Coping with climate change

Humans may find ways to get cope but is that true of the natural world?

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A study reports that birth rates have fallen four-fold with higher mortality in a caribou species

A great many animal species are likely to go extinct by the end of the century

Climate disasters in the past wiped out a vast numbers of species but there was time for many to adapt. A question is whether the current trend of global warming is giving the natural world the same opportunity.

Lead author Victoriia Radchuk and 60 others from Germany, Ireland, France, The Netherlands, UK, Czech Republic, Belgium, Sweden, Canada, Spain, US, Japan, Finland, Norway, Switzerland and Poland, attempt an answer in their paper in the journal, *Nature Communications*. Based on a review of 10,090 abstracts and data from 71 studies, reported in 58 relevant publications, they assess whether changes in the physical features of animals are coming about as a means of adapting to climate change. The results of the study are that although many species make a good showing, most seem to be losing the race.

Climate change, the study says, can affect the ability of species to survive, and extinctions reduce the mutually supporting mix of species in ecosystems. Species could maintain numbers if they responded with physical changes or changes in behaviour, which matched or lessened the effect of climate change. This could come about by physical adaptation, like changes in digestive secretions when there is a change in diet, or by minute evolutionary steps, or by migration to other regions.

Even the physical adaptation, like when mountaineers, who pause to acclimatise before they venture into higher altitude, must take time. Evolutionary changes, which occur because of the environment-favouring strains within a species, need several generations. Detecting and quantifying just how far the observed changes in species, over the last few decades, are evolutionary responses to climate change is hence important in forecasting species numbers and to plan interventions, the paper says.

An example of adaptation is the timing of breeding or egg-laying according to when sources of food to feed the young are most abundant. The authors cite a study where the mean egg-laying date of a species of birds in the UK has advanced by 14 days over a 47-year period of observation. This is a case where "individual adjustment of behaviour in response to the environment has enabled the population to track a rapidly changing environment very closely," the study says.

Another study, a case of maladaptation, is the response to climate change, by a bird species that breeds during the Arctic summer, which leads to low fitness when individuals migrate to the tropics for the winter. The summer-time adaptation is that chicks are born with smaller bodies, to lose heat more efficiently in the warmer conditions. But the smaller birds have shorter beaks, which prove to be a disadvantage when they migrate, in the winter, to places where the best feeding is buried a little deeper.

Herbivores, such as the caribou, have evolved to have offspring at the best plant-growing season. This timing is maintained by linking migration and breeding behaviour to the length of the day, while the plant-growing season is linked to the local temperature. With climate change, however, this timing falls out of step and one study reports that birth rates have fallen four-fold with higher mortality.

While there are changes of form and behaviour in species, over a period, the objective of the study was to identify changes that were instances of adaptation to climate change. The paper says this would be the case if three things are true. The first is that there has been climate change. The second, that it is climate change, and not some other cause, that has brought about the change in the physical features of an animal. And last, that the change arises from selection of traits that help the animal cope with the stress of climate change.

Testing the third condition, the authors say, requires data that has been collected over multiple generations in single populations. The large team of researchers carried out an extensive search of investigations of how change in temperature or precipitation, or both, affects the physical form or timing of life events in different animal species. And from the large data available, they found useful sets that were in respect to birds. This would be because of the relative ease of collection of data, of nesting, egg-laying and hatching, and movement over a period.

Most studies earlier of how species respond to climate change, the paper says, have focused on changes in the distribution and abundance of species. Changes in their behaviour, dimensions or physiology have been studied much less and models to simulate distribution and populations have not considered the possibility of species to adapt.

The present "study thus makes an important contribution by focusing on the temporal dimension of species responses to changing environments", the authors say. "We demonstrate that some bird species analysed here seem to respond to warming temperatures by adaptive advancement of timing their life events, emphasising the possibility of species tracking their thermal niches *in situ*, which can occur with or without shifts in geographic ranges. However, we did not find evidence for adaptive change in all species, and even populations undergoing adaptive change may do so at a pace that does not guarantee their persistence."

The authors add that the species studied are common and abundant, for which data is more easily collected. "We fear that the forecasts of population persistence for rare and endangered species will be more pessimistic," they say.

The conclusion is alarming — a great many animal species are likely to go extinct by the end of the century. There are many who consider that biotechnology would be the key to getting through the 21 century. True, the above study does not include plant species. But plants are also affected by climate change and there is close dependence of vegetation on animal species.

The results of the study may not be far from true in the case of bacteria and microorganisms. Massive decline of animal biodiversity would hence be mirrored in the botanical world and this would not bode well for the role of plants that we are counting on in the coming decades.

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PLUS POINTS

Glowing 'pocket' shark

A new species of tiny shark, which glows in the dark and squirts luminous liquid, has been discovered in the Gulf of Mexico. It is only the third of more than 500 known shark species, which is believed to secrete fluorescent liquid. It has been named the American pocket shark, *Mollisquama mississippiensis*, due to its diminutive size and because of the mysterious pocket-like pouches near its front fins, which it has been revealed are used to squirt little glowing clouds into the depths of the ocean.

The specimen — a 5.6-inch new born male shark — was collected during a 2010 survey to find out what Gulf of Mexico sperm whales eat. Scientists trawled in an area and at a depth where tagged whales had been feeding. National Oceanic and Atmospheric Administration ichthyologist (fish scientist) Mark Grace had spent three years identifying the collected specimens, and this one, still showing an umbilical scar, was in the last bag he opened.

The only other pocket shark known to science — a 16-inch adult female caught in the Pacific Ocean off Peru in 1979 — also has a pouch next to each front fin, which scientists were unable to determine the function for. But with this one, they realised what they did. The muscular glands are lined with pigment-covered fluorescent projections, indicating they squirt luminous liquid, Grace and his collaborators wrote in the journal *Zootaxa*. The shark also has clusters of light-emitting cells dotted over its stomach. The luminescence might conceal the shark from prey or from predators, he suggested.

A 2015 paper identified the shark as the second of its kind. It took years more, including high-resolution scans in the particle accelerator in Grenoble, France, to get more internal detail, to be sure it was a new species.

The independent

'Unknown climates' in 2050

Many of the world's major cities will face sharply different climates by 2050, with those in the tropics facing conditions they have never experienced before, including more intense rainfall and extreme droughts, researchers say. Half of the planet's population lives in cities and by 2050, little more than a generation away, three in four will live in urban areas, says the United Nations.

Researchers at ETH Zurich University in Switzerland wanted to find a way to visualise how climate change will affect major world cities. They chose 520 cities and examined the current climate for each, and then ran computer simulations for what the climate would be like in 2050.

The result is that the climate in 2050 for most cities shifts, in some cases dramatically. London's climate resembles Barcelona's to the south. The Spanish city has longer, warmer summers and milder winters but is also prone to prolonged droughts. Seattle's climate becomes milder, resembling San Francisco's current climate; Moscow becomes more like Sofia, and Paris like Canberra.

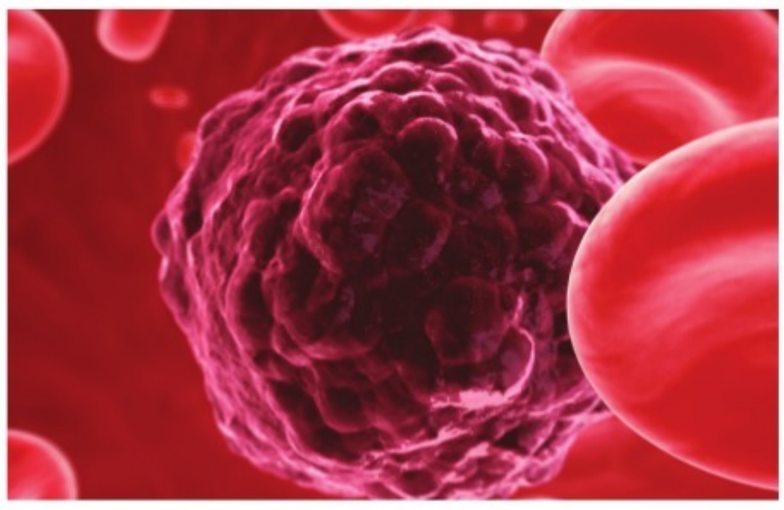
Across Europe, summers and winters will get warmer, with northern climates becoming more like those in the south, the researchers found. The results were published last month in the journal *Plos One*. The research team projected the future climate by using a series of existing computer climate models and taking an average of the findings. They used an optimistic assumption, which is that carbon dioxide emissions would stabilise by the middle of the century, based on technology and policy solutions to cut emissions.

They found 77 per cent of cities in 2050 were very likely to experience a climate closer to that of another city. And 22 per cent "of the world's cities are likely to exist in a climatic regime that does not currently exist on the planet today". But lead author Jean-Francois Bastin explained that the shift to new climate conditions in the tropics might not be extreme.

The strait times/ann

What is a disease?

It is a difficult question to answer even for healthcare professionals but debates still rage



Homosexuality was classified as a mental disorder by the American Psychiatric Association in 1968

Osteoporosis was considered a normal part of ageing

DUANE MELLOR & SHAHID MERALI

There is a lively ongoing debate among healthcare professionals about whether or not obesity is a disease. Differences between those who argue that it's a disease and those who argue that it's just a risk factor for conditions such as type 2 diabetes and heart disease are unlikely to be resolved any time soon. The debate, however, raises other questions, such as, what exactly is a disease and who gets to decide?

A simple definition of disease is an "illness or sickness characterised by specific signs or symptoms". But it is interesting that some dictionaries suggest that diseases are caused by "bacteria or infections", seemingly dismissing psychological and non-communicable conditions as diseases, which is odd given that non-communicable diseases, such as cardiovascular disease and cancer, make up most ill health in the world today.

Official catalogue of disease

On a global level, diseases are catalogued by an international groups of experts for the World Health Organisation. This catalogue, the International Classification of Disease, is now in its tenth revision (ICD-10). Despite its name, the classification doesn't stop at diseases but includes related health problems, which may be linked to a particular disease, or may be a symptom as part of a syndrome or even a consequence of a medical procedure. For example, even dehydration appears in ICD-10, where it is also called "volume depletion". So perhaps there is not even agreement on what is meant by disease. And what is classified as disease is essentially down to expert consensus.

While the WHO doesn't seem to have a clear definition of disease, it does at least have a definition of health. It is defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity".

The definition of health appears to be broad and inclusive, but defining disease appears to be more challenging than defining its opposite. Few people would disagree that measles, say, is a disease. But what happens when society decides to classify a certain human behaviour or characteristic, which some groups happen to find disturbing, as a disease.

Sin as a source of disease

Examples of classifying characteristics as diseases can be seen throughout human history. Many of these might be grounded in traditional beliefs and views of health, disease and their links to sin.

The development of psychology as a science potentially led some perceived "sins" to be translated into mental health disorders. Perhaps the best example of this is homosexuality. Homosexuality was classified as a mental disorder by the American Psychiatric Association in 1968. This was later challenged by a vote among APA members in 1973, where a majority of 58 per cent chose to remove it from the diagnostic manual. Homosexuality was not fully removed from the diagnostic manual for another decade and is now considered to be a normal characteristic within the diversity of human nature. This disturbing episode raises further questions — on what basis and in whose interests are diseases classified?

In 2013, researchers at Bond University in Australia looked at who gets to classify diseases. They found that common diseases often had their definitions widened by expert groups, without considering the potential risks or challenges of increasing the number of people living with disease. They also noted that experts who widened definitions of diseases often have conflicts of interests in the form of funding from pharmaceutical companies.

On the spectrum

Sometimes, risk factors for a disease — such as high blood pressure — eventually get defined as a disease in their own right. And once these risk factors are reclassified as a disease, their targets or ranges tend to shift over time, increasing the number of people who have the disease. For example, high blood pressure used to be anything over 140/90. But in 2017, the US changed the threshold to 120/80.

Distinguishing a disease from a risk factor is not easy, especially when it comes to chronic diseases, which tend to be a spectrum from health to illness. Blood glucose (sugar) is a clear example as levels move from healthy through pre-diabetes into type 2 diabetes. So spotting where health finishes and disease begins is difficult, to the point that the WHO and International Diabetes Federation suggest there is no such thing as a normal level of blood glucose.

Nevertheless, the definition of gestational diabetes (diabetes in pregnancy) changed in 2014, when the blood glucose threshold was lowered. The change increased the incidence of gestational diabetes by 74 per cent with no improvement in short-term outcomes, such as the mother needing a caesarean section, according to one Australian study.

Many clinicians are critical of this trend, calling it over-medicalisation.

Normal ageing or disease?

Sometimes, conditions previously thought of as being a natural part of getting older have become diseases. For example, osteoporosis was considered a normal part of ageing until 1994 when the WHO officially recognised it as a disease. Given osteoporosis's link with an increased risk of fractures and the devastating impact broken bones can have on the elderly, this seems like a change in definition that is justified.

Other physiological changes that occur in older age, such as a fall in testosterone levels in men, may not benefit from disease status. But that hasn't stopped some healthcare experts trying to create a new condition called "the andropause". So far, though, resistance to recognising this change as a disease has been strong.

All of the above goes to show that deciding what is or isn't a disease is not easy, but hopefully you'll be better equipped to ask some critical questions such as, who benefits from this new definition? And do they have my best interests at heart? The answer to the latter question is usually yes — but not always.

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