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MANAGING NATURE BY *COIN TOSSING*

Section: Commentary

The value of our natural environment is enormous. A recent estimate puts the price tag of global ecosystem services at 150 trillion rand -- a number twice that of the global GNP.[1] Individual components of that global total include the 10 trillion rand we pay to live near the world's oceans and the 3 trillion we pay for ecotourism worldwide.[2*] ***South*** Africa is uniquely favoured in both scenic shorelines and watchable wildlife and must sensibly devote energy to reaping economic benefits from them. It is the management of wildlife that I will consider here. To contrast two styles of management, consider betting your life on a ***coin*** toss.

The bet is this. I will return in a week and, if you correctly guess the outcome of the ***coin*** toss, then I will pay you a million rand. If not, you must go away quietly and kill yourself. Do you accept? The scientist says 'yes', and returns with a mathematical model of the physics of ***coin tossing***, and all the gadgets needed to measure the air's wind speed and the force of the finger flick. As a profession we are paid to study problems. Who has not said to a granting agency, 'Give me some money and I'll give you an answer'? Many of us have also returned to those agencies at later dates, asking for yet more money to study the problem in yet more detail. The answer proved to be more elusive than we thought initially. (All too often, politicians are only too happy to see us: it is generally much cheaper to pay the scientists to go off and study a problem than it is to fix it.) So, would you really bet your life on ***science's*** ability to predict a ***coin*** toss?

We bet the lives of rare species on the metaphorically equivalent. We assume that if we study an ecological problem in sufficient detail --and are given enough money to do so -- then we will be able to prevent extinction. There is overwhelming evidence that ***science*** advises management in sensible ways. In many, though not all, cases, we can identify the forces that drive the decline of wildlife populations and do something to alter them. Yet there is a limit to how well we can predict a population's fate.

The best empirical evidence comes from fisheries. There, despite well-funded ***science*** and a common need to maintain a sustainable harvest, most major stocks are overfished. Some would counter that this is because politicians do not listen to the ***science***. My rejoinder is that the politicians hear our uncertainties and pick the scenarios most favourable to their shortterm futures. It is uncertainty that is the key to my argument.

There are other data. The variance in the numbers of almost every population that has been studied in the long term increases continually as more years are uncovered by the study.[3] Extreme population sizes would increase even if the variance were fixed, and so, in practice, extreme values are also more extreme than we expect them to be.[4] We are constantly surprised.

Further, consider ecologists' ability to predict the direction of experimental changes. One removes a predator or a competitor and predicts that the target population will increase. In fact, it does so only in about half the experiments.[5] Remove a predator and perhaps another prey species will increase rapidly, so denying resources to the target population. As soon as we embed species interactions in a food web -- the road map of who eats whom -- how one species in the web affects another is hard to predict.

Theoretical models expect these effects. Population numbers will increase in variance over long intervals as the sums of effects propagate through the food web. The change in the density of species A affects its prey species B, then its competitor C, then its predator D, and so on, in long sequences that take time to unfold. Similarly, whether an increase in species A will harm or benefit species D will depend on this pathway and the myriad of other pathways through which a change in one species affects another.[5] Quite simply, there are limits to prediction that come from the complexity of the ecosystems to which all species belong. We will not be able to anticipate ecological changes in every case.

Earlier I promised a contrasting style of wildlife management based on the metaphor of ***coin tossing***. Rather than bet your life on predicting the outcome of one ***coin*** toss, you return the following week with 20 ***coins***. 'I'll bet that all 20 of these ***coins*** do not come up heads.' The chance of you losing your life is about 1 in a million, rather better odds than being killed in a car accident on the way to work. With the million rand, you might not need to work again and you accept the bet. No ***science*** is involved in this decision, other than a simple assessment of the risks involved.

Perhaps too cynically, I suspect that wildlife populations have often survived not because of good ***science***, but despite it. If we acted blind to our consequences, we would be right half the time and wrong half the time. As long as we are ***managing*** many populations, some will survive the near-random consequences of our interventions to complex systems. Unfortunately, human populations are growing exponentially. And human aspirations for better lives will increase consumption even if population numbers are fixed. The consequence to wildlife is that we are playing the ***coin tossing*** game with fewer and fewer ***coins***. As a further consequence, we are increasingly banking on ***science*** to predict the individual outcomes.

There is more hope in this view of ***nature*** than one might think. Anticipating what I consider to be the inevitable explosion of ecotourism in ***South*** Africa, many are establishing private game parks. The few I have visited are naturally not staffed with teams of first-class ecologists like those who run Kruger National Park. Some of the management decisions I observed seemed rather hit and miss. (One hopes that the current class of ecologists in training in ***South*** Africa's universities will find career opportunities in improving future hit-to-miss ratios.) Yet in the diversity and geographical spread of these attempts to restore ***nature***, I see the spreading of risk that complements the intensive efforts to manage populations within one or a few areas. If there is an answer to whether we should study one ***coin*** toss in detail or many superficially, it is surely that we should do both.

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* Recent changes in the rand-dollar exchange rate will have increased these amounts.

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