

Correspondence

'Flammable ice' — extract with caution

Methane gas hydrates, also known as flammable ice, are an abundant but untapped source of clean energy. Last month, China successfully extracted gas hydrate from the Shenhu area in the north of the South China Sea. However, further exploration demands great caution.

The challenge is to extract these gas hydrates from their reserves in sedimentary deposits along continental margins, and to find safe and economical ways to develop them industrially. Their stability depends on surface pressure and temperature, so transforming them from solid sediment into liquids and gases could weaken the sea floor, causing mass movement, landslides or subsidence. Hydrates are sensitive to changes in temperature and pressure and can rapidly release large amounts of methane, drastically altering the marine environment, harming sea creatures and affecting the climate.

We need a better grasp of the risks of such operations and how to manage them. Developing a solid and consistent regulatory framework will help industry and government agencies to avoid past mistakes, such as the horrendous consequences of the premature marketing of poorly understood chemicals, including DDT (see, for example, R. Dunn *Nature* **485**, 578–579; 2012).

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Growing threat of urban waste dumps

As researchers working on the sustainable management of urban waste, we are deeply concerned about developing countries' escalating production of municipal solid waste and of construction and demolition



Seed banks are used by both conservationists and taxonomists to study plants.

debris. Dump-site landslides have killed at least 220 people over the past 18 months in Shenzhen, China, in Addis Ababa, Ethiopia, and in Colombo, Sri Lanka. This growing threat to people and the environment demands greater attention, broader oversight and proper management.

Developing countries such as China and India are urbanizing at an unprecedented rate (see X. Bai *et al. Nature* **509**, 158–160; 2014). Many of the poorest cities in Africa and Asia are likely to double the waste they generate within 20 years. Drastic action is needed to control this trend (see, for example, D. Hoornweg *et al. Nature* **502**, 615–617; 2013).

Most such urban waste ends up in poorly operated landfill sites, or is dumped or burned. Some 3 billion people worldwide are not served by controlled disposal facilities. It is therefore crucial for governments in developing countries to provide safer alternatives for waste disposal, to pass and enforce regulations to eliminate the open dumping and burning of waste, and to finance sanitary landfill and recycling programmes. As cities continue to expand, careful and

sustainable planning is essential.
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Taxonomy: naming algae, fungi, plants

As president, vice-president and president-elect of the International Association for Plant Taxonomy (IAPT), we are concerned that Stephen Garnett and Les Christidis misrepresent the role of the IAPT in governing the nomenclature of algae, fungi and plants (*Nature* **546**, 25–27; 2017). The IAPT is not the equivalent of the International Commission on Zoological Nomenclature, as they suggest.

The IAPT provides the means for the community to undertake nomenclatural work, including our journal *Taxon* for publishing proposals. The governance of the rules for naming is laid out in Division III of the *International Code of Nomenclature for Algae, Fungi and Plants* (ICN; see go.nature.com/2rvaip8), and is in the hands

of the wider community. The ICN is debated and changed every six years by hundreds of international specialists as part of the International Botanical Congress, which this year is to be held in Shenzhen, China.

The role of the ICN is to facilitate, not to govern, the science of understanding life on Earth. We believe that fostering excellent science generally involves community engagement rather than regulation. The rules for naming algae, fungi and plants are governed collaboratively by the global community, not by the IAPT.
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Taxonomy: use the Red List as a registry

Taxonomy and conservation might seem to operate as separate bodies (S. T. Garnett and L. Christidis *Nature* **546**, 25–27; 2017). In fact, they are joined at the hip. Taxonomists provide the language to plead conservation's case. And conservationists could be taxonomy's greatest allies — the record of what lives and what might be lost is the field's strongest justification today.

The authors call for coordination between taxonomy and conservation, which is already happening informally. The International Union for Conservation of Nature (IUCN) has a huge stake in understanding species, with millions of organisms at risk but only 80,000 assessed so far. Its Red List of Threatened Species provides consistency in species' status. The IUCN also sets guidelines for predicting species' responses to climate change and for classifying the impact of invasive alien organisms. This interpretation of complex data underpins both

policy and practice.

The Red List is maintained by the IUCN's specialist groups, which include taxonomists. Although a species' taxonomic status is crucial to its conservation status and the data on populations and threats are assessed by strict criteria, no guidelines for species circumscription exist. By formalizing the updating and consistency of its list, the IUCN could provide a certified registry of the life worth conserving.

More species could be 'pre-listed' as extant, valid and potentially under threat using the Red List's Not Evaluated status. This would stimulate conservation thinking in taxonomy and promote formation of specialist groups. Because Red List maintenance relies on volunteer input, new funding mechanisms would be needed to expand its structure. **Klaas-Douwe B. Dijkstra** *Naturalis Biodiversity Center, Leiden, the Netherlands.* kd.dijkstra@naturalis.nl

Taxonomy: avoid extra bureaucracy

We agree with Stephen Garnett and Les Christidis that standardization and rigour in the delimitation of species and their interaction with society is beneficial (*Nature* 546, 25–27; 2017). In our view, however, their proposal would create unnecessary bureaucracy, be difficult and resource-intensive to apply across all taxonomic groups, and stifle scientific progress in the provision of data on species diversity and distribution.

The current lack of a universally accepted concept of what constitutes a species reflects biological and social reality. Complex processes underlie the genetic discontinuities that taxonomists recognize as species. The relative importance of factors driving diversification varies between clades, geographical regions and ecological backgrounds. And where standardized approaches are making huge progress in species discovery — as in high-throughput DNA barcoding of

insects (P. D. N. Hebert *et al.* *Phil. Trans. R. Soc. B* 371, 20150333; 2016) — it is not helpful to introduce another layer of intervention, given the global shortage of taxonomists.

Continued integration of conservation assessments with taxonomic accounts is a straightforward mechanism for peer review. In high-profile cases, taxonomists can work with conservation biologists, agencies and industry to resolve disputes (see, for example, R. M. Pringle *Nature* 546, 91–99; 2017).

Some 80% of species still await description. Let's not hamper these efforts by adding unnecessary administrative hurdles, lawyers' fees and protocols on the basis of the challenges facing conservation programmes for just a few lineages.

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Taxonomy: retain scientific autonomy

I see two important conceptual issues with the solutions proposed by Stephen Garnett and Les Christidis to minimize discrepancies between taxonomy and applied conservation efforts (*Nature* 546, 25–27; 2017).

First, taxonomy is an independent biological discipline, not a service provider for conservation biologists or policymakers. Second, as with any scientific discipline, hypotheses are its cornerstone. Forcing taxonomists to adhere to a particular species concept might be interpreted as a form of academic censorship.

Even though the species as a taxon is thought to represent a real entity in nature, a species description is no different conceptually from any other scientific hypothesis (H. Wägele *et al.* *Front. Zool.* 8, 25; 2011). Aside from unjustified and detrimental taxonomic vandalism (as discussed by H. Kaiser *et al.* *Herpetol. Rev.* 44, 8–23; 2013), every taxonomist should retain the right to formulate their own

hypotheses, provided that their rationale is clear and bolstered by unambiguous data.

It is then up to the taxonomic community to test and accept or refute these hypotheses. Instead of more governance concerning the 'why', I recommend putting more emphasis on the 'how' of presenting taxonomic hypotheses.

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Taxonomy: swallow the costly medicine

Stephen Garnett and Les Christidis propose that the International Union of Biological Sciences (IUBS) should establish a commission to co-ordinate the naming of species (*Nature* 546, 25–27; 2017). As a past president of the IUBS, I find this timely and appropriate. However, calls to restrict "freedom of taxonomic action" will not be enthusiastically adopted by all taxonomists, nor would a bottleneck resulting from a prolonged endorsement of new species be acceptable.

Establishing a body for defining new taxa is essential. Gentle persuasion and extensive funding will be needed if it is to be adopted by taxonomists and by groups such as the International Union for Conservation of Nature. Several bodies focus mainly on systems for naming, rather than on definitions of taxa; they include the International Commission on Zoological Nomenclature and the International Commission on Bionomenclature. An IUBS commission that complements such bodies would in my view make conservation of endangered species and ecosystems markedly more effective.

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Taxonomy: the IUBS responds

As president of the International Union of Biological Sciences (IUBS), I welcome the suggestion by Stephen Garnett

and Les Christidis that a single body should take overall responsibility for the taxonomy of all living organisms (*Nature* 546, 25–27; 2017). The primary aim would be to rationalize what constitutes a "distinct species". This will complement biological nomenclature systems that are already in place at the IUBS.

I am confident that the IUBS could help to develop a consensus on a method of taxonomy that uses the latest knowledge and modern technology for all living organisms — across every scale of size and complexity.

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An obituary for the impact factor

Eugene Garfield, who was key to the development of bibliometrics, died in February. Many obituaries testify to his achievements (see, for example, P. Wouters *Nature* 543, 492; 2017). But I find little of worth in one of the most celebrated outcomes of his scientific investigations — the impact factor. I suggest that the time has come to formally declare this metric's demise.

The impact factor is often used, improperly, to provide a mathematical measure of a scientist's productivity, on the basis of where they published their results. It has proved popular with bureaucrats, and even with many researchers, because it seems to offer an easy way to determine the value of a scientist's output for someone who is either unable or too lazy to read that scientist's papers and judge their true worth (see P. Stephan *et al.* *Nature* 544, 411–412; 2017).

It was and still is demonstrably ill-suited to this purpose — as many journals, including those of the American Society for Microbiology, are starting to admit (*Nature* <http://doi.org/b8wb>; 2016). It should never have been used and has done great damage to science. Let us bury it once and for all.

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