Guest Editorial

Marine climate change and conservation priorities

The most common public conservation issues usually involve terrestrial species and habitats, which is unsurprising given the habitat that we stand on. But most of our world is covered by sea, which produces most of our oxygen, absorbs half of our CO_2, buffers our temperature, provides services and goods on a vast scale and, from evaporation, waters our crops. It is the engine of the world. Why, therefore, are its systems and its mechanisms so little understood outside the world of marine and climate scientists?

Reasons are many. Several conservation issues have been hijacked by well-meaning but less important issues. Biodiversity is the classic example. As scientists, we know that one scoopful of soil contains a greater biodiversity than exists amongst the entire vertebrate population of the world. So why is there so much fuss about biodiversity conservation? Biodiversity isn't threatened in any truly quantitative way, surely - except, as vertebrates, we see things on a vertebrate size scale, with a viewpoint conditioned by our aesthetic senses. If you doubt this, ask why so many organisations have logos that include attractive animals (or large plants) rather than an African dung beetle or a coccolithophore, which are infinitely more important to us. We are a large species, dependent on a spherical, orbiting life support system, one of whose largest and most crucial components is called ocean, and we depend on things that we don't usually look for.

The condition of this ocean is crucial to us, not only because of the many and varied habitats it directly covers but because of its influence on us at a systems level. Several aspects of it are going wrong, and we need to understand this. There are several key marine issues, some global, many local.

Global first - sea surface temperature began rising around the 1970s (Sheppard, 2003). Rises of a degree or two don't immediately matter in many areas to most species; where an organism lies mid range in its temperate sea, for example, a rise from 18 to 19°C may not be noteworthy. When it does matter is where temperature crosses some ecological or physiological threshold. This may be at the poles, where the temperature difference changes the phase of H_2O, and we can see many examples of the problems caused by melting ice (Simmonds & Isaac, 2007). Another sensitive location is the tropics, where my own research lies, where coral reefs live close to their upper lethal limits. How many people know that in 1998 the upper temperature threshold was exceeded such that, in the Indian Ocean, over 90% of reef corals died? A mortality of that order would be front page news if it was a visible, terrestrial system, but, being out of sight, it is out of mind, and the millions of people directly dependant on reefs for protein are already marginalized in a global sense. Since 1998 several further though less severe warming events caused repeat mortalities of newly recovering juveniles, setting back the system to square one again. How many people know that either?

In all seas, species have many other complex thresholds and temperature-triggered responses of their own. Imagine that the cue to migrate and spawn for a commercially important fish species is temperature, so that the species now moves and breeds, say, 3 weeks earlier than it should. But imagine the planktonic food for its young is triggered by daylight length instead, which of course has not changed. The species becomes commercially extinct. Warming is probably the most difficult problem that the oceans will face in the next 20 years, at least where threshold values are approached.

Acidification is another issue, and this is linked to CO_2 also. In the last 200 years the surface ocean has absorbed about half of the CO_2 produced by industry, causing a fall in pH of 0.1, which sounds small, but means a 30% increase in H^+ ion concentration (Royal Society, 2005). This is essentially irreversible during the next few thousand years, ocean dynamics being what they are. This affects the calcification processes of marine organisms, and the greatest difficulties are likely to be faced by tropical corals and by vast quantities of calcifying plankton, especially in the southern oceans. As CO_2 is absorbed by the surface ocean, changes in acidity also mean that the oceans will absorb less atmospheric CO_2, which is the reverse of what we need in terms of CO_2 sequestration.

Local issues are more manageable in principle, and these include sewage outfalls, industrial and agricultural pollution, dredging, and landfill operations causing sedimentation, which all stress or destroy productive marine habitat. It is already being stated by some marine park managers that there is little point in trying to control these any more because the global

issues will overwhelm their system anyway. But, in terms of a decade or two, that is not usually true. In many cases a habitat collapses, or its keystone species die, because of a combination of stresses. Sewage may harm but not kill something if the temperature remains amenable, and a temperature rise may not kill a habitat if pollution pressure is low. In other words, it is a combination of events that causes many fatalities – death by a thousand cuts. That has been the history of many marine systems to date. If managers continue to tackle local, addressable issues, then they can put back the lethal effects of temperature by perhaps a decade or two, and who is to know how humans might respond during that intervening time? We are an ingenious species, if nothing else.

There is little doubt, based on past history, that we marine and conservation scientists cannot push sufficiently and effectively by ourselves to halt serious marine habitat deterioration. Things will get worse before they get better. And sadly, it is true to say that it really is little use going out and hugging a tree (or its marine equivalent). It may help slow down the chap wielding the chain-saw, but you can't chain yourself to that lagoon dredger forever. I have seen many small victories, hard won, later reversed by the next government or regional boss. So where are our essential allies? They are threefold. Firstly, and unexpectedly to some, is the insurance industry. That sector is one of the world's richest, and when they start complaining at the costs from storms and sea level rise then the primary movers and shakers do listen. Secondly are the funding agencies. Donors now commonly attach environmental terms and conditions to grants and loans. This is important, and rates of human population rise are a key part of this. After all, the need for conservation arises because natural resources cannot sustain the demands people place on them. This is tricky territory – how many environmental conferences have you been to where population rise is not even addressed? And thirdly, in the prosperous world we have voting and political clout which, even though apparently insignificant, is still orders of magnitude more than in many countries. Things may get worse before they get better, but there are many degrees of worse!

Now, imagine you write a proposal to your government agency saying that you want a grant to cook the world a little, pollute it with sex-changing hormonal mimics, and add fertiliser for good measure, to see what happened to the marine life. It would probably not pass the ethics committee, but that is what we are doing anyway in a grand, totally uncontrolled experiment that shows hints of dangerous positive feedbacks. However, the fact is that the marine environment doesn't itself need saving. It is an inanimate concept in this regard. It is the present life forms depending on it that may not survive in the warmer, more acidic and polluted water!

We may be due for another severe El Nino in 2007. It isn't certain, but we should keep our fingers crossed that it doesn't happen. Keeping fingers crossed though isn't a very helpful management tool (what a way to run a planet!). But we can do the research, make the information known, increase our influence, show what the cost is if we do not take action, and make the most of the science opportunity that governments wouldn't knowingly support!

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