The Bigger They Are . . . .

Malcolm Coe

Large body size is dangerous. The Pleistocene megafauna disappeared, it is now believed, at the hands of man. Large body size may help elephants and giant tortoises to avoid predators and to cover large areas in search of food. But this size also means that, because they must feed continuously, they need a large area of land to sustain them, and that the long gestation time and dependence of the young on their parents reduce population turnover. Only a very low harvest can be taken of such animals. The African elephant, if it is left to the mercies of poachers with automatic weapons, must become extinct.

No regular readers of *Oryx* over the last three or four years can have failed to feel utterly helpless as they read yet another instalment of the decimation of the elephant and rhino populations of East Africa. Ten to twelve years ago, although poaching was not uncommon, a visitor to the Rwenzori or Kabalega Falls National Parks in Uganda or Tsavo National Park in Kenya could still be thrilled by the sight of herds of elephants numbering thousands, while a flight over the Yatta Plateau in Tsavo would have revealed rhino quietly browsing on the scrubby vegetation in their hundreds. Yet such a short time later, reliable counts of these two massive herbivores reveal a reduction in their numbers of between 80 and 95 per cent in nearly every area that has been surveyed.[1, 6, 8, 11]

While it is true that, in areas suffering the pangs of civil strife, many of the smaller herbivores have also been drastically reduced, in general it is the larger species that have suffered most severely. Such large scale reductions can only occur when there is a ready market for the by-products of that slaughter, whether it be for ivory, horn, skin or even, less often, meat. Yet while we struggle to think of remedies, we perhaps forget that such wholesale slaughter and extinction is by no means a new phenomenon, and paradoxically it is the very thing we so admire – the large size – that has been instrumental in their downfall.

During the Pleistocene period (c.2m. years) the major continents of the world possessed terrestrial faunas, many species of which were similar to those existing today, but alongside these creatures were a number of other much more massive species, much larger than their ancestors which we observe in dwindling numbers today. These large creatures, which we refer to collectively as the Pleistocene Megafauna, all disappeared from the earth in the last 100,000 years.

Much argument has centred around this disappearance, and worldwide climatic changes associated with the glaciations have frequently been suggested as a contributory factor. In 1966 however, Martin produced evidence which suggested that man had been the primary agency in their extinction. This evidence was mainly related to the fact that if worldwide climatic change had been responsible, then their disappearance should have occurred on all continents at the same time. In fact, whereas in Africa a period of extinction took place between 40 and 50 thousand years ago, in the Americas

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and Eurasia this occurred between 13 and 10 thousand years ago, while the large species of New Zealand and Madagascar all disappeared within the last 1000 years. If we look at the human history of all these regions we find that the periods of extinction coincide with the appearance and/or arrival of bands of human hunters who possessed weapons with which they could kill the larger species. These events were so dramatic that they resulted in the disappearance of 40 per cent of the genera of African large mammals and 70 per cent of those of North America.

This does not of course mean that expansion of the African grasslands during periods of aridity did not also have a profound effect on the disappearance of predominant elements of the terrestrial vertebrate fauna, but the presence of the butchered remains of these creatures on inhabited sites in Africa indicates that man, the hunter, had quite rapidly become an efficient major predator (or scavenger).

The arrival of modern man in New Zealand coincides with the rapid extinction of seven genera and 27 species of moa (large flightless Ratite birds), while the invasion of Madagascar by the Melanesians (during the same period) may also be associated with the disappearance of many of the larger terrestrial diurnal vertebrates. The fact that there is no evidence to suggest that there has been any great climatic variation during the last thousand years indicates that modern man is likely to have been the primary agency in the removal of these faunal elements.[13]

Within the last 300 years the settlement of islands in the Indian Ocean, from the Seychelles to the Mascarenes, led rapidly to the extinction of the large dodo on Mauritius, and the two solitaires on Réunion and Rodrigues,[2] while within 100 years of the settlement of all these islands, populations of different species of giant tortoise, which occupied most of the larger islands, were extinct. At the present time the only surviving population of these cold-blooded reptiles is found on Aldabra Atoll, north of Madagascar, where due to its inaccessibility and difficult terrain the tortoise still survives as a huge population of 150,000 animals. A similar situation occurred in the West Indies where giant tortoise populations also became extinct within a few years of the arrival of modern man.[3]

At first sight it perhaps seems odd that it was the large species that became extinct; slow moving animals like tortoises and flightless birds would seem to be obvious candidates for predation by human settlers who required an easily harvested source of protein. The massive size of the large mammals of the Americas, Asia and Africa, however, would seem to have made them somewhat formidable opponents for early hunters, always supposing that they were hunted rather than taken as carrion or trapped in the mud of lake edges or similar situations.

If we look at modern large vertebrates we can perhaps see the major reason why even the largest species would have been equally susceptible to extinction. The advantages of evolving large body size would have been to avoid predation on the one hand and perhaps the ability to cover large areas in search of food, especially in the newly expanding semi-arid savannas. The increase in body size also meant that these herbivores required to feed almost continuously to sustain a large body mass, and a decreased surface area to volume ratio meant that the control of body temperature in both warm-blooded and cold-blooded vertebrates posed special problems. Since these large creatures required such a

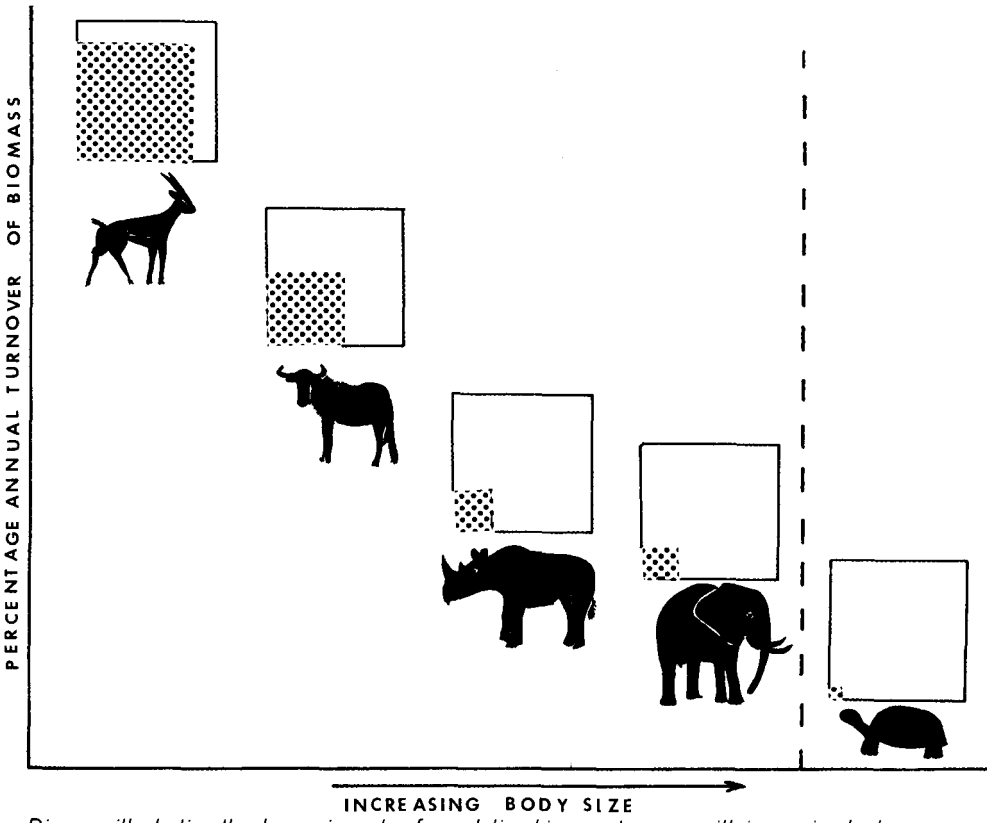

Diagram illustrating the decreasing rate of population biomass turnover with increasing body size in warm and cold-blooded vertebrates

large amount of food the area of land which was needed to sustain them was greatly increased, so that even at the present time the optimal carrying capacity for elephants in the African savannas seems to be more than one square kilometre per individual.[10,7]

Nearly all the features of a mammal's life history such as gestation and birth rate may be scaled to body size.[14] Thus we could with confidence predict that the generation time of the larger species will be much longer than that of the smaller species.[9] This increase in the time it takes to reach sexual maturity means that the young are not only dependent on the adults for extended periods, but their association with their parents allows them much longer to acquire learned elements of behaviour, whether these be concerned with anti-predation, feeding or breeding.

If we look at a whole spectrum of large warm-blooded vertebrates we observe that as the size and generation time increases so the rate at which they turn over their biomass decreases. Hence a population of Thomson's gazelle will turn over up to 70 per cent of their biomass each year while a wildebeest will turn over 27 per cent, the rhino only 10 per cent and the elephant 9 per cent each year.[4] (Fig. 1). If we look at a cold-blooded vertebrate such as the giant tortoise of Aldabra, whose mean weight is about 26kg., such a population will turn over less than one per cent of its biomass each year.

This quite simple observation immediately draws to our attention an important feature of large vertebrates in relation to their possible extinction. Since an elephant and a giant tortoise can only turn over a small percentage of

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their population biomass each year the rates of harvesting that such a population can sustain in the face of even a primitive hunter is very low indeed. We therefore observe why it is that giant tortoises became extinct within 100 years of the settlement of islands in the Indian Ocean, and the elephant and rhino populations of East Africa face extinction at the present time at the hands of modern poachers equipped with automatic weapons. Quite simply the evolution of large cold and warm-blooded vertebrates has not equipped them to cope with high levels of harvesting even though the reproduction of vertebrates is initially actually stimulated by harvesting, for within a short space of time their maximum reproductive rate is exceeded and their numbers subsequently rapidly decline.

Oddly enough the age at which both tortoises and elephants become sexually mature has marked similarities with those of *Homo sapiens*, but social factors have eliminated the controls exerted on other populations so that the human population continues to increase at a rate that cannot in the end be sustained, while other large vertebrates have suffered a fate imposed by the evolution of this large body size. Unless we recognise this fact and act immediately most of these creatures will have disappeared from the face of the earth in the wild state within twenty years.

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Barrages and the Indus Dolphin

The Indus dolphin *Platanista indi* is seriously endangered, largely as a result of barrages on the Indus that have split the population into small groups and made migration impossible; another cause is irrigation schemes that have changed the water level. This is reported by G. Pilleri and K. Zbinden, who have studied the species for many years. Pollution is not involved, but there is some hunting. Some of the people living along the river eat the meat, and oil from the blubber is widely used for medicines.