The Evolution of Man and the Extinction of Animals

Hermann Remmert
Fachbereich Biologie der Universität, D-3550 Marburg/Lahn

Africa has lost only very few big mammals at the end of the pleistocene. Evidence is put forward that the reason for the present richness of the African mammal fauna is a very early coevolution between evolving man and the megafauna of this area. Areas without such an early coevolution suffered severe losses (up to 100%) of their native megafauna, when early hunters invaded them.

During and after the late Pleistocene a great number of large herbivorous mammals became extinct, as did the big predators depending upon them. In an extensive survey Martin and Wright [1] summarized our knowledge about this phenomenon. The facts are:
Only large herbivores and large predators became extinct. Plants and smaller animals did not suffer any serious reduction.
This extinction comprised about 30% of the megafauna of Africa, but about 80% or more of the megafauna of North und South America, with percentages falling somewhere in between for Australia and Northern Asia.
There is a good temporal coincidence between the arrival of human hunters and the extinction of the animals.
Martin and Wright offer in essence the following explanation:
Because of lower rainfall the deserts enlarged and the ranges of the big herbivores contracted.
Early on, in a sort of gigantic "overkill", the big herbivores were eradicated by human hunters.
This explanation has not found unanimous appreciation because we tend to see primitive mankind as a member of the ecosystem and not as a cause of massive "overkill". The "rose-colored glasses" view of primitive mankind does not allow for such a hypothesis.
One species, primitive, prehistoric, in principle not very different from other mammalian species, cannot possibly be reponsible for such a worldwide eradication of large mammals.
In this paper I shall attempt to give reasons why even very primitive primates might well be able to eradicate whole faunas, and why very primitive man differs from all the animals he lives with.

The Evolution and the Spreading of Man

East Africa is unanimously regarded as the place where man very slowly evolved from apelike ancestors. This hearly evolution progressed at about the same speed as the evolution of all animals, especially of all the mammals living in the same area. So there was a great co-evolution between the different partners in the East African savannah. As giraffe and wildbeest coevolved with their mammalian predators, the lion and the wild dog, they evolved also with man and his special behaviour: Chimpanzees use sticks and stones in attack and defence, and so quite probably did very early man. As fleas and flukes evolved with early man and became specialized to him, many less well known animals also evolved together with him: the honeyguide (*Indicator indicator*), which points out beehives to man but never to honeybadgers or other animals, is an example, as is the house snake (*Boredon ssp.*), which is confined to native housing in Africa.
Probably at this stage of evolution primitive man had already spread and extended his range to Asia. The remains found in Java [2] belong to this *Australopithecus-Homo erectus* group and are about 1.8 million years old. Therefore we can conclude, that from 1.8 million years ago onward there was a coevolution between man and animals in southern Asia and Indonesia. The animals there suffered some disadvantages over their African relatives, since humans arriving in Asia already used sticks and stones (but probably not fire) as weapons.

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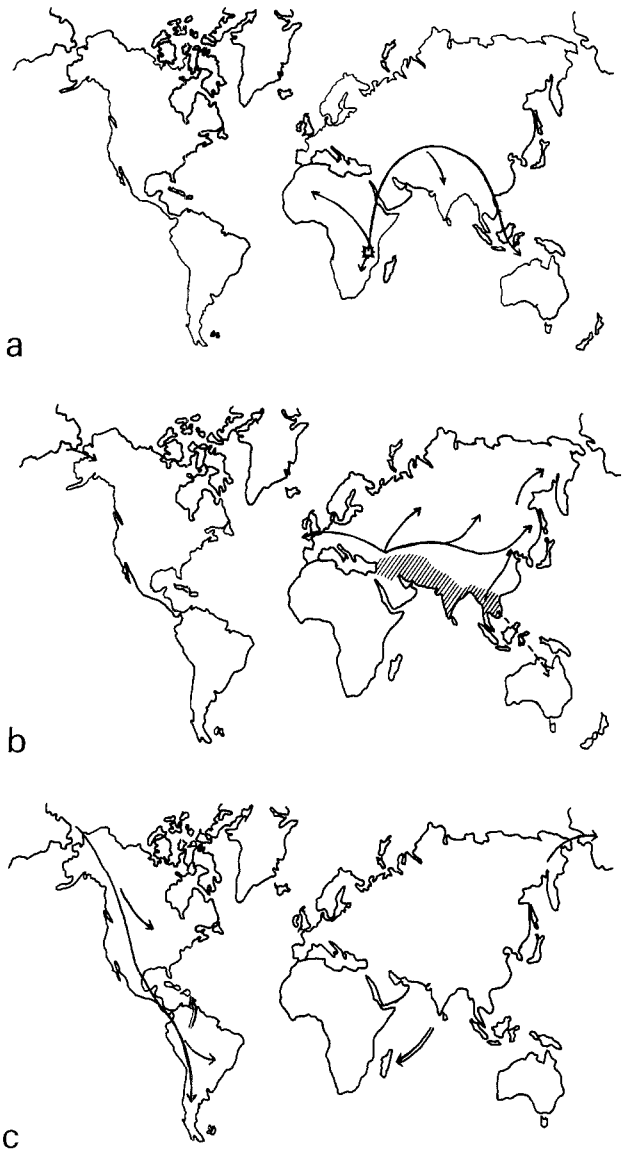

Fig. 1. Man's conquest of the earth, a) about 1.8 million years ago (asterisk: place of origin of human life; loss of megafauna about 30%), b) about 30000–20000 years ago (hatched area shows area of main domestication of animals; loss of megafauna more than 50%), c) 20000–4000 years ago (latest invasions ⟹; loss of megafauna about 70–100%)

Man continued to evolve in both Africa and Southern Asia/Indonesia, with spreading occurring in both places (perhaps *Homo erectus* from Asia back to Africa, and *Homo sapiens* from Africa all over the world). But all these (otherwise most important) systematic specialities are fairly trivial in this context, for now all the lines of primates on the way to early man evolved one speciality which made them really different from all the animals around them. This is the so-called "cultural evolution", which is, in essence, a dramatic change in the use and distribution of information.

Information in evolution is processed and distributed through genetic material. Mutations are tested and selected; an evolutionary step means that all the mutations which occur by chance in an organism are "tested"; the organisms with less useful mutations in their genetic information are killed by predators, by climate, or by parasites; organisms with favorable mutations escape, survive, and propagate.

They transfer their genetic information to their offspring, and thus, slowly, this information migrates in the course of generations through the whole population. This process is obviously slow. Its advantage is that no useful information is lost.

Very early man developed a new method of spreading information by social interaction through the population – the knowledge of any invention (spear, poison, trap) was transferred not in generations, but in minutes, days, or at most, years. Furthermore, this knowledge was transferred to the offspring too. The speed of mental evolution, or behavioral evolution, therefore rose exponentially compared with the genetic method. The drawback of this method was that information could be lost. The death of a group of men could mean the loss of extremely valuable information. Storage of information therefore began very early – we are all aware of the influence of medicine men and story-tellers in primitive societies, and later on, we all know the effect of the burning of the Alexandria libraries on the development of western culture.

Thus, we have in man two different kinds of evolution:

the old, slow kind of morphological change (with the result that even very early men are virtually identical in their remains with modern men) by change of genetic information;

the very rapid cultural evolution, which is restricted to behavior, to the processing and spreading of information.

Of course, this second mode of information transfer did not evolve suddenly. And there is, too, information transfer from specimen to specimen even in animals. But early man expanded the method dramatically and increased its effectiveness.

The result is a drastic difference in the speed of the evolutionary process between man and his prey. The inventions of man – long-distance stone or spear throwing, trap construction, the laying of poisons – were distributed among early hunters very quickly. Animals had to learn that man was dangerous, even if he was not physically present. They had to learn the difference between an active hunter and men just strolling by; they had to estimate the distance man might be dangerous. All this has been accomplished impressively by East African mammals. Animals in Africa and southern Asia, already co-evolved with

early hunters and their stones and sticks, were able to cope with those at least to a great extent. As well, social animals with a well-developed information transfer from individual to individual were probably favored against animals without or with very little such transfer. Therefore we might possibly predict:
In Africa and Southern Asia (Indonesia), where man co-evolved with animals, the animals had at least some time to learn and to keep pace with the progress of man. Extinction there ought to be earlier and play a more minor role than in Europe, Northern Asia or Australia. The strongest effect should show up in areas where man arrived as modern man with a modern information system:
in North America via the Bering Strait and from there into South America; in Madagascar, and New Zealand. All these areas, which were populated by human beings from about 20000 to 10000 years ago, lost between 70 and 100% of their megafauna. Social animals were less affected than solitary ones, but rather primitive mammals with small brains, such as sloths, were affected more than modern mammals. Thus wolves, deer, and bison survived better than giant sloths.
The worldwide success of many birds and mammals that had adapted to men is an other remarkable fact in this context: European sparrows probably evolved in the same region as domestication of plants and animals began, and their success in all continents – except of course Africa – is only explainable through a long coevolution with men. The same holds for New Zealand, where the villages and towns are populated by an essentially European bird fauna, whereas native species are restricted to open areas, woodland, and, to some degree, to agricultural areas. It is only a recent development that native species (and preferably species from the nearby continent Australia) begin to invade human settlements.
Human beings were therefore quite different from the behavioral point of view, although possibly nearly identical from the morphological point of view, when they invaded different areas. Their hunting methods were optimized and therefore highly superior to the hunting methods of the predators in the ecosystem.

Domestication and Extinction

Humans had yet another method of eradicating animals and plants: domestication. About 10000 B.C. several centers of domestication arose in the area between Sinai and South eastern Asia. Chickens, dogs, pigs, cattle (zebu, yak), horses, sheep, goats, dromedaries, and bactrican camels were domesticated. Probably at first semi-domesticated herds of deer and antelopes were "herded" [3], then groups of animals or single animals were kept in captivity until they were slaughtered. These methods severely affected the stock of wild animals, especially considering the condition under which they took place: as desertification began, the habitats of wild animals shrank and thus the whole population of one watershed might be killed in a single stroke. But still worse was domestication in its modern sense, with propagation in captivity and selection of "tame" and "quiet" individuals. These individuals served as easy bait, as today decoy ducks do, to attract their wild counterparts; these animals occupied the same ecological niche as their wild counterparts did and needed the same food; by crossbreeding with their wild counterparts they brought genetic information of "quietness" and "tameness" into the wild population and made this population easily vulnerable.
The result is that the wild ancestors of most of our domestic animals are extinct – some for a very long time – and the rest are on the verge of extinction. We do not know of any wild Arabian camels, probably no wild bactrian camels, the aurochs is extinct and so is the wild horse; wild burros are on the verge of extinction and the same holds for wild sheep and goats. Wolves survive only because of their vast area of distribution. From a purely zoological point of view, the species are still alive (in their domestic subspecies), but this is simply academic reasoning.
Remarkably, domestication has not been seriously attempted in Africa. Huge herds of cattle and goats (e.g. of the Masai in East Africa) were introduced into the country long ago, but they have no wild ancestors there and, therefore, they are from this point of view no threat to the local fauna (but only from this point of view).
There is only one larger part of the world with important domestication: Central and South America. The guanaco (domestic forms: llama and alpaca) is an important domestic animal. It did survive in the wild because it was (and is) used as a domestic animal in the high Andes, where the vincuña, which is not suited as a domestic animal, is at home. The typical home of the guanaco is the lowland of Tierra del Fuego, Patagonia, and parts of the thornbush savannah (Chaco).
Essentially the same holds for the domestication of plants: most of our domestic plants evolved from the area between Turkey and Sinai in the west and India in the east. And most of the wild ancestors of these plants have become very rare, or are as unknown as the wild ancestor of the Arabian camel. This means that they are probably extinct (rye, some *Sorghum* species, *Vicia faba*). But the extinction of wild ancestors holds, of course, also for the more

"modern" domestic plants such as potato, maize, and sugar cane [4–6].
In essence, even domestication can be regarded as part of the cultural evolution, as a part of the new method of transferring information more quickly than through biological evolution.

Conclusion

We can regard the cultural evolution of man as an important tool which enabled prehistoric hunters to defaunate their new homes in a grand and terrifying "overkill". The rich fauna of Africa and parts of southern Asia did only (in part) survive because the animals in these places were able to "co-evolve" with very early man. But the hunting groups invading northern Eurasia, and America after the retreat of the glaciers, killed the completely unprepared horses, camels, and mammonths, killed the sloths of North America together with the relatives of the pronghorn antelope; only the very social species (i.e. animals with social information transfer) survived. Probably still worse was man's invasion into South America. What the white man found 20000 years later was a mere relict mammal community to eradicate in comparison with what had already been eradicated. Australia suffered less than America because it was invaded earlier by less "progressive" hunters. But even here the destruction by primitive hunters is terrifying [7].
The recent invasion from Indonesia to Madagascar, from the coral islands of the Southern Pacific to New Zealand, resulted in complete destruction of the whole megafauna.
Africa, and to a lesser extent Southern Asia, are rich in mammal life, not because these continents were sparsely populated by man or because man had little influence – on the contrary: because man lived there from the very beginning of mammal evolution, and because the evolution of man occurred together with that of the rest of the mammals in Africa and Southern Asia. Since the influence of evolving man on his co-mammals was so great, the co-mammals were better adapted for survival than were their counterparts on the other continents. The huge headstart of man together with his incredible speed of cultural evolution was the reason for his outcompeting the rest of the mammals in the continents which were occupied by him rather late. And now man occupies the oceans as well – and no bird nor mammal is prepared for the catastrophe and they will not be able to learn in time.
Man was perhaps a co-evolving member of the ecosystem when he started his evolution. But with the start of cultural evolution about 1.5 million years ago his mental evolution separated him from co-animals and enabled him to partake in serious destruction. The story of primitive men living in harmony with their systems is a fairy tale. Ecologists, who tend to study "balanced, undisturbed systems", and conservationists have to accept these facts [8, 9].
Cultural evolution goes on now with higher and higher speed. There is a worldwide selection for rapid evolution (i.e. short generation times), good learning abilities and intraspecific communication abilities.

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