

sexual maturity<sup>2</sup>. This unusual pattern of near-indeterminate growth was probably present in *P. colossus*, too. The discovered specimen might have been sexually mature, but it was surely still growing as evidenced by the unfused end sections of the vertebrae (structures called epiphyses).

In the case of indeterminate growth, individuals that are heavier also tend to be older. For blue whales, fin whales (*Balaenoptera physalus*) and sperm whales (*Physeter macrocephalus*), published data<sup>3–5</sup> indicate that the proportion of body mass attributed to skeletal bone mass does not change greatly with age (Fig. 1). For these species, this suggests that buoyancy is controlled similarly across age groups. Blue and fin whales are fast and sustained swimmers that might migrate long distances, and their body composition and form are optimized for that lifestyle, which is strikingly different from the one proposed for *P. colossus*.

The life history of *P. colossus* might be more similar to that of two other whales (Fig. 1). Published data<sup>5</sup> shows that sei whales (*Balaenoptera borealis*) show a decrease in bone contribution to body mass with increasing size (and thus probably with age). Evidence available for the bowhead whale<sup>6–8</sup> is consistent with the trend found for sei whales.

Bowheads have a different buoyancy-control system from that of blue, fin and sperm whales. Bowheads have lots of blubber (fat underneath the skin that is used for energy storage, insulation and streamlining) and high bone mass in their first year of life when they are nursed. However, both decrease over the next few years as the whales lose body weight because of inefficient feeding, which is due to their small baleen rack (the organ in their mouth that strains water for food)<sup>6</sup>. However, buoyancy remains constant for bowheads during their lifespan because the amount of blubber and bone are reduced in tandem<sup>6</sup>.

A similar mechanism might also occur for right whales (of the genus *Eubalaena*) and sei whales. The large amount and high density of bone in *P. colossus* implies that the species must have had a lot of low-density tissues that combined to increase its total body weight.

*P. colossus* is a major discovery but the limitations of the fossil should be acknowledged. Many parts of the skeleton, such as the skull, for instance, remain undiscovered. We have few clues as to how old the individual was when it died and can only make inferences about its life history. Ribs of *P. colossus* show bands that indicate periodic, perhaps seasonal, growth and lack signs of remodelling, which is unusual for mammals.

If *P. colossus* had a life-history strategy similar to that of sei and bowhead whales, was this a young individual that carried copious and buoyant body fat, and its skeleton provided weight for ballast? Could this fossil be

a testament to the origin of blubber? That hypothesis is consistent with the fossil's age of around 39 million years old, from a time when Earth and the oceans were cooling and insulating blubber might have been an advantage. It is too early to tell, but such considerations demonstrate that the importance of this fossil goes beyond the documentation of a previously unknown life form.

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## Ecology

# Assessing the values of nature for policymaking

Giulia Sajeve

Understanding the diverse ways in which the natural world provides value aids informed policy decisions. The generation of a detailed catalogue of this diversity, and ways to assess values, paves the way to a more sustainable future. **See p.813**

What is the value of nature? Every aspect of human life and socioeconomic development benefits from nature and biodiversity, yet – or maybe precisely because of this – there is no definitive response to this question. On page 813, Pascual *et al.*<sup>1</sup> propose a common classification ‘language’ (typology) to deal with the variety of the values provided by nature, and the diversity of ways in which people’s lives, principles and behaviours are influenced by their perception of nature.

For some, the search for the value or values of nature might seem a trivial or an impossible enterprise. However, assessment of the different perceptions that people have of nature’s values is essential, given that policymakers must address the protection of ecosystems and the sustainable use of natural resources. To avoid what they call a values crisis, Pascual and colleagues provide policymakers with useful, clear and important information that might help to better integrate these diverse evaluations into decision-making procedures.

This study builds on the work of IPBES (the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services), an independent intergovernmental body founded in 2012 with the aim of reinforcing the dialogue between policymakers and science to promote the conservation and sustainable use of biodiversity, human well-being and sustainable development. Pascual *et al.* process

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the key results of IPBES’s 2022 report<sup>2</sup> (hereafter referred to as the Values Assessment). Thanks to the work of more than 100 specialist researchers and 200 contributing authors, and drawing on the analysis of more than 50,000 selected documents – including scientific publications, policy reports and information from Indigenous and local-knowledge sources on the perceived value of nature in different contexts and according to a variety of world views – the Values Assessment represents a key milestone in efforts to influence political and economic decisions that are being taken to address the current environmental crisis.

However, the need arose for this Values Assessment to be ‘translated’ in a more concise and systematized way, and Pascual and colleagues’ study addresses this need. To do so in the most effective way, the authors also rely on infographics that incorporate a great amount of information while remaining beautiful and straightforward.

Pascual *et al.* discuss the current gaps<sup>3</sup> in the processes and methodologies used for nature’s valuations. In particular, they propose that values be categorized into a typology with four layers (namely: world views; broad values; specific values; and value indicators).

This approach helps to identify which values are most often excluded from decision-making processes<sup>4</sup>. It also highlights the need to pay



HEMIS/ALAMY

**Figure 1 | The Chilika Lagoon, India.** The restoration of this lagoon took into account a wide variety of value types provided by the ecosystem. Pascual *et al.*<sup>1</sup> present a framework for how to assess the diverse values that an ecosystem provides, so that factors not as commonly considered during policymaking are also taken into account. Such factors might include the intrinsic value people get from their connection to the landscape and their work in the environment, or the value of interactions between humans and wildlife.

more attention to non-human-centric world views, non-monetary indicators<sup>5</sup> and existing power asymmetries<sup>6</sup>, to fully account for the needs, values and desires of all local people and stakeholders. Crucially, the authors stress the need to better assess Indigenous peoples' and local communities' world views and broad values, and to integrate them more fully into policies and projects to promote more-just and balanced decisions<sup>7</sup> that incorporate principles based on stewardship and oneness with nature<sup>8</sup>.

This work by Pascual *et al.* also proposes a classification of the methodologies that can be used to assess nature's values – how different disciplines extract the values that people ascribe to nature – into four families that are distinguished by the source of the value information (be it nature-based, statement-based, behaviour-based or based on integrated values). Thus the work provides a comprehensive picture of the different types of goal of such valuation studies, ranging from improving the state of nature and enhancing people's quality of life to generating outcomes that are more socially just.

It is interesting to see how the authors explain which are the main barriers to such

valuations being considered in policymaking, and provide input on how such obstacles might be overcome. The authors describe the four main leverage points for transformative change: recognizing the values of nature; embedding valuation into decision-making; reforming policies; and modifying underlying social norms and goals in ways that recognize the link between justice and sustainability. Furthermore, this research shows how real transformative change and win-win scenarios can be achieved only if market-based instrumental values cease to be at the centre of political and economic decisions<sup>9</sup>, and other types of attributes, such as relational values, intrinsic values and combinations thereof are properly incorporated (Fig. 1).

However, this still leaves the question posed at the start. Will the identification of nature's values typologies, or the reconstruction of the different methodologies to assess the value of nature, yield an answer as to the correct value of nature? Of course not, and the authors do not attempt to do this. Pascual *et al.* prefer to rely on existing studies on the perception of the value of nature to identify how such perceptions, rather than being translated into abstract ethical reconstructions, might

instead be transferred to policymakers more comprehensively and effectively to – as the authors put it – “underpin many pathways towards sustainability”, such as a green economy, nature protection, Earth stewardship and degrowth (avoiding overconsumption and excess production, and redistributing wealth).

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