called BIDS (Bad Ivory Database System) that was run by TRAFFIC International, the wildlife trade monitoring network. In 1997 Mr Robert Burn (then of the Statistical Services Centre, University of Reading), was contracted to carry out a review of BIDS and advise how it could be adapted to meet CITES requirements. He presented this review at a MIKE/ETIS technical design workshop in 1997 and identified the major analytical challenges. Subsequently he was invited to sit on the Technical Advisory Groups for both MIKE and ETIS and to carry out a number of consultancies for both monitoring systems, including: the design of the site selection protocol for MIKE; baseline analysis of the MIKE data for the 12 to 14th CoPs (between 2002 and 2007); developing the ETIS database; and carrying out comprehensive analyses of the ETIS data for the 12th to 15th CoPs (between 2002 and 2010). The methodology of these early analyses were largely ad-hoc and carried out to meet very short deadlines. Even so, the very first analysis of the ETIS data by Mr Burn, presented to the 12th CoP in 2002, indicated the importance of China in the illegal ivory trade at a time when the focus was on Japan. Partly as a result of these changes CITES allowed China to participate in the tightly controlled sale of ivory in 2008.In 2004, Dr Fiona Underwood joined the Statistical Services Centre and participated in some of the above work. She had previously been involved, together with Mr Burn, in designing the MIKE data analysis strategy published in 2003.

In 2008, Mr Burn and Dr Underwood (by then a lecturer at the University of Reading) were contracted by MIKE to develop methods for an in-depth analysis of the MIKE data. This effort resulted in a research paper with the MIKE data analyst (reference 3.1) that described the methodology and applied it to MIKE data on elephant mortality from 2002 to 2009. In 2009, Dr Underwood and Mr Burn (by then a visiting Research Fellow at the University of Reading), with TRAFFIC sought funding for a 3-year research project aimed at ensuring the long-term sustainability of ETIS through the further development of the analytical framework, new database software to support the system, formalised standard operating procedures and training materials to enhance global participation of the CITES Parties. One of the technical outcomes of the project was a scientific paper (reference 3.3) describing the new analytical methods and the results from analysing ETIS data from 1996 through 2011. A comprehensive report was issued to the 16th CITES CoP as a formal agenda item (reference 3.4), showing illegal ivory trade trends, identifying key countries in the illicit trade and describing trade routes and dynamics driving the trade. This report led to a series of actions directed at specific countries to curtail the illegal trade in elephant ivory.

Statistical research

The key statistical issue for both MIKE and ETIS is that they aim to monitor and report on covert and illegal processes, which cannot be monitored using standard statistical methods. The monitoring is carried out by law enforcement agencies that intervene in, rather than passively observe, the process being monitored. Furthermore, law enforcement agencies differ in their ability to intervene and to report their interventions to the relevant monitoring system. This variability is difficult to measure but must be accounted for so that estimates of illegal activity can be compared between countries and over time. There had been very little statistical research into these problems prior to this work. A further aim of the research was to produce simple indicators that can be used to inform policy makers about trends.

For both monitoring systems, proxy variables were identified or developed that could account for differences in detecting and reporting illegal activity over time and between countries or sites. These included background variables relating to corruption and development, and variables specific to MIKE and ETIS.

For MIKE, the indicator *PIKE*, the Proportion of Illegally Killed Elephants (of all elephant carcasses found on patrol) was developed. Bayesian hierarchical models were used to capture the structure of the data, trends in *PIKE* were described and the relative role of poaching in individual sites and countries was estimated.

For ETIS, a new modelling framework was developed that extended the ideas in MIKE by modelling the underlying process by which data enter ETIS using Bayesian hierarchical latent variable models. Proxies that describe differences in the latent variables (reporting and seizure rates) between countries and over time were identified and tested. A multivariate negative binomial model enabled different dynamics to be considered for trade in raw and worked ivory in three weight classes. Smoothed bias-adjusted relative indicators of the number of transactions by country, year and ivory class were produced and aggregated to give a global Transactions Index and Weights Index. The framework was applied to over 11,000 records of illegal ivory seizures from 1996 to 2011 from 68 countries. The headline result is that globally illegal ivory trade activity in 2011 has more than doubled since 2007, and tripled since 1998.

3. References to the research
Outputs:
Publications have been internally reviewed and assessed as of at least 2* quality. Outputs marked as * are suggested as those to assessed quality of research:

1. *Burn, R.W., Underwood FM, Blanc J. (2011) Global trends and factors associated with the illegal killing of elephants: a hierarchical Bayesian analysis of carcass encounter data. *PLoS ONE* 6(9): e24165. doi: 10.1371/journal.pone.0024165
2. *Burn, R.W. *et al.* (2010) Trends and factors associated with the illegal killing of elephants. CoP15Inf.41-p.1. http://www.cites.org/common/cop/15/inf/E15i-41.pdf.
3. Underwood, F.M., Burn, R.W. (2013) Dissecting the illegal ivory trade: an analysis of ivory seizures data. PLOS One 8(10); doi:10.1371/journal.pone.0076539
4. Milliken, T., Burn RW, Underwood FM, Sangalakula L (2012). The Elephant Trade Information

System (ETIS) and the illicit trade in ivory. A report to the 16th Conference of the Parties to CITES Proceedings of the Conference of the Parties to CITES (UNEP), Bangkok: 16, Doc 53.2.2. http://www.cites.org/eng/cop/16/doc/E-CoP16-53-02-02.pdf

Research Grant:
Who: F.M. Underwood R.W. Burn (Visiting Research Fellow), University of Reading (lead organisation), T. Milliken,TRAFFIC East/Southern Africa (project partner).
Grant title: Enhancing the Elephant Trade Information System to Guide CITES Policy.
Project Number: 17020. *Sponsor:* Darwin Initiative, DEFRA, UK Government.
Dates: September 2009 – August 2012. *Amount:* £239,399.

4. Details of the impact
Informing international policy
The main impact of the research has been to provide the substantive quantitative data that has informed international policy decisions both on the regulation of trade in elephant products and on law enforcement regarding the illicit ivory trade and the illegal killing of elephants. Research findings (references 3.1 and 3.3) formed the main evidence in mandated reports by MIKE (reference 3.2) and ETIS (reference 3.4) to the last two CoPs respectively. These reports provide the evidence framing much of the discussion between non-governmental organisations, governments and pressure groups. For example, at the 15th CoP in March 2010, partly as a result of the MIKE report, the decision was made not to allow regulated sales of ivory from Tanzania and Zambia.

At the 16th CoP in Bangkok in March 2013, there was "*unprecedented uptake of the ETIS results… and motivation to seriously tackle outstanding problems for the benefit of elephant conservation*" (as reported in *Pachyderm* magazine). The ETIS report identified three groups of countries most heavily implicated in the trade, including Thailand, the host country. At the opening ceremony the Prime Minister of Thailand announced that her country would be pursuing "*the goal of putting an end to ivory trade and to be in line with international norms*". CITES adopted a separate decision for each of the three groups of countries identified by ETIS, impacting over twenty countries from Africa, Asia and the Middle East. These decisions include the creation of a CITES Ivory Enforcement Task Force to review law enforcement strategies for combating illegal trade in eight countries in partnership with international organisations such as the World Bank, the World Customs Organization, the United Nations Office on Drugs and Crime and INTERPOL.

Raising public awareness
The research outputs, in particular the bias-adjusted indicators, have been used by environmental organisations to raise awareness of the increasing threat to elephants from the illegal ivory trade. For example, a major report *Elephants in the Dust – The African Elephant Crisis* by United Nations Environment Programme, CITES, International Union for Conservation of Nature (a global environmental organisation) and TRAFFIC, drawing together all the recent research on elephants, was released at a press conference at the 16th CoP in March 2013. The statistical contributions of this research form much of the evidential basis both for MIKE and ETIS. The headline result of the ETIS analysis was the primary lead in a plethora of news stories generated by the international media. The PIKE indicator is also referenced in the World Wide Fund for Nature Crime Scorecard produced in 2012.

Improving monitoring systems and informing best practice
Both monitoring systems have been refined and improved as a result of the research. For example, in developing the analytical framework for ETIS it became necessary to restructure the ETIS database to ensure that the data being collected are of the highest quality and the most relevant for the required analytical purposes. The fields in the database were therefore revised and data collection methodologies improved. In particular, an online, government-restricted mechanism enabling countries to directly enter and access data on illegal ivory seizures data is expected to be launched by the end of 2013. This is a significant development that will impact all countries that report to CITES (typically about 80 countries from Europe, America, Africa, Asia and Australasia report seizures to ETIS).

More generally, the long-term involvement of Mr Burn and Dr Underwood in guiding the development of MIKE and ETIS since their inception has led to a strong statistical underpinning to the two monitoring systems and has helped shape their overall direction and identify their limitations. This influence has, in part, been made via the MIKE-ETIS Technical Advisory Groups

(a group of experts working in elephant conservation and the illegal ivory trade), where the research methodologies and results have been presented and discussed.

During the period of the Darwin Initiative project, research methodologies, results and the new database were presented in 2012 to the United Nations Environment Programme's fourth African Elephant Meeting held in Nairobi, to the 62nd CITES Standing Committee and to a training event for African CITES Parties involved in reporting ETIS data to CITES. Mr Burn and Dr Underwood also initiated a workshop on the drivers of the illegal ivory trade, the results of which have informed UNEP's *Elephants in the Dust* report.

In a press release from TRAFFIC in June 2012, Tom Milliken, who manages ETIS, stated: "*Since 1997, our long-term collaboration with Bob Burn and Dr Fiona Underwood from the University of Reading has progressively scaled up the science behind ETIS and made it a 'best practice', state-of-the-art monitoring tool for the global conservation community*". During the 62nd CITES Standing Committee, the Secretary General of CITES also publicly recognised Mr Burn's contribution to the scientific underpinning of MIKE and ETIS.

MIKE and ETIS are unique global databases. Reading statisticians are the only researchers who have been given access to the raw ETIS data and, until 2010 (when Mr Burn stood down from the MIKE Technical Advisory Group), the only statisticians who had been given access to the MIKE data.

5. Sources to corroborate the impact

Informing international policy
- CITES decisions taken at the 16th CoP (http://www.cites.org/eng/dec/valid16/E16-Dec.pdf) Decisions 16.78-16.80 are all derived from the ETIS analysis, and the latter two are specifically referenced in that way. Decision 16.81 mandates even broader linkages with the United Nations Office on Drugs and Crime to tackle illegal ivory trade issues.
- Milliken T (2013) Progress in updating the Elephant Trade Information System. Pachyderm 53 111-117 describing the outcomes of the 16th CoP with regard to elephants http://www.pachydermjournal.org/index.php/pachy/article/view/328/226
- CITES decisions at 15th CoP regarding Tanzania: http://www.cites.org/eng/cop/15/doc/E15-68A06a%29.pdf

Raising public awareness
- UNEP, CITES, IUCN, TRAFFIC (2013) *Elephants in the Dust – The African Elephant Crisis. A rapid response assessment.* United Nations Environment Programme, GRID-Arendal
- WWF Wildlife Crime Scorecard Report (2012): http://www.wwf.org.uk/wwf_articles.cfm?unewsid=6135
- 'Stop ivory poaching or face sanctions, nations warned at Cites' (*Guardian*, 6 March 2013): http://www.guardian.co.uk/environment/2013/mar/06/ivory-poaching-sanctions-cites

Improving monitoring systems
- Minutes of Technical Advisory Group meetings - in particular the minutes of the 8th meeting stressing the need to ensure that results of analysis are communicated in non-technical language to a broad audience, and the minutes of the 11th meeting which demonstrates the continuous use of PIKE. http://www.cites.org/eng/prog/mike/mike_etis_tag.php
- Press release regarding initial release of new ETIS database http://www.traffic.org/home/2012/7/26/statisticians-help-fight-against-increasing-illegal-ivory-tr.html
- Minutes of 4th African Elephant meeting where new ETIS database presented http://www.cites.org/eng/prog/mike/reg_meet/aem4/AEM4_summary_record_EN.pdf

Individuals who could corroborate the impact (contact details provided separately)
- Secretary General of CITES: importance of scientific evidence base to inform discussions in CoP as well as ETIS and MIKE roles within this.
- Executive Director of TRAFFIC International: role of ETIS report on CoP
- Director of ETIS / Elephant and Rhino Programme Co-ordinator, TRAFFIC: role of statisticians in the development of ETIS analytical framework and its database, contributing to best practice and improving the monitoring systems.
- Acting Coordinator, CITES MIKE: role of statistical analysis in developing PIKE to ensure scientific basis of MIKE