Correspondence

'Tree of life' took root 150 years ago

As thousands of scientists and policymakers gather in Mexico this month for the COP13 summit on biodiversity (see www.cbd.int/cop2016), we should take a moment to celebrate the earliest 'tree of life' model of biodiversity.

Charles Darwin published the idea of a tree of life in *On the Origin of Species* in 1859. Seven years later, German zoologist Ernst Haeckel painstakingly drew up a much more comprehensive tree (pictured). This represented Earth's wealth of species in the context of evolution — a concept he dubbed phylogeny (*General Morphology of Organisms*; 1866).

The root of the tree symbolizes a common primordial ancestor from which all other forms emerged. Haeckel developed his tree over almost 1,000 pages, basing it on palaeontological, embryological and systemic data — a precursor to modern biology's phylogenetic trees.

He also coined the term ecology ('oecologie'), describing it as "the whole science of the relations of the organism to the environment including, in the broad sense, all the 'conditions of existence'".

Haeckel's ideas were harbingers for discoveries such as that by ecologist Santiago Soliveres and colleagues, who demonstrated that ecosystem multifunctionality depends on high species richness (*Nature* 536, 456–459; 2016).

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Conservation: smart advocacy needs data

We agree that data alone will not save species (A. M. Ellison *Nature* 538, 141; 2016). However, using data in combination with smart advocacy can make a difference.

For example, ecologists

specializing in seabirds, fishes and coral reefs shared their data to show that protection of an area in the northwest Hawaiian Islands was scientifically justified. This evidence was required in order to use the US Antiquities Act to conserve the region. As a result, this became the world's largest no-take protected area earlier this year.

Contrary to Aaron Ellison's implication, some ecologists have been inspirational advocates for biodiversity. For example, biologist E. O. Wilson campaigns to protect half the planet (*Half-Earth*; Norton, 2016) and ecologist Daniel Janzen helped to save huge tracts of dry forest in Costa Rica (W. Allen *Green Phoenix*; Oxford Univ. Press, 2003).

More scientists need to be engaged with society and make the case for conservation — with good, compelling data in hand. None of us wants our publications to serve as pages in a wildlife obituary.

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Conservation: big data boost in China

I disagree with Aaron Ellison's contention that biodiversity data only rarely drive conservation decisions (*Nature* 538, 141; 2016).

In China, better data are guiding changes in conservation policies and on-the-ground actions.

For instance, huge long-term data sets on species, ecosystems and human activities have enabled China to identify many priority conservation areas for protecting biodiversity and maintaining ecological security (R. Wu *et al.* *PLoS ONE* 9, e103783; 2014). Intensive development is prohibited in these areas.

Furthermore, a huge amount of data from hundreds of scientists are used by China's Ministry of Environmental Protection to compile biodiversity 'red lists' (R. Wu *Science* 353, 657; 2016). And the systematic collection of more and better data is crucial to implementation of the government's nationwide 'Red Lines', which demarcate ecological conservation regions (see W. Sang and J. C. Axmacher *Nature* 531, 305; 2016).

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Conservation: thrive on slings and arrows

Aaron Ellison rightly calls for conservation scientists to engage more actively in the political process (*Nature* 538, 141; 2016). Unfortunately, those doing so can become targets for physical and verbal threats, personal abuse, bullying and trolling on social media.

As a conservation scientist, I have experienced many such reactions at first hand. I have been embroiled for more than 30 years in the politics of native forest logging, tree-plantation expansion and culling of over-abundant native and exotic animals. Resilience against such attacks is underpinned by a drive to conduct and communicate high-quality science that contributes to the conservation and management of natural environments and biodiversity.

Communicating good data

and sound science to resource managers, policymakers and politicians is crucial for managing environmental resources and for reinforcing political decisions. Scientists need more training and mentoring in such skills — and in dealing with unwelcome fallout from lobbyists and the public.

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Cities: factor in their biological impact

Richard Forman and Jianguo Wu identify several zones around the world that might be suitable for future urbanization (*Nature* **537**, 608–611; 2016). We suggest that the problem of supporting a growing population needs to be considered from a biological as well as an urban-planning perspective: 'suitable' is not necessarily synonymous with 'biologically sustainable'.

The authors propose that urbanization should avoid biodiversity hotspots — regions that are rich in endemic species and undergoing rapid habitat loss. But this would exclude highly biodiverse yet well-conserved areas, which also need environmental protection.

Forman and Wu also call for global-scale planning. Until that is properly coordinated, governments should not view natural ecosystems as offering potential accommodation for the next billion people. Instead, they need to maximize land-use potential while minimizing its biological impact — for example, by improving cities and the surrounding lands that feed them, and by promoting biodiversity research and protection in conserved areas.

We probably do not need more "suitable" land: we need to make sustainable and efficient use of the land we already live on.

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Cities: new fringes to act as safety nets

Richard Forman and Jianguo Wu suggest that sustainable city expansion should be restricted to selected urban peripheries (*Nature* **537**, 608–611; 2016). Our investigations across five Indian cities indicate that proper planning of such peri-urban areas is crucial.

We define peri-urban areas as a 5-kilometre fringe of development beyond a city's jurisdiction. The India Research Initiative for Peri-Urban Human–Animal–Environment Interface (see <http://perimilk.phfi.org>), funded by Canada's International Development Research Centre, is examining the effects of expansion around Bangalore, Ludhiana, Guwahati, Bhubaneswar and Udaipur on city dwellers. The populations and calculated decadal growth rates of these cities vary from 8.44 million and 49% (Bangalore) to 0.45 million and 14% (Udaipur).

Our findings indicate that poor farming practices across all of these peri-urban areas could put food safety at risk, promote the spread of tuberculosis and other zoonotic infections, and accelerate microbial resistance through antibiotic overuse in livestock (our unpublished results). Public health is further threatened by minimal access to proper health care and by inadequate waste-management systems.

Without strict oversight, sound planning and investment in building infrastructure, peri-urban belts stand to aggravate many of the adverse effects of rapid urban growth.

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Trump: voters show importance of SDGs

Many of the factors that contributed to Donald Trump's win in the 2016 US presidential election are those that make achievement of the

United Nations' Sustainable Development Goals (SDGs) so pressing. Drawn up to end poverty (goal 1) and inequality (goal 10) and to ensure prosperity, among other aims, the tenet of the SDGs is to 'leave no one behind'.

In the United States, rising inequality and increasing poverty have created a groundswell of the disenfranchised and the dispossessed. Health care (goal 3) and tertiary education (goal 4) are unaffordable for many. Decent work (goal 8) and industry (goal 9) are under threat from automation and globalization, leading to job losses, fuelling racism and driving up crime (counter to goal 11). Extreme weather events related to climate change are on the rise.

All of this has created a potent cocktail of discontent that has manifested in anger towards the establishment. Yet I fear for most, if not all, of the SDGs under a Trump presidency. For example, he has vowed to undermine action against climate change (goal 13) and could jeopardize the development of clean energy (goal 7). He could put biodiversity at risk by making cuts to the Environmental Protection Agency (goals 14 and 15), and he seems to dismiss gender equality (goal 5).

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Trump: offset fracking risks

Unconventional gas extraction ('fracking') is likely to be central to the energy policy of president-elect Donald Trump. I urge the US Congress to tighten current regulations and strike a balance between energy independence and the safeguarding of public health and the environment (see also J. C. S. Long *Nature* **539**, 495; 2016).

The shale-gas revolution has given the United States a security blanket for energy, at a cost to the environment and to health (see M. L. Finkel and J. Hays *J. Epidemiol. Community Health* **70**, 221–222; 2016). Several European countries and US states (including New York, Maryland and parts of California, Colorado

and Texas) have therefore issued a moratorium on fracking.

This means that the US energy-policy debate needs a strong public-health and environmental presence. Before drilling starts, it is crucial to collect baseline data to track any related increase in morbidity and mortality. During the extraction process, environmental monitoring will be needed to assess air pollution and its impact; and details of all chemicals used in the process must be disclosed. Flowback fluids should be properly disposed of to protect surface and groundwater. These safeguards will help to counter potential harm to human health and the environment.

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Trump: polls right, models wrong

Contrary to popular opinion, the polls were not wrong in last month's US presidential election (see also *Nature* **539**, 339; 2016). The most recent polls in each state predicted the outcome for individual states — but only when the 95% confidence interval lay outside the polling error. For those predictions with confidence intervals within the polling error, the results were uncertain.

Many pollsters used predictive models to estimate probabilities. Permutations and models are reliable, however, only when projections capture the uncertainty of both the underlying data and the model itself. We cannot claim to make highly certain predictions from highly uncertain data. In this case, some models claimed a certainty of 99% even though 31% of the electoral-college vote was too close to call.

We need to improve the way we explain uncertainty: uncertain data are not wrong, only uncertain. And we must become better consumers of models.

The polls were right. The models were wrong. In this era of big data, we need to emphasize the distinction.

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