MIGRATION

Seeking cool

Science **333,** 1024–1026 (2011)

Although it is generally accepted that Earth's species are migrating up mountainsides and towards the poles because of global warming, demonstrating this trend in a statistically robust way has not been easy. Now, an analysis that combines all published studies on the subject has revealed a migration rate that is two to three times faster than previous estimates.

Using more than 2,000 measurements of species' movements, Chris Thomas, of the University of York, UK, and his colleagues report that the world's flora and fauna are, on average, shifting their distributions towards higher elevations at a rate of 12.2 metres per decade and to higher latitudes at a rate of 17.6 kilometres per decade. However, they found great variation among taxa. A quarter of all species shifted their ranges downhill, for example, and 22% moved towards the Equator. Birds changed elevation the least, but moved most rapidly away from the Equator.

There is a good correlation, the researchers say, between predicted range shifts for different regions (based on average temperature change over the past 40 years) and how far species in those regions have actually moved. *AP*

CLIMATOLOGY

Long-term temperature

Climatic Change **107,** 247–265 (2011)

Many climate sceptics have used studies that report a long-range dependence in temperature time series to imply that the sustained warming of recent decades is a latent effect of natural variability.

William Rea and his colleagues, at the University of Canterbury in Christchurch, New Zealand, have looked in detail at data in such studies. They reasoned that true long-range dependence should be evident in sub-intervals of the data selected by these studies' authors, rather than merely between the start and end points of a time series that may have been politically selected.

They found that a basic check on the logical consistency of these papers rendered their conclusions invalid. The New Zealand team were able to remove the effect of long-term temperature dependence by simply breaking up the time series in these studies into segments, and reanalysing the data. The new empirical results are complemented in another paper by Michael Mann of Pennsylvania State University, who uses a simple climate model to demonstrate theoretically how a naïve application of time-series-analysis tools can generate false conclusions. *AP*

IMPACTS

Measuring metropolises

Int. J. Clim. Change **3,** 275–301 (2011)

What makes a city a big greenhouse-gas polluter? A study comparing seven large metropolises — Bangkok, Chicago, London, Madrid, Mexico City, Milan and New York City — has picked apart the relative importance of factors such as population density and mobility patterns.

Edoardo Croci and colleagues from Bocconi University in Milan, Italy report some obvious conclusions. For example, a densely populated city such as New York, where people walk a lot, generates fewer emissions from transport than a more spread-out city such as Chicago, whose residents often drive to work. However, the authors also found that the improved energy efficiency of new electronic devices (usually owned by the residents of rich cities) is outweighed, in terms of emissions produced, by the increased number of such devices in wealthier cities. Although not measured in this paper, they also note that certain waste-disposal methods can significantly add to emissions, with 11% of Mexico City's contribution to climate change emanating from its methane-leaking landfill sites.

With per capita emissions varying between cities by as much as 2–30 tonnes of carbon dioxide per year and an ever-urbanizing world, the findings should help planners everywhere. *AP*

ECOLOGY

Weaker sea butterflies

Proc. R. Soc. B. http://dx.doi.org/10.1098/rspb.2011.0910 (2011)

Thecosome pteropods — or sea butterflies — are planktonic molluscs that exert a disproportionate influence on many marine ecosystems because they are a major food for whales, salmon and birds. By the end of the century, the increase in dissolved carbon dioxide in sea water will have acidified the oceans so much that pteropods will be unable to form their external, calcium carbonate shells in some high-latitude regions, and will be able to grow only slowly in temperate zones, according to Steve Comeau at the Oceanographic Laboratory of the French National Centre for Scientific Research in Villefranche-sur-Mer and his colleagues.

The team used data describing the relationship between ocean chemistry and the growth of two pteropod species, the extent of the creatures' daily vertical migrations in the water column, and a model of how ocean pH and carbonate ion concentration are expected to alter over this century under the projections of the Intergovernmental Panel on Climate Change.

Pteropods in the Arctic region will struggle the most. Weaker shells will probably make them poor buoyancy regulators and more vulnerable to new predators, leading to a decline in pteropod populations that would impact other ecosystems. *AP*

CARBON STORAGE

Irrigation factor

Glob. Biogeochem. Cycles **25,** GB3016 (2011)

Agricultural land accounts for almost a fifth of carbon fixed through photosynthesis. Water scarcity limits crop productivity, hence irrigation is expected to increase agricultural productivity and carbon fixation. But it is not known by how much.

Now, Mutlu Ozdogan from the Center for Sustainability and the Global Environment and the Department of Forest and Wildlife Ecology at the University of Wisconsin-Madison, has investigated how much irrigation contributed to global agricultural primary productivity between 1998 and 2002, using a modified terrestrial ecosystem