

Climate change

Antarctic life on the edge

by Mario Lebrato

Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. The global increases in carbon dioxide concentration are due primarily to fossil fuel use and land-use change, while those of methane and nitrous oxide are primarily due to agriculture. Carbon dioxide is the most important anthropogenic greenhouse gas. The global atmospheric concentration of carbon dioxide has increased from a pre-industrial value of about 280 ppm to 379 ppm in 2005. Warming of the climate system on Earth seems unequivocal, as it is only now that we are starting to recognize the situation, when we are in the position to do something about it. Could it be too late? Evidence from observations of increases in global average air and ocean temperatures have been recognized, as well as widespread melting of snow and ice, and rising global average sea level. Global warming is melting glaciers in every region of the world, putting millions of people at risk from floods, droughts and lack of drinking water. Is this not enough? Do we need more dramatic disasters to recognize the process that we humans have created? It is hard to believe that the only means by which human beings will learn to respect the environment is going to be through the “hard way”.

Coming back again to the melting glaciers,



Glacier in San Jorge Island (Antarctica). (Copyright: Dr. Marcelo Leal Gregorio).

projected climate change over the next century will further affect the rate at which glaciers melt. Average global temperatures are expected to raise 1.4-5.8 °C by the end of the 21st century. Models project that a 4 °C rise in temperature would eliminate nearly all of the world's glaciers (the melt-

down of the Greenland ice sheets could be triggered at a temperature increase of only 2 to 3 °C). Even in the least dramatic scenario, a 1 °C rise along with an increase in rain and snow, glaciers will continue to lose volume over the coming century. Although only a small fraction of the planet's permanent

ice is stored outside of Greenland and Antarctica, these glaciers are extremely important because they respond rapidly to climate change and their loss directly affects human populations and ecosystems. Continued, widespread melting of glaciers during the coming century will lead to floods, water shortages for millions of people, and sea level rise threatening and destroying coastal communities and habitats.

These are just some of the dangers humanity may have to face, and if we are not even worried about our own future, how are we going to be bothered about what will happen to the other animals that like it or not, inhabit and “share” the Earth with us?

Antarctic biodiversity in the spotlight

Since the hypothesis was put forward early in the last decade that a decrease in winter sea ice in the western Antarctic Peninsula due to climate warming was a major factor driving long-term changes in the relative abundance of some regional, krill-dependent predator populations, several lines of investigation have significantly enhanced our understanding of the dynamics addressed by this hypothesis. Understanding how these trends may affect marine ecosystem processes has



Penguin in the beach of San Jorge Island (Antarctica). (Copyright: Dr. Débora Iglesias Rodríguez, UK).

focused primarily on the significance of sea ice to the Antarctic krill and the significance of krill to the marine food web. Krill are crustaceans, which are used as a dominant food-web component in the marine system, and play a critical role in the transfer of energy between primary producers and secondary consumers. Changes in krill distribution and dynamics are thus key factors that can profoundly impact food-web interactions as well as controlling



Pup from an elephant seal at Elephant Island. (Copyright: Dr. Marcelo Leal Gregorio).

bottom-up processes. Adélie penguins are a sea-ice-dependent species throughout their circumpolar range, which diet relies on the krill species *Euphausia superba* along part of its biogeographical distribution. There is thus a causal relationship between variability in ice cover, which will be affected by a warming planet, krill recruitment and availability, and Adélie penguin foraging ecology. Ice formation dynamics will be thus a major concern in the coming years

regarding the disruption of ecological functions and levels. Changes in the ecosystem structure and function will be certainly introduced, and the main problem is that the evolved life-histories of many key components species, such as penguins, will be irremediably modified, with unknown consequences for the rest of the trophic web.

The sea ice environment is an important part of the Antarctic ecosystem, and it is of particular



*Southern Right Whale in Mosselbaai (South Africa).
(Copyright: Mr. Mario Lebrato, UK)*

relevance for seals, as well as any kind of biological activity, which depends on one way or another in the physical component of the ice. Elephant seals foraging efforts are commonly focused on oceanic frontal zones, much of which are determined by the very thermal structure of the water column. Climate variations such as El Niño Southern Oscillation can be detrimental for those areas through pressure and sea temperature changes. Slight climate modifications will undoubtedly affect seal behaviour and survival capabilities, because the general structure of their foraging medium will change, and their life histories and survival will be constrained. It is important thus to direct specific studies to quantify in a qualitative and quantitative way the links between higher order predators and environmental conditions, providing conservationists, ecologists and managers with vital information to effectively tackle future ecological problems. If both the intensity and frequency of inter-annual sea-surface temperatures are to



*Oceanography Boat from the Brazilian Marine (Ary Rongel) in a research cruise in Antarctica.
(Copyright: Dr. Marcelo Leal Gregorio).*

be increasing, as it seems to be the case, then, it follows that seal populations of different key species will be negatively affected by those negative predictions on warmer temperatures.

Whale populations do not seem in direct and imminent danger from a warming Earth, but preliminary studies suggest that their abundance and preferred grounds for rearing calves may be linked to sea temperatures. Indeed it has been hypothesized that migration routes could be disrupted in the long term through warming sea water conditions, as well as their habitual resting grounds. Feeding areas in the Antarctic are particularly important, since krill is a major dominant species in their diet. As already mentioned, sea ice extent and dynamics may directly impact on krill abundance and thus if production is diminished, higher trophic levels, where whales are placed will suffer. Diet changes or slight modifications may ensue, but for those specialized species it will be hard times.

Are we really learning the lesson through the “taught way”?

Human intelligent machinery has been clever enough to create a global problem with far reaching consequences than previously imagined. Biodiversity should not be enduring our own mistakes, because they have done nothing wrong as their nature dictates. Our own “failure” as a species on this planet, as I am afraid we must be labelled, should at least be wise enough to be able to protect the rest from the incoming disasters. Perhaps our well-defined selfish nature as individuals has gone too far, forgetting the sentiment of a primordial welfare in the group dynamics. Selfishness defined at the level of the individual, at the level of a society as an individual, and at the level of a country as a single individual, should be avoided by all means, if we really wish to tackle the problem, which starts in ourselves as “human animals”. I hope that the “shrinking glacier”, the “hesitant penguins”, and the “protesting seal”, seen through the lenses of a camera have all illustrated the need of immediate action and deserved attention, if we want to safeguard our last corner of human dignity and respect, in the mediocrity of a “dark” society.



Mario Lebrato

Dep. Marine Biology
and Oceanography
University of Southampton

ml1104@soton.ac.uk