Monitoring the Illegal Killing of Elephants (MIKE)
PIKE trend analysis 2003-2020

1. This report has been prepared by the CITES Secretariat.

Background

2. The CITES programme for Monitoring the Illegal Killing of Elephants, commonly known as MIKE, was established by the Conference of the Parties (CoP) to CITES at its 10th Meeting (Harare, 1997) and is conducted in accordance with the provisions in Resolution Conf. 10.10 (Rev. CoP18) on *Trade in elephant specimens*. The CITES MIKE Programme is managed by the CITES Secretariat under the supervision of the CITES Standing Committee. Since implementation began in 2001, the operation of the programme in Africa has been possible mainly thanks to the generous financial support of the European Union.

3. The CITES MIKE programme aims to inform and improve decision-making on elephants by measuring trends in levels of illegal killing of elephants, identifying factors associated with those trends, and building capacity for elephant management in range States. It operates in a large sample of sites spread across elephant range in 32 countries in Africa and 13 countries in Asia. There are 69 designated MIKE sites in Africa, which together hold an estimated 50% of the African elephant population, and 30 sites in Asia. Yok Don National Park in Viet Nam was added to the MIKE site network in Asia in 2020.

4. MIKE data is collected by law enforcement and ranger patrols in the field and through other means in designated MIKE sites. When an elephant carcass is found, site personnel try to establish the cause of death and other details, such as sex and age of the animal, status of ivory and stage of decomposition of the carcass. This information is recorded in standardized carcass forms, details of which are then submitted to the CITES MIKE Programme.

5. The programme evaluates relative poaching levels based on the Proportion of Illegally Killed Elephants (PIKE), which is calculated on an annual basis as the number of illegally killed elephants found divided by the total number of elephant carcasses found, which includes elephants illegally killed, elephants that died of natural causes, management-related deaths as well as deaths recorded as unknown (cause of death could not be determined).

6. Based on reporting by range States, it is clear that deaths associated with human elephant conflict are sometimes categorized as “illegal”, while in other cases these are reported as “management related deaths” or other types of death. The CITES Secretariat assessed the 773 records (3% of all carcass records) where Parties reported that elephant deaths were associated with human elephant conflict. In Africa the majority of records indicated that the deaths associated with human elephant conflict were management related deaths (58% or 387 records), while in Asia deaths associated with human elephant conflict are most commonly recorded as “illegal’ (67% or 70 records). In Africa, 39% (259 records) were recorded as “illegal” and the remainder (3% or 23 records) as other types of death. In Asia, 4% (4 records) were categorized as “management related” and the remainder (29% - 30) as other types of death. Because PIKE is used as an index of poaching, it is important to understand to what extent illegal deaths associated with human elephant conflict, which may not be considered poaching, is included. The CITES Secretariat will continue to collaborate with participating range States and the MIKE-ETIS Technical Advisory Group (TAG) to get further clarification on this matter and refine the MIKE analysis accordingly.

7. PIKE is an index of poaching pressure and provides trends relating to the levels of poaching. It may be affected by several potential biases related to data quality, reporting rate, carcass detection probabilities, variation in natural mortality rates and other factors, and hence results need to be interpreted with caution.

8. In the previous MIKE report for Africa and Asia, published on the CITES website on 16 November 2020, the new PIKE trend analysis methodology was shared with CITES Parties. As indicated in that report, the TAG recommended the use of the unweighted Bayesian GLMM (**MM.p.uw**) to interpret PIKE trends over time. A weighted Bayesian GLMM (**MM.p.w**) model that includes elephant population estimates from each MIKE site was trialled on an experimental basis but requires further work by the CITES Secretariat in collaboration with the TAG.

PIKE trend analysis for 2020: Africa

9. The dataset used for this PIKE trend analysis for Africa consists of 22,015 records of elephant carcasses found and recorded between 2003 and the end of 2020 at 66 MIKE sites in 30 range States in Africa, representing a total of 760 site-years.

10. Compared to the previous PIKE trend analysis published in November 2020, the PIKE trend analysis presented in this document considers an additional 1,285 records of elephant carcasses encountered in the course of 2020, that were reported by 62 MIKE sites in Africa. The number of reporting MIKE sites increased from 58 in 2019 to 62 in 2020 (see Figure 1A).

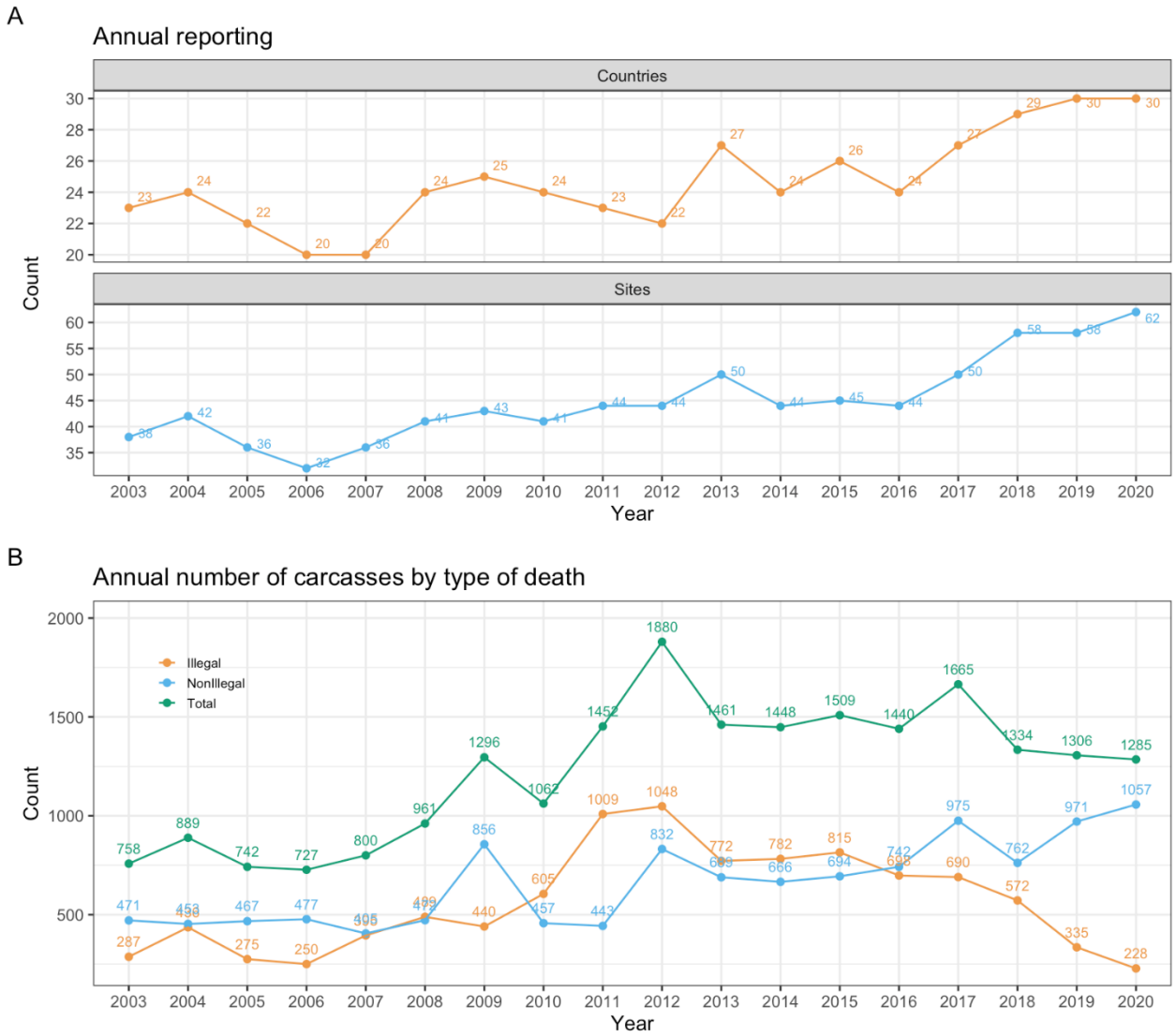

Figure 1: *A. Number of countries and MIKE sites that submitted reports (2003 – 2020). In 2020, the number of sites that reported from Central, Eastern, Southern and West Africa were 12, 14, 18 and 18 respectively. B. The total number of carcasses reported irrespective of cause of death (green), the number of carcasses of elephants illegally killed (orange) and the number not illegally killed (blue) (natural deaths, management related deaths and unknown type of death) reported by year.*

11. In 2020, the number of sites that submitted reports in central Africa were 12 of 16 sites (75%); in eastern Africa 14 of 16 sites (87%); in southern Africa 18 of 19 sites (94%); and in west Africa 18 of 18 sites (100%). Of the sites that reported, four in central Africa, two in eastern Africa and ten in west Africa reported zero

carcasses found in 2020. Compared to 2019, 21 more elephant carcass records were submitted in 2020 (see Figure 1B). Two hundred and twenty-eight (228) of the 1,285 carcasses reported in 2020 were recorded as illegally killed; while 335 of the 1,306 carcasses reported in 2019 were recorded as illegally killed.

12. As indicated in paragraph 7, the results of the unweighted Bayesian GLMM (**MM.p.uw** – unweighted by elephant population estimate) are used to interpret PIKE trends over time.

Continental PIKE trend (Africa)

13. Figure 2 shows the continental PIKE estimate across years based on the unweighted Bayesian GLMM (**MM.p.uw**) analysis. The error bar or confidence/credible interval shows the level of uncertainty in the annual PIKE estimates. In Bayesian analysis, a 95 percent credible interval (CI) is an interval within which a PIKE estimate falls with a 95% probability.

14. The annual mean PIKE generally increased from 2003 to 2010, peaked in 2011, and decreased from 2011 to 2020. Prior to the maximum value of PIKE in 2011, the trendline for the unweighted Bayesian GLMM PIKE estimates (MM.p.uw) shows that there is sufficient evidence to confirm an upward trend (increase in PIKE) from 2003 to 2011, and a downward trend (decrease in PIKE) from 2011 to 2020 (see **Annex 1** for the table with details relating to the statistical support for the downward trend). Over the last five years (2016 to 2020), the unweighted continental PIKE estimate shows a downward trend with a level of certainty over 95%. The 2020 PIKE estimate is the lowest since 2003.

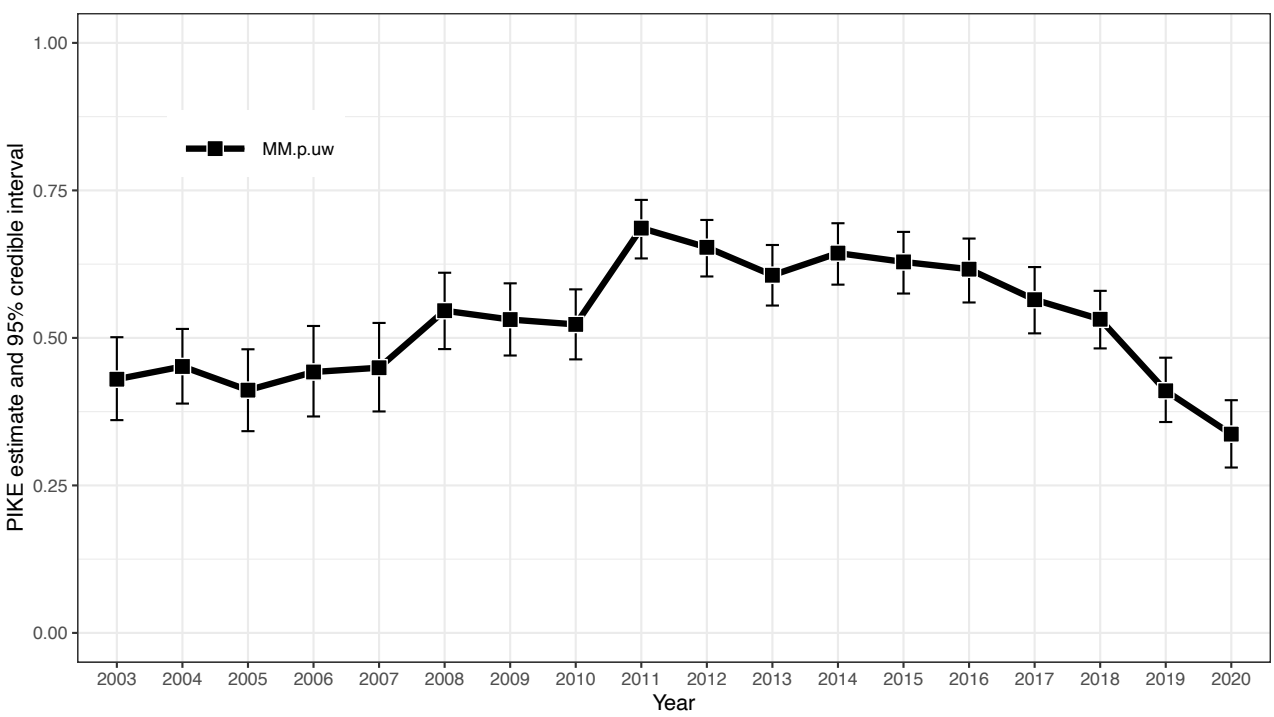

Figure 2: *Continental PIKE estimates based on the unweighted Bayesian GLMM approach (**MM.p.uw**). The error bar or the confidence / credible interval shows the level of uncertainty in the annual PIKE estimates.*

Subregional PIKE trends (Africa)

15. Figure 3 (A-D) shows the subregional PIKE estimate across years based on the unweighted Bayesian GLMM (**MM.p.uw**) approach for central, eastern, southern and west Africa. The error bar or confidence/credible interval shows the level of uncertainty in the annual PIKE estimates. Results below show that the PIKE trend differs across years and subregion.

Central Africa

16. The PIKE estimates for central Africa are shown in Figure 3. A. Based on the unweighted Bayesian GLMM approach, there is strong evidence that the PIKE trend increased from 2003 to 2011 and remained at high PIKE levels up to 2019 and decreased in 2020.

17. In the previous report, the unweighted Bayesian GLMM analysis over the most recent 5 years (2015-2019) showed neither an upward or downward trend. However, the 5 most recent years of this new analysis (2016-

2020) show a likely decline in PIKE (Table 1, Annex). Overall the trend in the last five years is downward due to a decrease in PIKE estimate in 2020. In sites that reported in 2019 and 2020 (n=6), PIKE remained the same or decreased at 5 sites and increased in one site during this period. For 2020, the unweighted PIKE estimate for central Africa remains high, with an average PIKE estimate of 0.44 (range: 0.28 - 0.59) and above the average continental PIKE estimate of 0.34 (range: 0.28 – 0.39) for the same year.

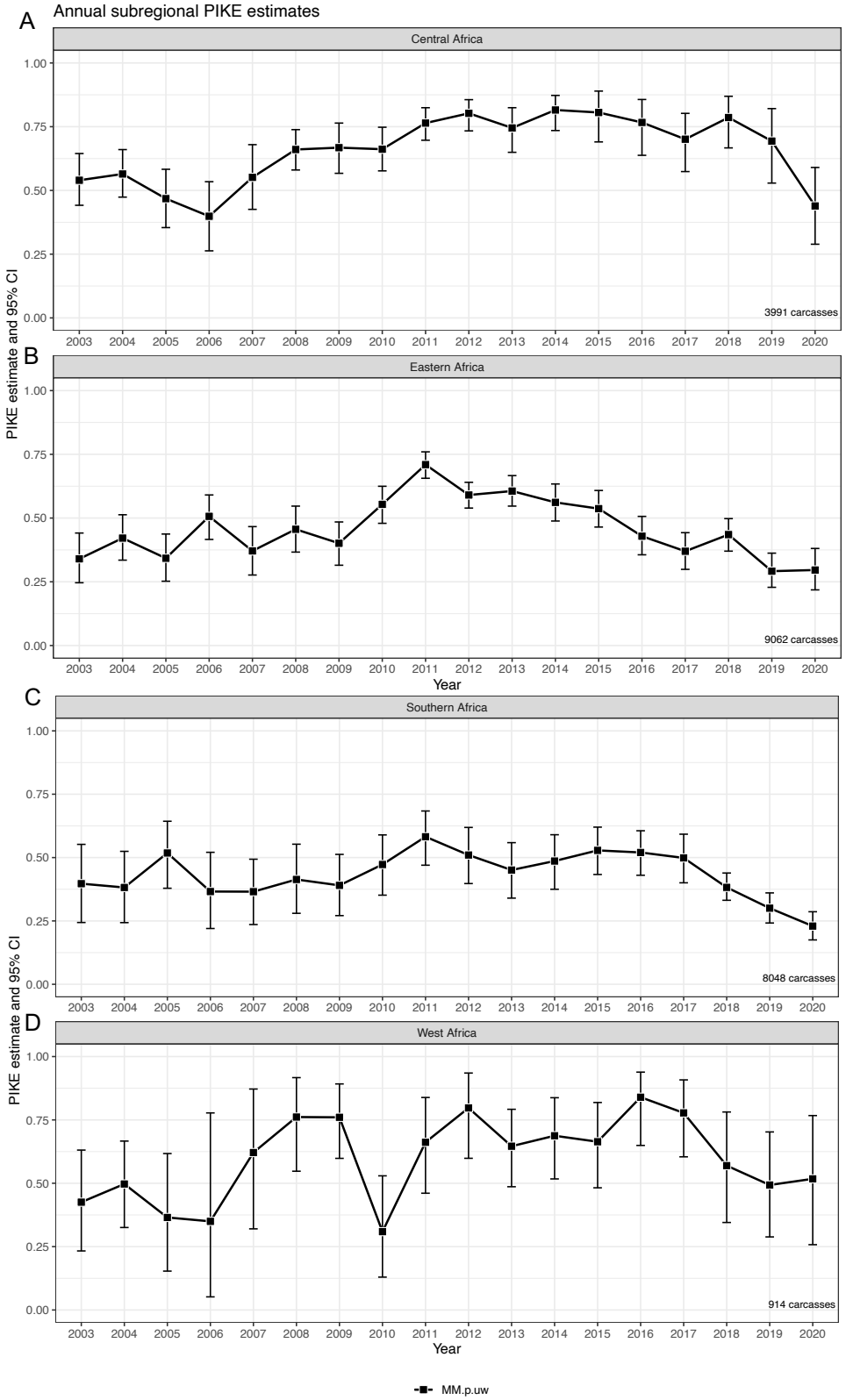

Figure 3: *Subregional PIKE estimates across years based unweighted Bayesian GLMM approach. The error bar shows the level of uncertainty in the annual PIKE estimates and represent 95% credible intervals. The total number of carcasses (from 2003-2020) for each subregion are shown at the bottom right corner of each graph. A – Central Africa; B – Eastern Africa; C – Southern Africa and D – West Africa.*

Eastern Africa

18. The PIKE estimates for eastern Africa are shown in Figure 3. B. Between 2003 and 2019, the highest PIKE estimate for the subregion was in 2011. Based on the unweighted Bayesian GLMM analysis, there is strong evidence of a downward trend in PIKE between 2011 and 2020. Overall, the trend in the last five years is downward. Between 2019 and 2020, the PIKE estimate has remained relatively unchanged, being at its lowest value in 2019. For 2020, the unweighted PIKE estimate in eastern Africa remains relatively constant, with an average PIKE estimate of 0.30 (range: 0.21 - 0.38) and below the average continental PIKE estimate of 0.34 (range: 0.28 – 0.39) for the same year.

Southern Africa

19. The PIKE estimates for southern Africa are shown in Figure 3.C. Based on the unweighted Bayesian GLMM analysis, PIKE likely increased between 2003 and 2011 and subsequently decreased from 2011 to 2020. Between 2015 and 2017, the PIKE estimate remained relatively unchanged, and a downward trend started in 2018 which continued in 2020. Overall, the trend in the last five years is downward due to a decrease in PIKE estimates in the last three years from 2018 to 2020. The unweighted PIKE estimate for 2020 in southern Africa is 0.22 (range: 0.18 - 0.29) and below the average continental PIKE estimate of 0.34 (range: 0.28 – 0.39) for the same year.

West Africa

20. The PIKE estimates for west Africa are shown in Figure 3.D. Inferring a subregional trend for the subregion with the smallest African elephant population is difficult, given the total number of carcasses reported and the number of sites that reported zero carcasses found. Compared to the three other subregions, west Africa reported the lowest total number of carcasses: 914 carcasses reported over 18 years (Figure 3. D). In 2020, a total of 12 carcases were reported from 8 sites while 10 sites reported not finding any elephant carcasses. This results in a high level of uncertainty of the PIKE estimates (i.e. the width of the credible intervals) and the trend needs to be interpreted with caution. Based on the unweighted Bayesian GLMM approach there is marginal evidence of a downward trend over the last five years. From 2019 to 2020, the PIKE estimate remained relatively unchanged. For 2020, the unweighted PIKE estimate in west Africa is 0.52 (range: 0.25 - 0.77) and above the average continental PIKE estimate of 0.34 (range: 0.28 – 0.39) for the same year.

PIKE trend analysis: Asia

21. The CITES Secretariat reported on the levels and trends in illegal killing in Asia for the years 2003 – 2017 in the MIKE report released on 16 November 2020. Through an EU-funded project in South and Southeast Asia, engagements with Asian elephant range States were strengthened and support was provided to range States to facilitate MIKE data submission. In 2018 and 2019, a total of 29 Asian sites reported. In 2020, all fifteen MIKE sites in southeast Asia submitted reports and ten of the fifteen MIKE sites in south Asia submitted data. Unfortunately, a full complement of MIKE sites in south Asia could not report due to complications associated with the COVID-19 pandemic. As a result, the data set used for this analysis consists of 3,887 records of elephant carcasses found between 2003 and the end of 2019 at 29 MIKE sites in 13 range States in Asia, representing a total of 254 site-years (Figure 4 A).

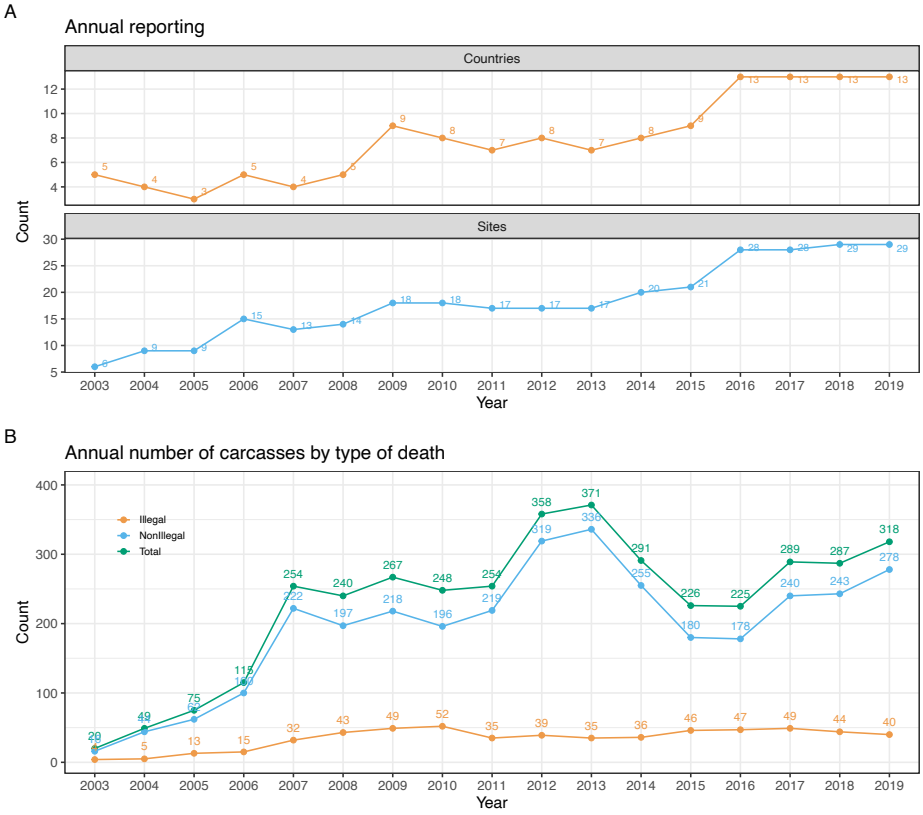

Figure 4: *(A) Total number of countries and sites that submitted reports by year. (B) The total number of carcasses reported irrespective of cause of death (green), the number of carcasses of elephants illegally killed (orange) and the number not illegally killed (blue) (natural deaths, management related deaths, unknown type of death) reported by year.*

22. Approximately 94% (=3657/3887), of the carcasses are from MIKE sites in south Asia and the remaining 6% (=230/3887) from MIKE sites in southeast Asia. It should be noted that more than 70% of Asian elephants occur in south Asia. The number of countries and sites reporting remained the same in 2018 and 2019. The total number of carcases between 2018 to 2019 increased from 287 to 318, and the number of carcasses reported as illegally killed decreased slightly from 44 to 40.

23. Figure 5 shows the continental PIKE estimate across years based the unweighted Bayesian GLMM (**MM.p.uw**) analysis. The error bar or confidence/credible interval shows the level of uncertainty in the annual PIKE estimates. In Bayesian analysis, a 95 percent credible interval (CI) is an interval within which a PIKE estimate falls with a 95% probability. The PIKE trend based on the unweighted Bayesian GLM in the last five years (2015-2019) has remained relatively flat. From 2018 to 2019, the PIKE estimate slightly decreased. For 2019, the unweighted PIKE estimate is 0.33 (range: 0.24 - 0.43).

24. Trend analysis disaggregated by subregion is not reported because a large proportion of carcasses are reported from south Asia as stated above. In addition, approximately 91% of the records (3,568 carcass records) are from MIKE sites in India, which holds the largest population of Asian elephants.

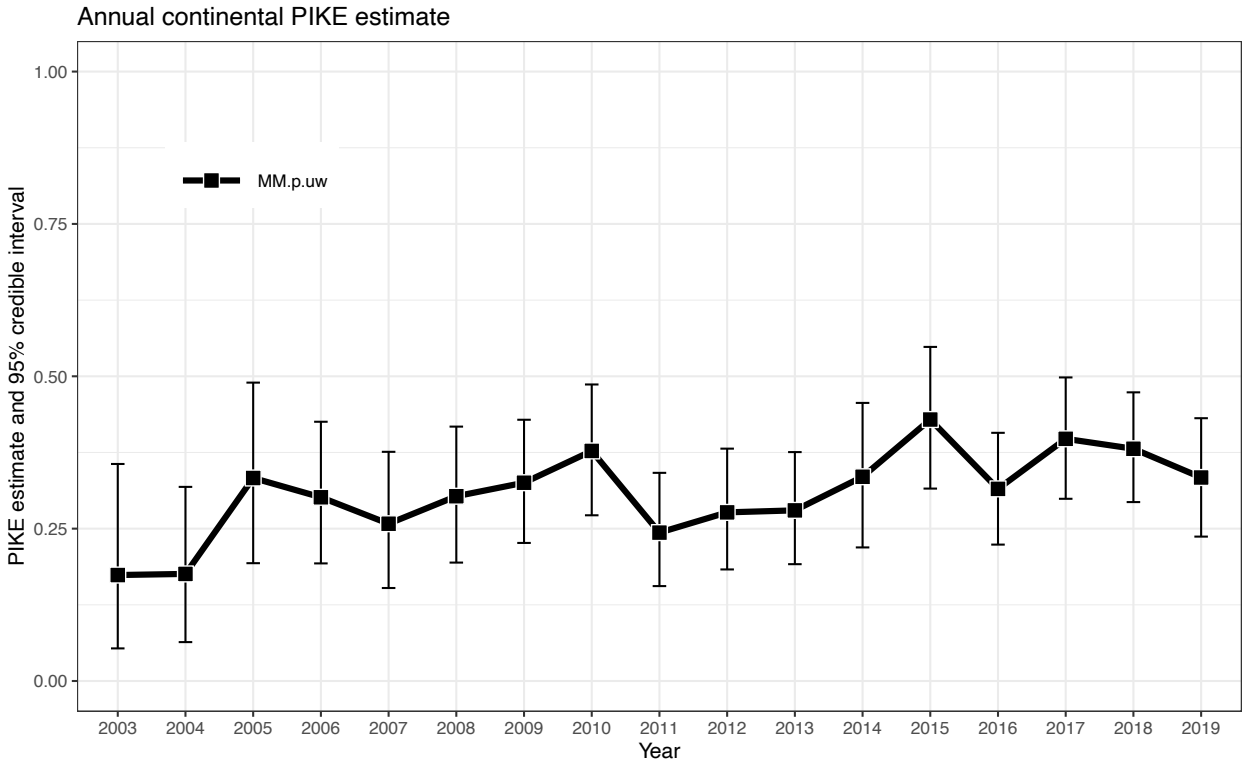

Figure 5: *Continental PIKE estimates for Asia, based on the unweighted Bayesian GLMM approach (**MM.p.uw**). The error bar or the confidence / credible interval shows the level of uncertainty in the annual PIKE estimates.*

ANNEX 1

ESTIMATED TRENDS IN PIKE FROM UNWEIGHTED BAYESIAN GLMM BY REGION AND TIME PERIOD AND STATISTICAL SUPPORT FOR A DOWNWARD TREND

Region	Time period, Years	Estimated slope (annual estimate of PIKE change) ($year^{-1}$)	95% Credible interval	Probability that trend is negative	Level of certainty associated with the reported trend (i.e. slope)
Africa	2003-2011	0.026	[0.019, 0.034]	0	highly certain upward
	2011-2020	-0.033	[-0.039, -0.027]	1	highly certain downward
	2016-2020	-0.071	[-0.089, -0.055]	1	highly certain downward
Central Africa	2003-2011	0.031	[0.019, 0.043]	0	highly certain upward
	2011-2020	-0.023	[-0.036, -0.011]	1	highly certain downward
	2016-2020	-0.066	[-0.105, -0.024]	0.998	likely downwards
Eastern Africa	2003-2011	0.032	[0.022, 0.042]	0	highly certain upward
	2011-2020	-0.045	[-0.051, -0.038]	1	highly certain downward
	2016-2020	-0.034	[-0.058, -0.011]	0.998	likely downwards
Southern Africa	2003-2011	0.013	[-0.002, 0.03]	0.051	uncertain of a trend
	2011-2020	-0.030	[-0.04, -0.019]	1	highly certain downward
	2016-2020	-0.078	[-0.102, -0.053]	1	highly certain downward
Western Africa	2003-2011	0.026	[0.001, 0.052]	0.023	uncertain of a trend
	2011-2020	-0.020	[-0.043, 0.002]	0.96	likely downwards
	2016-2020	-0.093	[-0.154, -0.024]	0.997	likely downwards

The slope estimate indicates how much PIKE changes on average over a single year over a given time period. A negative value of the slope means that the trend is downward and positive value that the trend is upward. The credible interval gives the range of values the slope can possibility take with 95% certainty. The probability that the trend is downwards is based on a linear regression model of the posterior PIKE estimate over a specified time period. Probability of downward trend is highly certain when the probability value is 1 (or 0 if the slope is positive), a value less than 1 is likely, and value of less than 0.95 is uncertain.