Elephant Hunting Patterns

In the last AERSG newsletter we presented mathematical techniques for determining the sex and age of elephants from tusk measurements. We will now present a mortality pattern developed by their use, and discuss its use as a basis for making well-founded guesses as to the hunting patterns which produce the tusks in the ivory trade.

The empirical hunting mortality pattern for East African elephants is presented in Fig. 1. It was calculated from data collected by Parker (1979: Table 175). Examining tusks in Hong Kong warehouses, he recorded country of origin, sex (determined by visual inspection) and lip circumference. Using
the proportion of elephants taken from each category is directly proportional to tusk weight.

Selective hunting of a young population is the only simple way to get the correct pattern of peaks in the mortality pattern. Natural mortality occurs early or late in life, and the only change with population structure is the relative proportion dying early and late, not age of death. Random cropping, which takes elephants in direct proportion to their numbers in the population, will produce a peak in the middle only if there are more animals of middle years than there are young. This sort of distribution is possible, but unlikely.

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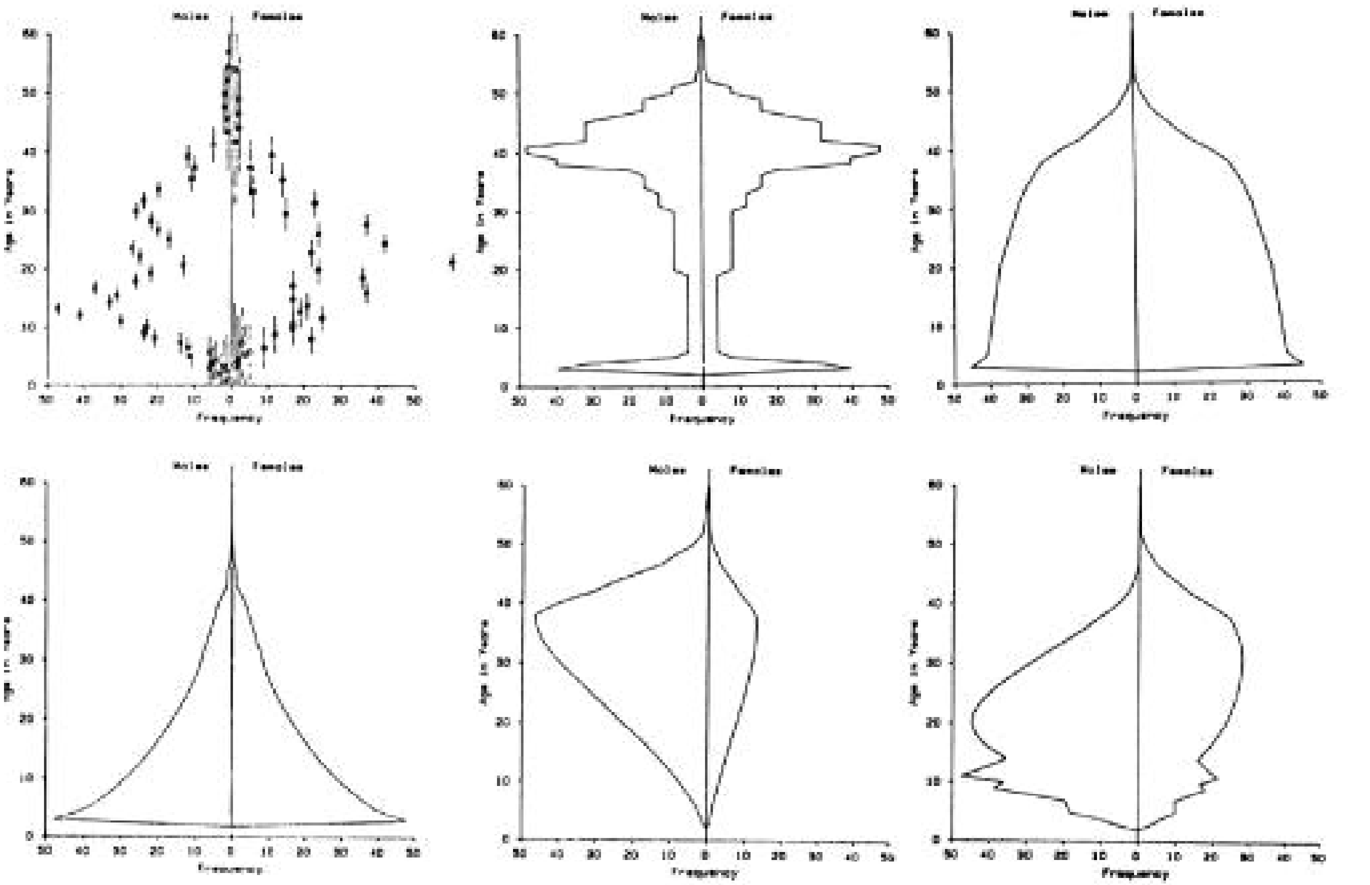

Fig. 1. Mortality patterns represented by tusks. Top, left to right Empirical hunting pattern for Kenya and Tanzania (1977); natural mortality in a mature population; random cropping from a mature population. Bottom, left to right Random cropping from a young population; selective hunting from a mature population; selective hunting from a young population. Frequencies are absolute for the empirical population only. The rest are adjusted to be on the same approximate scale.

calculated estimates and confidence intervals for the ages.

The overall pattern is for the number killed first to increase, and then decrease with age. This pattern produces a peak in the middle of the age distribution, with the peak for males occurring at an earlier age than that for females.

A variety of possible scenarios, including different hunting techniques and intensities on different-aged populations was computer-simulated in an effort to duplicate the pattern in Fig. 1. The pattern which appears to be most similar is selective hunting of a young population. Selective hunting is simulated by multiplying the base hunting intensity by the mean tusk weight of an elephant's age and sex category. As a result, selective hunting of likely populations will produce peaks in the middle of the distribution. With a mature population, the hunting mortality peaks will occur late in life. With a young population, the number killed diminishes late in life because there are few old animals to be hunted, while the youngest animals will be hunted very lightly because of their small tusk size. Animals in their middle years will be reasonably numerous and hunted very intensely. Males will be hunted more intensely than females at a young age because their tusk growth is more rapid, producing a mortality distribution very similar to the empirical one.

Determining the hunting pattern is useful because it allows well-founded speculation about its long-term consequences. This is a more complicated procedure, because the pattern determined to be the best one can be produced by

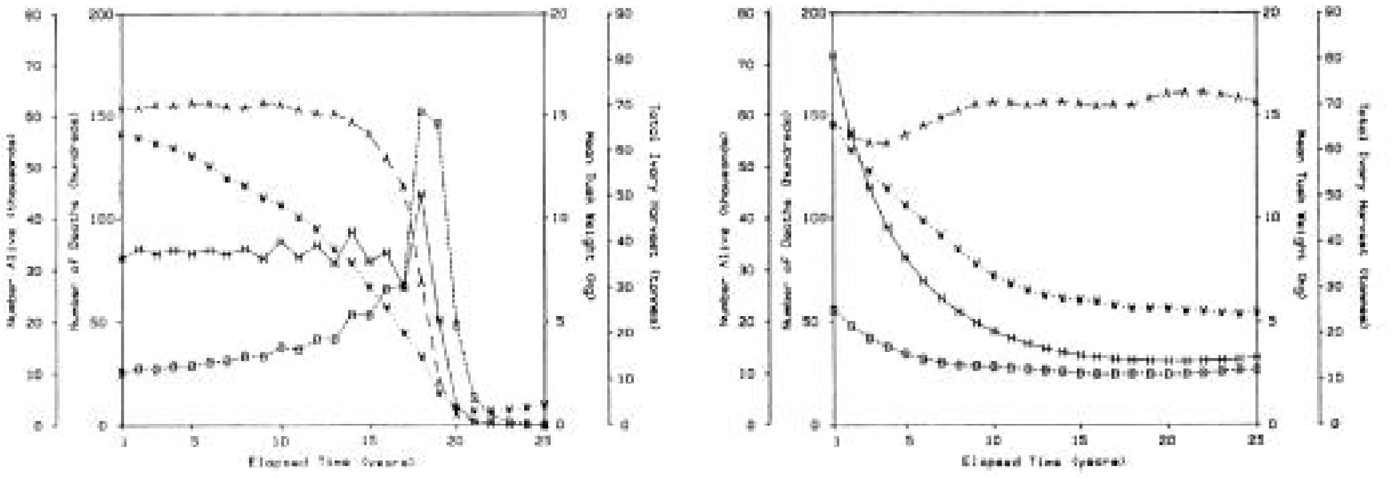

Fig. 2. Simulated patterns of harvest and mortality for different hunting strategies. Left Increasing base hunting intensity with constant harvest. Right Constant base hunting intensity. Key: A - Number alive, D - Number of deaths, H - Total ivory harvest W - Mean tusk weight.

different means. It is worth examining the two most different techniques to consider their implications.

The pattern presented was actually produced by starting with a mature population and simulating selective hunting with a target harvest 150% the amount produced by natural mortality alone. Hunting was increased to maintain this harvest as the population became younger, and birthrate increased to attempt to maintain population numbers. The pattern shown was produced after a simulated 15 years.

An essentially identical pattern can be produced by maintaining a constant base hunting intensity. The ivory harvest diminishes steadily, in contrast to the previous example, but the population effects are the same. The population becomes younger as a result of heavy hunting among older animals and an increased birthrate to compensate for their loss, and the pattern of animals killed is the same as for the scenario above.

Though these different scenarios produce identical hunting mortality patterns in their 15th year, they can be distinguished by their histories (Fig. 2). The key differences are in the number of elephants killed and the total ivory harvest.

In the population being hunted with steadily increasing intensity, the ivory harvest has remained stable, with the number of elephants killed to maintain that harvest increasing as mean tusk weight declines. With a constant base hunting intensity, mean tusk weight decline has resulted in both a slight decrease in total deaths as selective intensity declines, and a considerable decline in total harvest. Though the mortality patterns are similar, other aspects of their past are different.

Their futures are even more different. The population being hunted with increasing intensity is on the verge of collapse, while that hunted at a constant intensity has settled into a stable pattern in which all measures will remain relatively constant. These different futures provide a real impetus toward deciding which is the actual pattern.

This is a difficult task, since there is great variation in the local patterns. The continental pattern, roughly, is for the total ivory harvest to remain constant, while mean tusk weight declines and number of elephant deaths increases (Parker and Martin, 1983). As we have shown, a decline in mean tusk weight does not, by itself, necessarily indicate a situation of population decline. However, in combination with a constant harvest and, therefore, an increasing number of elephant deaths, it very well might.

The simulated scenario of increasing hunting intensity could be achieved in reality by more intense hunting by more individuals. This possibility has been suggested by both Parker and Martin (1983), who mention human population increase as a threat to elephants, and by Douglas-Hamilton. (1983), who points to an even more rapid increase in the number of automatic weapons available. Either of these explanations, or both in combination, could provide the hypothesized increase in hunting intensity.

Although this explanation as to what the pattern of ivory in the trade represents makes sense on a number of levels, it should not be accepted too hastily. There are large numbers of individual elephant populations in Africa, doubtless hunted by a variety of techniques at a number of different levels of intensity. A simple explanation for a complicated situation may be substantially correct, but should be treated cautiously.

If it would be premature to view our results with alarm, it would nevertheless be unreasonable not to view them with concern. They constitute one kind of evidence that the African elephant population may be in decline due to hunting. As many other kinds of evidence as possible should be examined as well. If there really is a danger, it should be possible to present the case for it convincingly, and to determine measures which could reduce it.

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Few places exist in Africa where populations of elephants