of the population. At the same time, indices of all other classes of illegal activity were reduced by between 75 and 90%.

5. Analysis of the relationships between indices of illegal activity and various law enforce≠ment parameters demonstrates logarithmic relationships indicative of diminishing re≠turns on law enforcement effort and expendi≠ture at low levels.

6. This result leads to the conclusion that, for most wildlife management purposes, includ≠ing the conservation of elephant, acceptable levels of illegal offtake can be achieved for about US$ 70/ km^2/year, that is considerably less than the amounts recommended by other authors. It is noted however, that this result was achieved in the context of the LIRDP community participation programme. More≠over, it implies a significant increase in staff efficiency, requiring in turn a focus on staff quality at all levels.

7. The proposed scenario is probably not effec≠tive for rhino, which are both more attractive to illegal hunters and have lower sustainable yields than elephants.

8. The analysis provides no evidence that the 1990 CITES ban on ivory trading has had an influence on the rate of illegal offtake of elephants.

The African Elephant Database

Iain Douglas-Hamilton

The African Elephant Database is a repository of information on numbers and range of the species arranged on a country-by-country basis. Each record of elephant numbers is accompanied by a map showing the specific area to which the estimate refers. Each record is clearly labeled with its own numerical code. Computer-generated maps can be related to accompanying tables that give details such as name of the census zone, date of estimate, counting method, quality of estimate and source of data. The geographical information is digitized from maps of varying scales into a computer where it is stored for further use. In this way, data from different populations or countries can be combined to make maps or produce data overviews on a country, regional or continental scale. Currently the database holds three different layers of geographical information: elephant range, estimates of elephant numbers and distribution of protected areas. However, in our earlier attempts to con≠struct a continental population estimate many more data layers were entered from existing continental datasets such as human population, rainfall, habitat type, various economic indicators at a country level, even tsetse fly distribution. These data were analysed by multiple regression to identify which factors were significantly associated with elephant density. Of all the factors analysed protected status was most positively associated with elephant density (Burrill and Douglas-Hamilton 1987).

Uses of the database

Once these data are entered, the computer has great powers of analysis and presentation. It can generate areas from its internal maps and calculate elephant range based on different factors such as country, region, protected status, or the quality of Input data. It thus allows overviews to be constructed at a variety of levels.

While the technique of multiple regression has been valuable in creating a continental overview, it could be even more useful on a country or regional basis where the datasets are of far higher quality and better resolution. For example, a field-derived relationship between elephant densities and the distances from roads or rivers, a GIS technique, coupled with the database, was used to calculate elephant estimates for some Central African forest areas (Michelmore *et al*, in press). The database also has far greater analytical potential which has yet to be tapped. For example, two additional factors that may be strongly associated with elephant densities on the continent are land use and investment in law enforcement within protected areas. The database allows the juxtaposition of these

and any other existing data sets to assess the factors providing the most predictive powers for the estimation of elephant numbers, densities and trends.

Some controversial aspects of the database

Data Quality

The quality of data is a controversial topic, because it harks back to the debate over the actual methods used for censusing elephants. For example aerial counting of elephants, although widely accepted, has several different methods each with its own adherents and detractors. The relative merits and demerits of sample versus total counting could fruitfully be discussed to establish which should be the preferred technique for different situations. The need for reporting of confidence limits or other indicators of variance should be discussed also. As things now stand, many of the estimates in the database are not even based on numerical surveys. One person's "informed estimate" may be regarded as another's "unsubstantiated speculation".

The database imposes a challenge to informants to prepare data in a standardised and rigorous way. Its value hinges on the reliability of these estimates. At best, estimates are derived from well-executed elephant censuses. At worst, informants may be tempted to invent data to fill in blank spaces on posted questionnaires. However, variability in the quality of data is a fact of life and it is necessary to classify all data in the database according to reliability. The role of classifying these data has traditionally been asked of the African Elephant Specialist Group. The end result, however imperfect, should be an agreed set of data within the limitations of what is possible. In the past, interpretation of these data has been carried out by many different individuals with differing goals and in some cases, this has created controversy.

The history of variability in data quality has not been all bad. In fact, it has in some cases served to establish where good data are lacking and as an aid to those planning new censuses. Governments may have to choose between maintaining limited but good coverage or improving deficiencies in the extent of census coverage to date. The provision of standardized data quality indices provide the necessary information to formulate these decisions.

This AESG meeting will hopefully accept the challenge to propose and develop new ideas as to how we might improve the classification of data on elephant numbers. In addition we should try to look critically at the definitions of elephant range versus distribution and to reach a group consensus over a common definition to be used in future. This may also enable us to go back in time and reanalyze historical data in a productive and mutually acceptable way.

Trend Analysis

Given the variability of data can one compare earlier versions of the database with later ones in order to calculate trends? For a continental dataset of variable quality this is a risky enterprise, but it has been done. For some populations there are consistent data-sets of high quality where such comparisons are generally accepted as valid, although there are few for which a rigorous trend analysis has been performed. In any event there is no general agreement as to how these different data-sets could or even if they should be combined into a regional or continental picture .

Conclusions

Given the importance of elephant numbers and trends in the conservation and management of the species we cannot walk away from estimating them. Numerous models have been produced, it is our challenge to come up with a mutually agreeable formula for interpreting and presenting data on the African elephant for ourselves and outside audiences. This meeting would do well to explore how better data can be obtained and what acceptable norms can be used for trend analysis. We must also clarify our thinking on the end product, its value for end-users, and who and where these users are.

These issues are open for discussion. There are no prescriptive solutions but I would suggest we should openly discuss these sometimes controversial issues. In so doing we may finally reach some useful definitions of range and distribution, reconcile different types of data gathering and the resulting population estimates, address the problems of analysing population trends over time, and provide a satisfactory product for end-users.