Technical Meeting of the long-term programme for Monitoring the Illegal Killing of Elephants (MIKE) in South East Asia

Bangkok, Thailand
17 – 18 March 2003

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1. Welcome and Opening

Welcome and opening remarks were made by Mr Nigel Hunter, Director of the CITES MIKE Programme.

He expressed gratitude to the donor community, in particular the US Fish and Wildlife Service which had made available the funding for this technical meeting. He also thanked the Wildlife Conservation Society in helping to facilitate the meeting in Bangkok.

The Director then introduced the participants and noted that the MIKE Technical Advisory Group (TAG) was represented at the meeting by Dr Holly T. Dublin.

2. MIKE Overview

A presentation summarizing the objectives and intended benefits and results of the MIKE programme was made by the Director.

In summary, the Director emphasized the nature of the MIKE programme as a range States owned programme authorized for implementation by the CITES parties at CoP11 (Gigiri, 2000). This decision was confirmed by the parties at CoP12 (Santiago, 2002) with a few refinements under Conf. Res. 10.10 (Rev CoP12).

Its purpose is to determine the levels and trends of illegal hunting. Illegal hunting may not be the main issue in Asia but the sustainability of elephant populations in Asia is a major concern. The mandate of MIKE is to help the range states integrate the monitoring system into their own institutional routine. A great deal of effort has gone into a dialogue with the range states clarifying this objective and confirming that MIKE will not support a process which requires bonuses, DSA, etc. to undertake what they themselves have mandated to be developed as part of their own capability. To be fair, the range states have acknowledged and confirmed this objective. But in this regard, MIKE is requesting site partners who are willing to help with MIKE, to negotiate at the outset of any project, a commitment from the relevant government that they can and will absorb any incremental staffing and other resources into the government's recurrent budget. As law enforcement monitoring (LEM) and data analysis can still be very effective using existing resources, this goal is not believed to be unrealistic. There is then the challenge of getting population surveys, particularly forest ones, integrated on a self-sufficient basis.

2.1 Site Selection issues

MIKE is based on a sample approach, using enough sites to provide that sample. The MIKE sites are chosen using the list of influencing factors and situations that prevail in each range state. Resources permitting, the MIKE process will be extended to other sites to address the bias that inevitably occurs. In the list of the sites identified for MIKE implementation, the influencing factors have been taken into account by the range States.

The Director also explained that determining trends in elephant populations and the factors influencing such trends was not dependent on population surveys alone. However, this meeting had the following main objectives because questions have been raised about the appropriate methods in the South East Asia context :

i) to discuss the pros and cons of possible elephant population survey methodologies in the South East Asia forest context;

ii) to suggest appropriate approach for each of the provisional MIKE sites; and

iii) to identify and recommend research needs where no current approach appears viable for any site.

2.2 Influencing factor issues :

MIKE will undertake to experiment with spatial analysis of influencing factors at the site level. At present, the use of geo-referenced data for analysis of changes in adjacent land-use patterns and other factors is intended for the African and Asian sites.

The off-take of live elephants for domestic trade as well as the lack of registration of domestic elephants could be important influencing factors for illegal off-take. The question was raised as to whether MIKE needed to monitor domestic elephant populations as well. The Director responded by explaining that MIKE had no mandate to study domestic elephants, but any offtake from the wild for such purposes would be part of the monitoring process.

2.3 MIKE and ETIS

ETIS is designed to monitor and record levels of illegal trade in ivory and other elephant products particularly in regard to law enforcement data on seizures and confiscations. Under Conf. 10.10 (Rev CoP12), technical oversight will be provided to both MIKE and ETIS through the Technical Advisory Group (TAG) which shall be expanded by 8 members to 14; comprising 1 member representing each of the six subregions, 6 members who are recognized for their technical expertise and a further 2 ETIS specialists. The ETIS report to the CoP12 is available at http://www.cites.org/eng/prog/ETIS/index.shtml. It is intended to have the MIKE and ETIS analyses interact both in terms of contributing information to each other and revealing trends not detected by the other.

3. MIKE Sites in SE Asia

The meeting went through a thumbnail description of the South East Asia MIKE sites and the challenges for monitoring that were present at each site. These factors are reflected in the 'Remarks' column of the table titled "Sites identified for MIKE Implementation in South East Asia" attached in **ANNEX I.**

4. Review of Possible Population Survey Methods in S.E. Asia Forests

4.1 Group Methods

Group method is based on the idea of 'census' or 'total counts' which it was felt did not adequately consider the problems of 'spatial sampling' and 'incomplete detections'. Total counts may be possible using alternative methods such as individual recognition, camera trapping or fecal DNA, particularly when dealing with very small populations. Nevertheless, if individuals can be recognized, mark-recapture based approaches to estimate population size would be more appropriate. However, it is important to note that individual Asian elephants could not be recognized with sufficient certainty where WCS used camera traps in the forests of Sumatra (see Section 4.7).

4.2 Footprint Counts

This method can be used to map distributions. However, if used to count individuals, substrate variability is a major problem as not all tracks show up. There is no link between number of footprints in an area and the number of elephants using it. Individual recognition of elephants by footprint characteristics is unlikely to be successful. However, footprint counts combined with mapping of elephant trail type and density (c.f. the work of Vanleeuwe & Gautier-Hion 1998) has some value as a method for stratifying a survey area by elephant use, but care needs to be taken to avoid errors due to variation in perceptions of trail use as well as the substrate-related problems mentioned above.

In the absence of peer reviewed references, the adoption of this method is problematical. It was stressed that without such a peer-review, the MIKE TAG would have difficulty in recommending it as a method.

4.3 Patch Occupancy approaches

The topic of patch occupancy approaches was introduced by Joe Walston based on his recent work in Cambodia. Discussion focused on the potential applications of the method : a) for determining an initial assessment of presence, absence and distribution; b) as a preliminary or exploratory pilot approach for determining appropriate survey techniques; c) where applicable, for helping to stratify line transect dung counts in the future and d) for estimating population trends.

It was agreed that the design of a patch occupancy study to achieve these ends will require the development of standard guidelines if adopted by MIKE.

(i) For determining an initial assessment of presence, absence and distribution

It was felt that in some designated MIKE sites in Southeast Asia, very little is currently known about the existing elephant numbers and their range. Before deciding on the appropriate survey technique for determining population trends, it is essential that some basic information is available. The patch occupancy method may offer this first important "snapshot" for these sites – providing information on dung-pile density and other elephant signs.

(ii) For determining appropriate survey techniques

In addition to providing baseline information on elephants, a patch occupancy study could be used to assess which methods might be appropriate for follow-up surveys (e.g. to assess whether dung-pile encounter rates are high enough for standard dung-count transects or whether fecal DNA methods and a mark–recapture study design would be more appropriate).

(iii) For stratifying line transect dung counts

The results of the patch occupancy study could also be used to stratify the survey area by expected dung-pile density, which would help with the design of follow-up surveys. For example, higher survey effort could be allocated to the higher-density strata, which could help improve the precision of the population estimate obtained. Such pilot surveys are recommended practice for the design of line transect surveys (Buckland *et al*. 2001).

(iv) For estimating population trends

Several issues were raised concerning the use of this method in the context of MIKE for determining population trends over time. The patch occupancy approach is generally viewed as a means of estimating the proportion of sites occupied by a species of interest. In essence, it is a sampling method that involves multiple visits to sites during an appropriate period (e.g. a particular season) during which a species or signs of that species may be detectable. The patterns of detection and non-detection revealed over the multiple visits allow estimation of detection probabilities and thus estimation of the proportion of patches occupied (Mackenzie *et al.* 2002).

However, the use of site or patch occupancy approaches to monitor trends in population size is challenging due to possible changes in elephant range over time. Royle & Nichols (2003) have developed an approach for estimating occupancy rate or the number of sites or patches occupied when heterogeneity in detection probability exists as a result of variation in abundance of the organism under study. They note that a key feature of patch occupancy is that variation in abundance induces variation in detection probability. However, this feature can be exploited, since heterogeneity in abundance can be modelled as heterogeneity in detection probability. This linkage between heterogeneity in abundance and heterogeneity in detection probability allows one to exploit a heterogeneous detection probability model to estimate the underlying distribution of abundances. Their method allows estimation of abundance from repeated observations of the presence or absence (or more accurately, detection or non-detection) of animals. A related method has been developed by Royle (in review).

While it is given that variation in animal abundance among sites/patches is an important source of heterogeneity in detection probability (it is probably the most important source in many situations, when indirect signs of animal presence such as dung-piles are recorded instead of sightings of the animals themselves), an additional source of heterogeneity in detection probability is introduced, *viz*. **differential dung persistence time among sites/patches**. This requires the inclusion of area-specific decay rates as a covariate in the analyses. This is likely to be problematic, if for no other reason than determining appropriate decay rates for areas of low animal density will be difficult (because finding adequate numbers of fresh dung-piles to monitor will be difficult).

Although the patch occupancy approaches are not yet sufficiently developed for use in MIKE, their application to MIKE as described above hold much promise and the MIKE TAG should be encouraged to evaluate their suitability.

4.4 Carcass Surveys

As an alternative to monitoring trends in numbers of live animals, it was generally felt that monitoring trends in carcass numbers was not appropriate. Nevertheless, collecting carcass information is an important part of the MIKE process. In response to whether it was therefore necessary to have a systematic carcass detection process (e.g. systematic transect surveys to look for carcasses throughout selected MIKE sites), it was generally agreed that about 80% of carcasses were likely to be detected through information networks, existing patrol reports, and other non-patrol reports. The cost and effort therefore of undertaking a systematic approach was likely to far outweigh any added value.

Given the value of identifying carcasses to determine cause of death, the possibility of using specially-trained detection dogs to locate carcasses was discussed as a means of enhancing these efforts.

4.5 DNA Approaches

Dr Lori Eggert of the Smithsonian Institute, presented the basics of using DNA methodology for estimating population sizes and monitoring trends resulting from her study of forest elephants' fecal DNA at Kakum National Park, Ghana (Eggert *et al.* in press).

One of Dr Eggert's conclusions was that fecal DNA based methods are likely to be most effective at estimating forest elephant population size when used within a mark-recapture survey design. Fecal DNA based methods have a number of advantages over more traditional methods of identifying elephants, especially in forest environments. The advantages are : (i) a mark-recapture study can be done without physically capturing the animals, (ii) genetic 'marks' or 'tags' cannot be lost, (iii) capture probabilities for individual animals will not be subject to behavioral responses to capture, and (iv) the method provides information about sex ratio, genetic diversity and probable relatedness between individuals.

DNA methods are also of particular value for monitoring small populations where there is a question as to whether the sex ration is too skewed for the population to be viable, ie. an all female population or one where the males are all very young. A further important potential use of the DNA approach was flagged, i.e. if the appropriate DNA markers could be identified, then it should be possible to distinguish male elephants with tusks from tuskless males.

It was recommended that before this method is adopted in larger populations, the experts in mark-recapture analysis be consulted to design a robust sampling strategy that is as cost effective as possible. The current lab cost per DNA sample is approximately US$50, making cost an important consideration when selecting methods for surveying and monitoring MIKE sites.

The possibility of using detection dogs trained to identify dung from the same individual was raised as a means to greatly reduce the costs of mark-recapture analyses.

4.6 Dung Count Methodology

A summary of the presentation by Simon Hedges on the paper : Hedges, S. & Tyson, M. J. (2002) "Some thoughts on counting elephants in SE Asian forests, with particular reference to the CITES Monitoring the Illegal Killing of Elephants Programme", Wildlife Conservation Society, Sumatran Elephant Project, Bogor, Indonesia is attached here as **ANNEX II.**

The gist of the discussions centred on the dung-counting techniques for population estimation (especially for some of the very small populations in the proposed Asian sites) and some of the inherent challenges which will require further consideration.

The main issues highlighted for the attention of the meeting, and ultimately the TAG, are set out as follows :

(i) Analytical Models

It was felt that the "steady state" approach to estimate elephant population density was no longer appropriate. This is because the assumption that "defecation and decay rates are constant and so dung-pile density will remain constant once the system is in equilibrium" is invalid (refer to Annex III and Hedges & Tyson 2002 for discussion of this problem). Three alternatives to the "steady state" approach were identified :

- the DUNGSURV model (Hiby & Lovell 1991);
- iterative approaches developed by Plumptre & Harris (1995); and
- rainfall models developed by Barnes *et al.* (1997) and Barnes & Dunn (2002).

Harmonisation of the approach for analyzing these dungs counts might facilitate the development of models linking dung decay rates to rainfall and other measurable environmental variables and, ultimately, reduce the need for time-consuming and tedious studies of decay rates. However, it was agreed that the applicability of these alternative approaches in the different sites and the potential for harmonizing the approach will need further discussion.

(ii) Classification of dung piles into recognizable stages

For dung decay to be monitored accurately, and for the decay rate data to be of use for converting estimates of dung density into elephant density, there is a need to be able to assign dung-piles into classes based on their state of decay, and to do this consistently. Several classification systems exist and were identified, these include the methods of Wiles (1980), Barnes & Jensen (1987), White/MIKE – Central African Pilot Project (e.g. Beyers *et al.* 2001), WCS – Sumatran Elephant Project (Hedges & Tyson 2002). The problems with these systems were discussed and possible improvements suggested.

It was suggested that harmonization of the methods used in Africa and Asia would be desirable before any training or survey work under the MIKE process is carried out in SE Asia.

(iii) Estimation of dung pile density

The use of the line transects, recce transects, belt transects and plots (including adaptive cluster plots) for the estimation of dung pile density per unit area were discussed. The main issue concerns the power of line and recce transect surveys to detect change in population size, particularly when elephant populations are small. Precision can be improved by re-surveying line transects in subsequent years. This was shown to be possible using current GPS technology during the MIKE Central African Pilot Project, provided start points are well marked and the transects are conducted along closely controlled compass bearings (Beyers *et al*. 2001). It is not possible to re-survey recce transects with anything like the same precision. It was also agreed that recce transects are not an option.

(iv) Dung decay rates

The main issues concern the need for site-specific decay rates and the high variability of decay rates as a function of variability in rainfall and vegetation types. It was noted that while dung-count based methods can be relatively low cost and that local capacity can be built to conduct these counts in order to produce valid estimates of elephant population size (Barnes 2001), they do have to be done properly to be of use. It was further argued that doing a dung count properly requires site-specific decay rates and therefore, elephant population estimates derived using decay rates from sites thousands of miles away or from areas within large sites that have highly variable rainfall patterns cannot be accepted. Recognizing that dung-counts are “low-tech” does not mean that the same quality-control standards are required as for the more “high-tech” methods.

(v) Elephant defecation rate

It was generally felt that whilst some variation in defecation rates would occur, this variation was unlikely to be large among forest populations. Therefore, this particular issue was thought to be much less of a priority compared to other issues. The possibility of using WCS’s extensive data set on the defecation rates of free-ranging Sumatran elephants, which indicated a rate of 18 defecations per 24-hour period, was discussed. Other alternatives were suggested (see Annex II).

(vi) Dung-based ageing methods

The ability to monitor trends in forest elephants would be improved if both population age-structure and population size could be determined from dung surveys. Studies in Africa and Sumatra suggest that dung dimensions can be used to age elephants. Ongoing data analysis suggests that dung bolus circumference is a better predictor of elephant age than dung diameter. The question is whether this method can be combined effectively with the fecal DNA based methods to determine the age and sex structure as well as the size of elephant populations. The work of Eggert *et al.* (in press) suggests that this is likely to become a cost-effective method in the near future.

(vii) Precision in small populations surveys

Barnes 2002 suggests that the precision of both aerial sample surveys and dung counts is inversely proportional to elephant abundance. This mean that the power of a monitoring programme such as MIKE to detect changes in elephant abundance declines as population size declines. Unfortunately, this problem becomes disproportionately more severe as population size drops to a few hundred animals.

Since one of the main goals of MIKE is to determine trends in the illegal killing of elephants and their likely causes, little will be gained from consecutive surveys of small elephant populations if those surveys have poor resolution. Barnes (2002) argues that it would make more sense to allocate most effort to monitoring elephant mortality (from carcass density and changes in population sex- and age-structure), law enforcement, and indices of illegal activities including trade in ivory and other elephant products. However he argues that determining sex- and age-structure is likely to be as difficult as detecting trends in numbers, and the estimates of these parameters are unlikely to be either accurate or precise.

While this may well prove to be the case, Hedges & Tyson suggested that further thought needs to be given to the utility of combining dung-counts to estimate population size with dung-measuring to estimate age-structure. The power of such combined surveys to detect population trends (and their likely causes), especially when combined with carcass surveys and indices of illegal activities, may be superior to dung-counts alone, and could facilitate the inclusion of smaller elephant populations in the monitoring program than would a solely dung-count based survey strategy.

4.7 Camera Traps

In recent years, the use of camera trap-derived accumulation rates from photos as indices of population size for cryptic mammal species has received a fair amount of attention, particularly as a survey method for tigers (*Panthera tigris*). In theory, such photograph accumulation rates could be calibrated against estimates of population size, derived using one or more independent methods. However, recent work by WCS in Sumatra has suggested that there is a poor relationship between photograph accumulation rate and elephant density (derived from dung-counts). Furthermore, in this work there appeared to be a threshold density (i.e. between 66 and 14 elephants/100km^2) below which camera-trapping was not able to reliably detect the presence of elephants.

4.8 Use of Scenting/Sniffer Dogs

Dr Wasser illustrated the use of dung-detecting sniffer dogs in the study carried out at the Jasper National Park in Canada to estimate the population size of grizzly bears using dung samples.

That sniffer dogs can be very effective in dung and carcass detection is evident with consistent and higher achievements compared to humans. The sniffer dog methodology could therefore make an important contribution in the field and in the lab where they can link dung to individual animals through scent. However practical issues on the interface between handler and dog need to be carefully thought about in the range States context. For instance, the commitment of a handler to the dog in between the surveys could be for long periods and is a delicate matter, if the dogs' motive and efficiency are not to be impaired. The implications of leeches, ticks, regulations banning dogs in protected areas, local culture etc will all have a practical bearing.

The best way forward for this approach may be through a pilot study, where the practical issues described above could be explored further.

Description of the precision encountered in this technique is available at **Pradel**, **R**. (1996). "Utilization of Capture-mark-recapture for the study of recruitment and population growth rate." Biometrics 52: 703-709.

5. Recommended Approach per site

Having discussed the pros and cons of the various survey methods, the South East Asia MIKE sites were addressed with a view to signaling the way forward for each site in terms of population survey methods. These suggestions are reflected in the matrix listing provided in **ANNEX I.**

6. Summary of Discussions

The meeting then concluded the technical discussions with a summary of the issues being provided by Dr Ullas Karanth.

This summary was then reflected in a logic tree presented by Dr Holly Dublin and agreed by the meeting. The logic tree attached hereto in **ANNEX III,** is not intended as a comprehensive identification of all the issues, but reflects a logical approach to some of the important issues discussed by the meeting.

A list of the relevant citations referred to in these minutes and annexures are attached here as **ANNEX IV.**

7. Next Steps

The Director confirmed that he will continue to work on and address the issues raised in the meeting. For example, he would constitute a small working group as soon as possible, under the TAG auspices, to further the discussions on dung-count methodology. He would try to identity appropriate resource person(s) to evaluate the Patch Occupancy approach. He would encourage the evolution of the DNA markers for distinguishing tuskers from tuskless male elephants.

The Director then stressed the importance of those attending to allow him, after conferring with the TAG, to communicate with the range States regarding the possible way forward for each site. He made this point as the range States were expecting him to report back on the technical meeting and to involve them in any decision-making process.

8. Concluding Remarks and Closure

The Director expressed his gratitude to those present for their participation and to the WCS Thailand Programme's staff for their logistical support throughout the meeting.

A special thank you was extended to Dr Dublin who attended the meeting as the representative of the TAG and to the US Fish and Wildlife Service whose funding has facilitated the implementation of MIKE in Asia.

On behalf of the CITES Secretariat, the Director wished all the collaborating partners every success in supporting the implementation of MIKE in the South East Asia sub-region.

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