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On the brink

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My young student, Alessandro Lo Cacciato confessed shock when witnessing the death of a sick roe deer at the knife of a passing-by hunter by a Danish roadside. "Why such cruelty?" – he asked. – "I understand that this animal is destined to die but can it not be done by causing less pain?"

Israeli friend and colleague, Yael Lubin, with whom we evaluated spider captures she collected many years ago in the Israeli desert, resisted to mention in a conference abstract the number of individuals collected, because, she wrote: "It shames me to have killed so many animals." And there is a cruel irony, she added, in that ecologists/entomologists continue to collect large numbers of animals, usually by killing them, in order to document the loss of biodiversity.

Are the two colleagues sentimental "softies"? I do not think so. Their behaviour underlines an important message: the world is not for us to use as we please. We may have the power to do so but this does not automatically authorise us to use that power as we please. In biological science, we seek to recognise laws of nature not only by observing, but also by manipulating, reorganising, measuring and yes, killing other living beings. They provide data, serving – in the best case – our understanding of the world. Hopefully they did not give up their lives in vain. Can we honestly tell? I do not think we can. Consequently, it is always worth thinking carefully how much destruc-

tion is needed to generate the required data for ourselves. Respecting life and minimising damage done to living beings is a principle worth adhering to. In the current "anthropocene" more than ever before.

This viewpoint may sound strange to many readers. In my travels in Africa, as well as in China, I often encountered an unfettered attitude that yes, we humans have the right to use anything and everything for ourselves. Nothing can and should stand in the way if people ... and here a long litany of wants and wishes usually follows. Take note, my reader – I purposefully did not use the word "needs" because the three, needs, wants and wishes (or even worse: whims) are frequently mixed together, and all are dubbed "human needs". This is wrong, as even a superficial reading of ethical texts will soon make it obvious. This attitude does not distinguish between a vital need, a strong desire, an ambition or a whim. Anything is justified – because we can do it. Humans must flourish, and costs (to other beings) are only counted after this is declared successful. Numerous religions and ideologies exist that support this attitude.

To an ecologist, this attitude has never been justified. Many ethicists and philosophers have also expressed doubts whether such an attitude is acceptable, wise or even advantageous. Now the ecologists have sounded a very strong warning: we continue on this path at our peril.

A recent book by US palaeontologist, Anthony Barnosky (Barnosky, 2014) brought home to me the strong message that we live way beyond our means – and do so at global scale. He presents the following argument: life on Earth eventually depends on the amount of energy arriving to the surface as sunshine. Some of this energy is captured, mostly by plants, who produce about 53.1 petagrams of net primary production (a petagram is 10^{15} g). This is the base of all life (nearly, discounting some bacteria using other sources of energy to support themselves). Other organisms, feeding on plant biomass, and then on each other, forming a trophic pyramid. The net primary production, the base of the trophic pyramid allowed the existence of about 200 billion kg biomass of megafauna (animals >44 kg of body mass; animals of the size of a sheep or bigger), distributed into ca. 350 species. This has been more or less at this level for hundreds of thousands of years – until about 13,000 ~ 10,000 years ago. At this time, the number of megafaunal species crashed to 183, and remained at about this level until today. Parallel with this, the total megafaunal biomass suddenly also halved, and it did not reach its former value for nearly 10,000 years. The gap was gradually filled by the increasing biomass of humanity. Then in the last 300 years, something very "unnatural" happened: the megafaunal biomass skyrocketed to 1.5 trillion kg. We broke through the "natural energy ceiling" – megafaunal biomass became much larger than it has been possible on the basis of natural processes. This was made possible because humans started to utilise fossil fuels, first coal, then oil and gas reserves, that remained unused during geological ages, and fossilised. This fossil energy was "liberated", and used to support a higher biomass – of humankind –, through indirect processes, such as synthesising fertilizers to produce more biomass (mostly consumed by humans). Additionally, we appropriated an increasing amount of the naturally available energy to ourselves. Now it is clear that we cannot continue to exhaust these reserves without causing severe, possibly irreparable damage to life on Earth, including ourselves.

This extraordinary human flourishing has had a large cost on biodiversity – and some recent publica-

tions started to shed light on the global effects of land use on biodiversity. Newbold and his 40 collaborators (Newbold *et al.*, 2015) started to analyse a recently published, large database on terrestrial biodiversity, PREDICT (Hudson *et al.*, 2014). PREDICT contains >1.6 million samples of over 28,000 species from 78 countries, including the major biomes, making it the largest such database so far collated, even if it has an almost inevitable bias towards some taxa such as birds (Hudson *et al.*, 2014). In the worst affected habitats, write Newbold *et al.* (2015), within-sample species richness has been reduced by 76.5% and rarefaction-based species richness by 40.3%, together with a decrease in abundance by 39.5%. Effects are regularly larger in the vicinity of humans, roads or cities. However, both Barnosky (2014) and Newbold *et al.* (2015) emphasise that we can turn things around, and stop biodiversity loss, even restoring some of it. We do have ideas and global mitigation measures to do this. Only "business as usual" will get us over the brink.

Given this state of affairs, it is not a bad place to start modifying our behaviour by changing our attitude to other, non-human life. Such respectful attitude will make us, biologists and non-biologists equally, more careful how we handle other animals, and this is where Alessandro's feelings are totally relevant. In addition, biologists can start by not forgetting that such other life is not merely a source of data for the advancement of science and personal careers. And thus I share the feeling of shame for the spiders killed in the pitfall traps. Life is unique and precious, in all forms, small or large. We disregard this, and not only will our world be poorer, but our own existence may be at risk.

References

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