Weathering a storm of global statistics

Sir — Another El Niño 'event of the century' has come and gone, and with it a wide variety of estimates of how much damage the world has incurred, ranging from US$14 billion to $69 billion[1–3]. Damage from all natural disasters in 1998 alone is believed to have cost some $93 billion[4]. Of greater concern than this lack of accuracy is a general tendency to describe impacts through a few global totals.

By aggregating impacts into a single estimate, much of the knowledge of and insight into the human–climate interface is lost. The environment does not affect us in simple, one-number packages. Only recently have we begun to measure quantitatively the varied losses and benefits (impacts) associated with climate variability, and these estimates have yet to be referenced to a baseline of impacts occurring in 'normal' years[5].

Regional variations in reported damages, for example, do not inherently represent the reality of losses. Burton *et al.*[6] note that biases exist "toward overestimating losses from industrialized countries and underestimating losses in developing countries or in areas remote from centers of government and mass media". It is not easy to attribute and distinguish between losses associated with climate variability and maintenance costs. Although biases and uncertainties do exist, other factors need to be accounted for, for example the use of a prejudiced vocabulary to describe losses. Many estimators are unfortunately tempted to represent a globally perceived value rather than inter-regional functionality, for example. A thatched house may not fetch a global market value, but its loss during a flood is nonetheless an impediment to livelihood maintenance or to development.

Climate impacts are also largely a function of perception and scale. What is devastating to an individual is not likely to register on an international scale, except in extreme calamities. The incentives, disincentives and cultural preferences of an affected area often guide this perception of impact, which influences the reporting and visibility of climate events. It is likely that incentives such as 'relief aid' have increased the number of reported events. There are many other complex variables that need to be taken into account.

Not all impacts associated with climate variability are disastrous or even negative. To better understand the interaction between humans and climate, the popular vocabulary used to describe and record impacts of climate variability must move beyond deaths and dollar losses.

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1. Obassi, G. O. P. Secretary-General, WMO, Presentation at International Seminar on the 1997–98 El Niño Event: Evaluation and Projections, Guayaquil, Ecuador (9 November 1998).
2. McPhaden, M. J. *Nature* **398**, 559–562 (1999).
3. NOAA Office of Global Programs *Compendium of Climate Variability* Draft (May 1999).
4. Munich Re Group Press Release (15 March 1999).
5. Glantz, M. *Climate Change* **1**, 305–306 (1978).
6. Burton, I., Kates, R. & White, G. *The Environment as Hazard* 2nd edn (Guilford, New York, 1993).

Colonial adventures

Sir — Walter Gratzer, in his review of Freeman Dyson's book, writes: "Dyson's guess, based on a typical interval between discovery of a new land (America in 1492) and its settlement by outsiders (the arrival of the *Mayflower*), is that colonization of space could begin in about 2085" (*Nature* **398**, 770; 1999). This perpetuates a mistaken view of the early settlement of the Americas. The first lasting European colony in the Americas was established by Nicolás de Ovando in Hispaniola in the West Indies in 1502, only ten years after Christopher Columbus's first voyage and more than a century before the *Mayflower*.

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Modern museums are far from fossilized

Sir — In his review of Steven Conn's book *Museums and American Intellectual Life, 1876–1926*, Thomas Gieryn asserts that long ago "museums ceased to be centres of intellectual work" (*Nature* **399**, 31–32; 1999). He offers reasons for this decline, which, among other things, "made natural history collections . . . almost irrelevant to the production of new knowledge".

While these and similar comments may accurately portray the changing role of many museums earlier this century, they fail to acknowledge the predominant and vital role that is played by both public and private research museums in contemporary intellectual life. This is especially true in the United States, where several prominent universities (such as Berkeley, Harvard, Kansas and Michigan) have wisely continued to support, and even expand, their research museums.

The result of this investment is that many such museums now constitute the centres of intellectual enquiry in several fields, including evolutionary biology, anthropology and human biology. Knowledge of the past offers many important lessons, but it is not an infallible guide to the present or future.

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Secondary metabolism and the risks of GMOs

Sir — The potential problems of altering the chemical composition of crops were discussed in your Briefing[1]. One aspect of this debate relates to secondary metabolism, which is an attractive area to exploit because of the importance of such compounds in resistance, defence and product quality. In our view, the rules governing the evolution and role of secondary metabolites need to be discussed and understood in order to understand the risks associated with the genetic modification of crops.

We have previously proposed[2,3] a model based on the well-known fact that potent, specific biological activity is a rare property for a molecule to possess. In this model, organisms with a rich secondary metabolism (most plants and many microbes) have gained fitness by possessing metabolic traits that enhance the production and retention of chemical diversity. Two such traits could be a broad substrate tolerance of some of the enzymes involved in secondary metabolism, and the utilization of matrix pathways.

Two examples from terpenoid metabolism illustrate the metabolic flexibility proposed. In spearmint (*Mentha gracilis*), a mutation caused an enzyme to produce a new product, but several other new compounds were also made, at least one of which was unpredictable[4]. In the grand fir (*Abies grandis*), two enzymes can make multiple products from a single substrate (one produces 52 and the other 34)[5]. If such metabolic properties exist in all organisms with a rich secondary metabolism, the introduction of a gene could potentially have quite unpredictable outcomes, as in the following examples.

First, the introduction of an enzyme