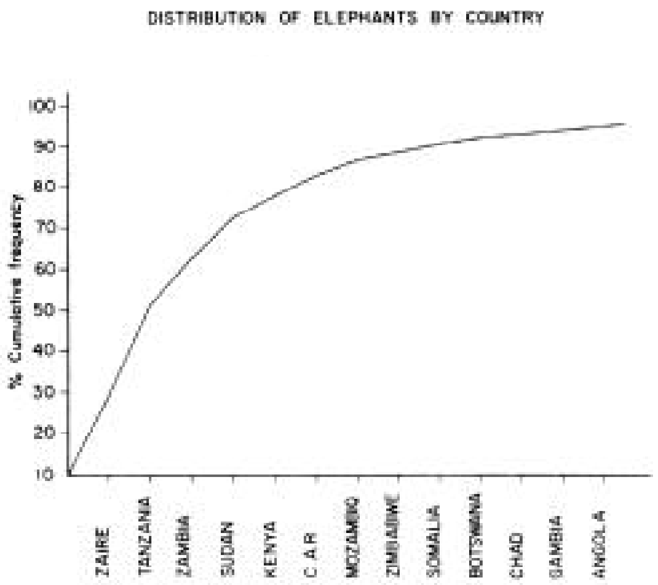

UNDP and EEC, but no new hard information has come in since the 1982 surveys reported in'*Newsletter 1.*

Rwanda: Nicole Monfort writes that the 25 elephants still survive and are well in the Akagera Park, survivors of an eradi≠cation scheme where adults were shot and small calves were immobilized and transported.

Southern Africa (21% of range, 32% of population)

Angola: A reply from the Ministry of Agriculture indicated that no hard data is available on account of the war. Reports continue of guerillas trading ivory for arms, but no quantitative measures have been obtained.

Zambia: A count in the Luangwa Valley in 1979, suggested that elephant numbers had declined by approximately 30%. The evidence available suggests that poaching may initially have caused a build up in numbers in the better protected areas, followed by a reduction. Whatever may have been the case formerly, it now appears that, the remaining elephants have been compressed with in the national park, and recent reports suggest that despite local overcrowding the overall decline has continued.

Botswana: The country-wide range may be somewhat smaller than thought previously; Botswana is one of the few countries where elephants may be stable or increasing. Recent aerial surveys in Chobe National Park have returned record dry season concentrations of elephants.

Mozambique: According to Tello, the elephant range still covers a third of the country, but the largest components in the centre and south of the country may have become fragmented between 1975 and 1983. By 1983 Tello believed that elephants in Niassa and Rovuma in the north and Marromeu in the centre of the country were increasing and expanding their range.

The elephant situation since 1982 has changed radically for the worse through most of the country, with the exception of the north. The national elephant estimate, based on aerial reconnaissance and informed guesswork, fell sharply from about 51,000 in 1982 to about 27,000 in 1984. The actual numbers are not as important as the trend.

The principal reason has been increasing civil strife, with units of the army, the militia and the “resistance” each poach≠ing in areas which they control. Gorongoza National Park has been overrun by rebels of the resistance, who have killed elephants for ivory and meat, reducing their numbers from an estimated 6,000 to 2,000. In the centre and west of the country the fall in elephant numbers is estimated to be of the order of 65% in the space of two years. Only in the Zambezi Utilization area was there some increase, due to immigration of elephants into a relatively safe area. Pitched battles were fought between rebels and wildlife departmental staff in this area.

In the south declines are thought to be more severe, of the order of 76% with the exception of Maputo Reserve, where numbers are still estimated around 200. In the north, Rovuma, Niassa, Cabodelgado ranges seem stable.

Zimbabwe: Cumin ing quoted a *5%* annual increase in a 1981 questionnaire survey. This value is taken for the graph. The secure status of the elephants in Zimbabwe appears to be the result of strong government support for conservation policy.

South Africa: Elephants in the Kruger National Park, after a dramatic increase through immigration and natural reproduc≠tion in the sixties, are now held stable by culling.

Namibia: The population of the Etosha National Park is thought to be secure, but the western elephants living in desert conditions in Kaokoland are under threat. 1982 aerial censuses revealed some 220 animals left, which are unanimously agreed to be in decline due to poaching. In the latest Namibia Wildlife Trust *Newsletter,* a figure of 3,000 was quoted for the Kaoko≠land elephants in 1962 from the Odendaal report, which has been used as the base for the trend graph.

I. Douglas-Hamilton

Note: Sources available from author

Managing African Elephants for Ivory Production

In the last *Newsletter***,** we presented information indicating that large regional populations of African elephants may be in decline due to over-killing. A substantial decline in the number of elephants is to the long-term advantage of no one involved in the ivory trade. Producing nations, carvers and traders will all suffer financial losses.

In light of the economic drawbacks of a large decline in elephant numbers, those involved in the ivory trade should be interested in management strategies that will preserve both African elephant numbers and ivory production at a high level for the foreseeable future.

In this article we will discuss several general types of manage≠ment strategies and their effects on long-term ivory production. These management strategies are expressed as regulations of killing patterns.

The results were obtained through the use of a computerized simulation model. Basic parameters of elephant population dynamics, such as natural mortality and fertility, were built in, and a variety of management strategies were tried. Both population response and ivory production were recorded.

Constant Weight of Harvest

One strategy was to maintain a constant total weight of ivory harvested. The simulation adjusted killing intensity to main≠tain a nearly constant total ivory offtake by weight. Two types of killing were examined, one random and the other selective for large tusks.

The results were essentially identical for both killing techniques (Fig. 1). If the total weight of offtake was greater than that provided by natural mortality alone from a stable population, killing eventually exterminated the population. The greater the offtake, the more rapid the extermination.

Extermination resulted from the increased killing intensity necessary to maintain a constant weight of ivory offtake. Killing reduced the age of the population, which reduced the average tusk weight More tusks were needed to achieve the weight target, which translated into more elephants killed. The process fed on itself, leading to a population collapse.

Constant Number of Tusks

Another strategy was to harvest a constant number of elephants, which can be expressed as a number of tusks. The simulation adjusted hunting intensity so that nearly the same number of elephants was taken each year. Again, both random and selective killing were simulated.

The population impacts of both types of killing were similar (Fig. 2). Small increases in mortality could be compen≠sated for by increased fertility, but large increases could not

The weight of ivory harvest differed considerably for the two techniques. Selective killing had a high initial harvest as the largest-tusked animals were taken first, then a sharp decline as they disappeared. Random killing had a slowly declining weight of harvest as the population became younger through increased fertility.

Again, the greatest long-term harvest was achieved through natural mortality alone. The population could sustain killing and produce more tusks than it otherwise would, but these tusks were smaller and lighter, as was the overall harvest.

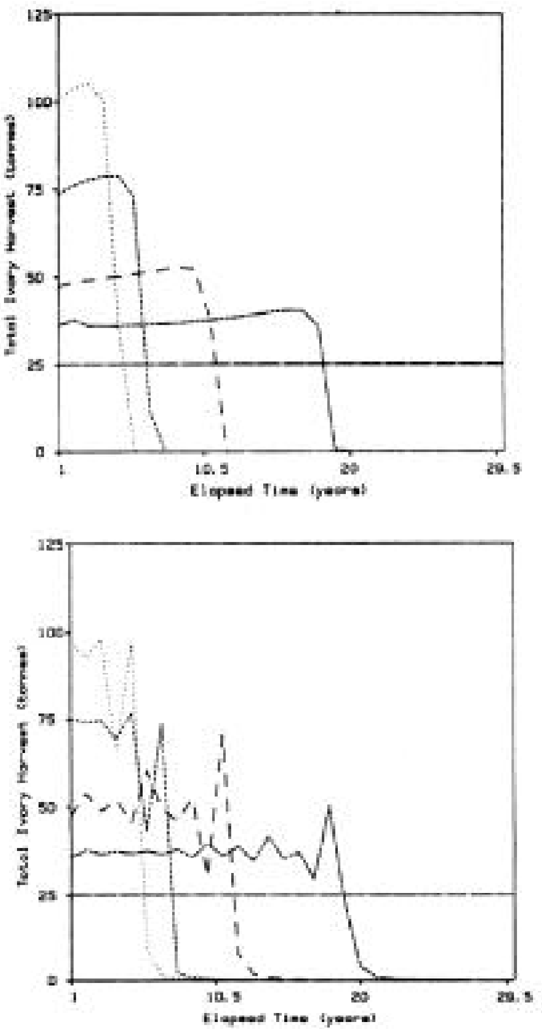

Fig. 1. Constant weight of harvest Ivory harvest per year. Lines represent different weight targets natural mortality only (—,—,—,—),
*150% the natural mortality harvest(**-- - - — - - —**), 200% the natural mortality harvest **(— — — —),** 300% the natural mortality harvest **(- - - -),** 400% the natural mortality harvest **(. . . . .)**. The results in the top graph were simulated using random killing and the bottom graph with killing intensity proportional to tusk size.*

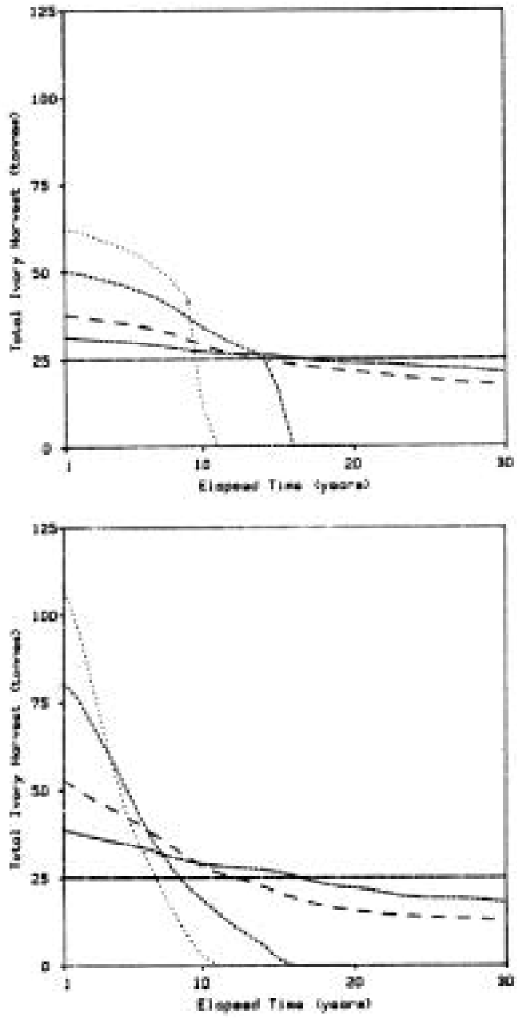

*Fig. 2. Constant number of deaths ivory harvest per year. Lines represent different death targets: natural mortality only **(—,—,—),** 150% the number from natural mortality **(- - — - ——),** 200% the number from natural (— — —), 300% the number from natural mortality **(- - - - -),** 400% the number from natural mortality (. . . . .). The results in the top graph were simulated using random killing, and the bottom graph with killing intensity proportional to tusk size.*

Minimum Tusk Weight

The final strategy was to take no elephants with tusks smaller than a preset size. All elephants were taken as soon as their tusks reached minimum size, and totals for the simulated 30 years were calculated with natural deaths both included and excluded.

Total harvest for the 30 year simulation increased up to a minimum weight of 7 kg for both totals (Fig. 3). Above that, the total from killing only began to decline as female natural mortality was excluded. The total including natural mortality would continue to increase until it reached the value for natural mortality, which again produced the maximum harvest.

Mean tusk weight increased with minimum allowed weight, as would be expected. Mean weight is an important considera≠tion, because carvers prefer large tusks. They will pay more per unit weight for a large tusk than a small one, so profit. ability would probably peak at a higher minimum weight than would production.

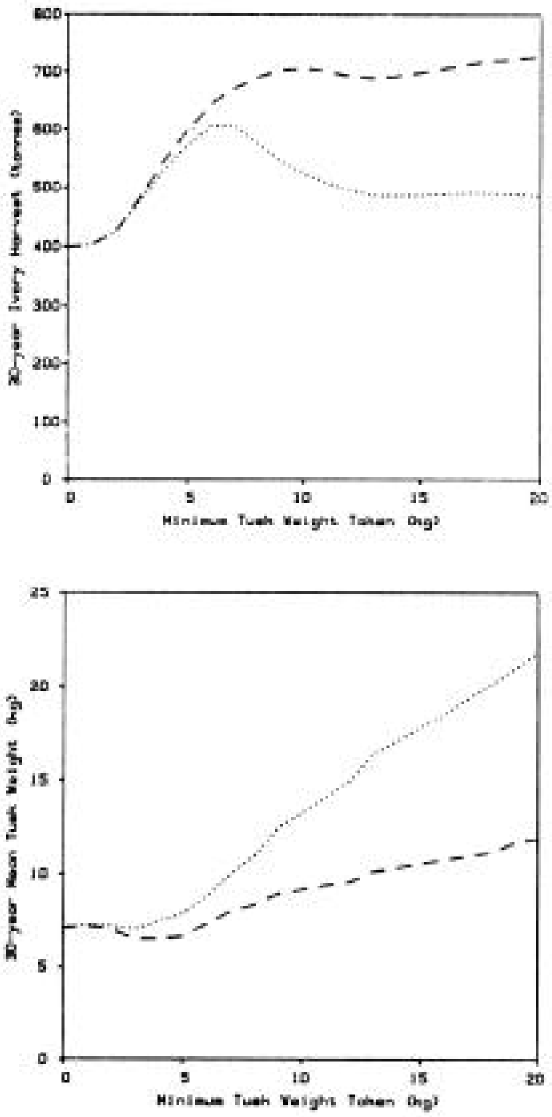

Fig. 3. Minimum tusk weight 30 year total harvest by mini≠mum weight. The lines represent different acceptance strategies accepting tusks below the minimum weight, if from natural mortality ***(— — — — —),*** *accepting only tusks above the minimum weight(. . . . .).*

Summary

The management strategies discussed can easily be expressed as regulations for the ivory trade, and all would be relatively simple to enforce. However, some would be more effective than others at ensuring large elephant populations and high ivory production in the long term.

Setting a weight limit on the harvest is by far the least effective technique. It is likely to encourage a steadily increasing number of deaths, as the population becomes younger and their tusks lighter.

A limit on the number of tusks taken is a reasonably effective management strategy. In a region with a number of local populations, a regional quota could allow for a series of local exterminations, but this could be monitored.

Setting minimum weights for tusks is a more secure form of protection, If the minimum were set high enough, female elephants could have enough reproductive years before being taken to allow an increase in numbers.

All these techniques, even those which allow an increase in the number of elephants, will reduce the ivory, yield per elephant. The maximum yield per elephant is achieved in the absence of killing through natural mortality alone.

Maximum production through natural mortality is an un≠usual finding, but tusk growth in elephants follows an unusual pattern. Most animals, such as beef cattle, achieve maximum production when cropped at or near the end of their growth spurt.

Tusk growth in male elephants, which provide the bulk of ivory production, never peaks. It increases at an exponential rate throughout life, so any hunting of male elephants removes them before the end of their growth spurt and reduces production.

The ideal management strategy, then, is to allow only natural mortality. This will provide the best protection against extermination, and also the greatest ivory production per elephant. Unfortunately, it would be almost impossible to enforce.

A compromise could be effected by setting a limit on the total number of tusks, in combination with limits on the mini≠mum weights accepted. As a management strategy, this could, in its most sophisticated forms, begin to approach the level of ivory production achieved by natural mortality alone.

As matters stand, the current exploitation pattern is most similar to constant weight of harvest. The total continental harvest has remained roughly constant, while mean tusk weight has declined and the number of elephants killed has increased (Caldwell 1984). This is the worst management strategy of those examined, and it is in the best long-term interests of all involved in the ivory trade to institute another in its place.

Tom Pilgram (WCI) and David Western

REFERENCE

Caldwell, J R (1984) Recent developments in the raw ivory trade of Hong Kong and Japan. *Traffic Bulletin,* 6, 16-20