CREATURES

RADICAL ECOLOGICAL CONVERSION AFTER LAUDATO SI'

Discovering the intrinsic Value of all Creatures, Human & Non-human

Migration of Non-human Species in Response to Climate Change: Data and Implications

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I want to thank the hosts of this splendid and significant meeting for their invitation. My aim in this short presentation is to broaden that treatment to cover migration of non-human species in general, and at the end to offer some theological and ethical reflections that flow from the science.

The Holy Father in his important encyclical *Laudato Si'* affirms that 'each organism, as a creature of God, is good and admirable in itself (Francis 2015: para 140), also that 'the earth, burdened and laid waste, is among the most abandoned and maltreated of our poor' (Francis 2015: para 2). That in itself is sufficient mandate for paying close attention to the impact of our maltreatment. It's natural to begin from one of the most iconic images of the seriousness of what we are doing to the planet.

Polar bears as you will all be aware are fast losing the unique habitat that makes their lives possible, namely the Arctic sea-ice, which is declining at a rate of around half a million square km per decade. This is a part of the world that is experiencing some of the most rapid warming, and the polar bears are one casualty.

I begin with the polar bear because it is a large and beautiful animal, also incidentally the only land animal known to set out to hunt human beings, so perhaps an important and humbling reminder that we are not simply and securely top animal wherever we go. Indeed one of the dangers of the contractions of truly wild polar bear habitat, and the concomitant increase in development of Arctic lands, is that starving bears will be brought more and contact with human settlements. An important index of the health of an ecosystem is the survival of the top

predator, and the polar bear is top predator of a rare and delicate ecosystem which is all under threat from the disappearance of the sea-ice.

Some argue that polar bears must have survived previous interglacial warmings, but the difference now is not only the extent of the warming, which looks almost certain to reach 2 degrees C if not significantly more, but also the rate of change of temperature. It is most unlikely that a previous warming took place over a few decades, which is what we are seeing now.

Nature, it might be said, tries out solutions to these crises, such as the much-publicised interbreeding of grizzly bears and polar bears, but there is evidence that this hybridisation has been going on for a long time without the hybrids becoming established, so it's probably not a way of saving polar bear genes. And of course, evolution doesn't care. Perhaps as many as 99% of the species that have ever lived have become extinct. But if each organism as a creature of God is good and admirable in itself, I suggest we do and must care.

The 2006 Stern Report on the economic challenge of climate change mentions almost casually that a rise of 3 degrees C would be expected to lead to a 20-50% loss of species including 25-60% of all mammals (Stern 2006). So clearly some species simply won't cope. But let's look more generally at species migration in response to perturbation of environment.

Lenoir and Svenning (2015: 24) report six eventualities when a species is challenged by a shift in conditions that means its optimal range is subject to change. A very specialised creature like a polar bear just doesn't have successful migration strategies, so there we would expect extinction, or at best what Lenoir and Svenning call 'crash'. But some species may actually be able to 'expand' their range, moving into new territory without significant loss of habitat at the trailing edge of their zone. Or they may be able to 'march', moving to a new range without loss of overall abundance. The subtler situations are called 'lean', where the abundance remains the same but with a distribution skewed towards the new habitats, and 'retract', where the distribution moves but there are significant extinctions at one or both edges.

The effects of perturbed environment are seen most rapidly in small, short-lived creatures. Parmesan et al (1999) report on butterfly ranges. They contrast a butterfly species that was able to expand its range, such that it was seen in places in Scotland for the very first time, with a 'non-shifting' species, that experienced retraction – its range in the UK and Southern Scandinavia was simply lost as the climate shifted.

With longer-lived creatures, with lower reproduction rates, and longer maturation times, the effects of loss of viable range may take longer to be detected. And we know least, paradoxically, about the areas richest in biodiversity, tropical habitats at low elevation, even those may in fact be the most vulnerable, because they may already be living close to the limit of their thermal tolerance (so Lenoir and Svenning).

A dramatic example of a highly diverse ecosystem stressed already to the edge of its thermal tolerance is the Great Barrier Reef, which has now experienced 50% bleaching. Again, many

organisms dependent on the reef may have no strategies with which to preserve their range, and would be expected to crash or go extinct. But there are many other marine examples less well publicised, and reflecting the fact that 90% of the energy of the warming to date has gone into the oceans.

A recently published example of a marine species coming under pressure concerns the king penguin (Cristofari et al, 2018). As the Antarctic Polar Front, a current rich in the fish penguins eat, moves southward in response to global warming, it moves away from the few ice-free Southern Ocean islands king penguins need for their nests. This is an example of a fragmented ecosystem particularly vulnerable to perturbation. Again, penguins survived previous warming events, but nothing of the rapidity of the current changes.

As Pecl et al (2017) emphasise in an important review, the impact of these shifts on human well-being will be complex, ranging from the increased threat of malaria as mosquito range expands to increased food-stocks in Europe occasioned by the shift in range of various species of fish. In other cases, humans may be able to assist species adaptation. Woodruff, writing as far back as 2001, asserted that 'Bioneering, the interventionist genetic and ecological management of species, communities and ecosystems in a postnatural world, is poised to become a growth industry.' (Woodruff 2001: 5474) Assisted migration might be effected in two main ways: either by ensuring that corridors exist that would enable species to move gradually to a more favourable habitat, or by 'managed relocation', physically moving organisms to new environments they have never occupied, but in which they might be expected to be able to continue to flourish.
As with the new technologies for manipulating genes and embryos, managed relocation would change our sense of what is a 'given' of the natural world and what is properly an object of human manipulation. Many introductions of species have proved very destructive – anyone who has lived in the American South will be familiar with the impact of Japanese knotweed on those ecosystems, and famously Australian ecosystems have been badly damaged by a whole series of introductions of exotic species (for examples see Morrison 1999:30).

It is not necessarily easy to determine in advance what species will prove to be damaging in a new environment. This is all the more the case because there will be relatively few cases in which a species could be moved by itself. This may be confined to the cases of top predators being introduced into places with abundant potential prey, and species being re-introduced into contexts from which they had previously been eliminated by human action (as in recent experiments with the re-introduction of wolves). It is much more likely that species may need to be moved in clusters or 'functional groups' (Western 2001: 5460) (e.g. in the case of a herbivore with a specialised diet, which in turn would depend on a certain matrix of other organisms). The sheer complexity of such an operation suggests that wherever possible the approach to assisted migration should be via the provision of corridors that enable species or combinations of species to migrate by themselves, rather than by out and out translocation.

Holmes suggests that perhaps initially only 10% of the introductions of species will work (Holmes 2007:47). However I note that since I first published on this subject (e.g. Southgate 2009) attention to the feasibility of managed relocation has greatly increased. As the climate crisis deepens, the sense that managed relocation of species may be forced upon us becomes stronger, and efforts to model the challenges of such projects have intensified (see Schwartz et al 2012 on the work of the 'Managed Relocation Working Group').

I return to the case of the polar bear, a top predator with literally nowhere to go as the Arctic warms. Consider as a thought-experiment an effort to establish polar bears in the sea-ice of Antarctica, which is actually growing in extent at present. Could they survive such a journey? What would be the disruptive effect on indigenous species? These are huge imponderables.

Christian environmental ethics includes some 'meta-ethical principles', which may overrule other considerations in the Christian response to a particular dilemma. One of these, as identified by my colleague David Horrell, is 'other-regard' (Horrell 2005: Ch 7; Horrell et al 2010: Ch 8). We see in the writings of St Paul that the imperative to do good to others goes well beyond the Christian community (Horrell 2005: 261-7). *Laudato Si'* clearly affirms God's concern for non-human creatures, and hence the appropriateness of extending human concern and other-regard to them. Other-regard is underpinned by that resonant language of the Philippian hymn: 'the mind that was in Christ Jesus' (Phil 2.5), which led him not to snatch at status but to empty himself, taking the form of a servant (2.7-8).

Other-regard, then, has broad application, and carries with it an expectation that it will prove costly and sacrificial. Such an 'ethical kenosis' – of aspiration, appetite and acquisitiveness - is vitally needed in the lives of those whose current affluence and level of consumption is unsustainable (Southgate 2008: Ch 6). This is what the Holy Father calls 'differentiated responsibilities' (Francis 2015: para 52). The more general principle however is one of costly self-giving – other-regard is expressed through the expenditure of prayerful effort, imagination, care, as well as material resources. And this may well imply, in the sorts of situation now arising in ecosystems, the active consideration of costly managed relocations, where the alternative is the irreversible damage of a biological extinction.

This meta-ethical principle does not necessarily tell us which costly choices to make, and this indeed is a characteristic of such principles. But both the general biblical emphasis on creatures belonging to the Lord, and the theological stress, so strong in the Pope's writing, on the priority of the voiceless and those whose flourishing is most threatened, do add power and poignancy to the crisis of extinction. These emphases resist the discounting of the future on which other systems of valuing are based. They reinforce the principle of other-regard, and draw into its application both future human generations (to whom life with a whole range of other species may be lost if predictions of extinction rates prove accurate), and also the potentially lost generations of non-human creatures. Including of course those polar bears that may simply never exist as a result of anthropogenic melting of the Arctic ice.
Some managed relocations may be relatively easy and cheap, such as the introduction of the magnificent and extremely rare Florida *torreya* into North Carolina. But clearly many managed relocations will be neither. The enormous effort and care required of such a project as polar bear relocation, its costliness and precariousness, would have another value. It would not only serve the needs of that species. Great thought-experiments like saving the polar bear should act as a rhetorical device to make yet more plain to those who influence the course of the most carbon-intensive economies in the world just how vital a change of overall policy has become. There is a whole complex of measures – economic, fiscal, technological, socio-political – which needs to be put in place to mitigate the impact of climate change, and most of these measures will be easier, cheaper and more dependable as means of preventing mass extinction than great projects in managed relocation of species. The thought-experiment of considering adaptive fixes in the face of climate change reinforces the urgent and vital importance of mitigating its onset.

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