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Connecting ecosystem services research and human rights to revamp the application of the precautionary principle

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With ecosystem services (ES) vital for human wellbeing[1], the protection of nature is a human rights matter. We outline how recent advances in international human rights law should inform a revamp of how precaution is applied within environmental decision-making. Critically, precautionary decision-making must evolve to make use of best-available evidence, including novel ES research approaches, to assess 'foreseeable' harms to all aspects of human wellbeing that are protected as human rights.

Recent developments in international law underscore the obligation for all decisions that have a potential positive or negative impact on nature to consider their potential to effect human rights that depend on healthy ecosystems. The international recognition of everyone's human right to a healthy environment means that public authorities must prevent "unjustified, foreseeable infringements of human rights arising from biodiversity loss"[2]. This builds on mandates to consider healthy ecosystems as preconditions for the protection of basic human rights to life, health, food and water, as well as culture, including for Indigenous peoples, other biodiversity-dependent communities, women and children[2–5].

The precautionary principle (PP) is an important aspect of environmental protection. International law requires that the PP is applied to any decision that has a bearing on environmental health and so includes decision-making relating to environmental impact assessment (EIA), the licensing of natural resource use, and that relating to climate change measures. The PP steers environmental decision-making to avoid biodiversity degradation in the absence of complete knowledge of potential threats. Yet current application of the PP, leans on interpretation from the 1992 Rio Declaration, emphasises cost-effectiveness[6] and rejects uncertainty beyond the most tangible and readily quantifiable human-nature connections. This focus misses the complex multi-scalar ecological relationships that give rise to ES fundamental to basic human rights to life, health, food, water, and culture[2–5] and has perpetuated broadscale biodiversity loss, which in turn sets these critical dependencies at risk[7,8].

The role of ES is therefore essential to update the interpretation of precaution where international environmental and human rights law intersect. This interpretation emphasizes that the lack of full scientific certainty does not justify postponing *effective and proportionate* measures to prevent negative impacts, particularly when there are threats of serious or irreversible harm to the environment and to human rights[4].

Ecosystem services research and decision-making

Limitations in knowledge and data prevent the quantification of the effects of specific measurable biodiversity losses on ES such as climate regulation. This situation is exemplified by the deep ocean, where we can broadly describe the ecological functions and processes that remove carbon from the atmosphere, for long-term or permanent storage at depth[9]. Yet we lack the granular detail of the relative contribution of individual biodiversity components to ES such as climate regulation. Similarly, the cultural and spiritual wellbeing of many if not all Indigenous peoples and local communities is dependent on the health of deep-sea biodiversity often via intangible pathways not amenable to measurement[10,11].

Deep-sea biodiversity contributes to globally diffuse ES that are experienced locally and give rise to 'place-based' traditions and cultures[11–13], such as the availability of species (e.g., sharks, marine mammals, tuna) important for cultural practices and knowledge[14]. These 'places' often refer to land-based locations, yet demonstrate the inextricable dependency of humans globally to the deep-sea and the ocean system. Further, Indigenous knowledge systems, cultures and spiritualities, and those of local communities often do not separate humans from nature, and deeply value the health and ongoing life of the full ecological system. These profound human-nature-spirit connections[15] are commonly missing or weakly included from the basis of evidence used to inform decisions[14,16,17]. This omission is attributed to the intangible 'place-based' qualities of these ES and a lack of detail to identify and quantify the components of biodiversity, at different scales, that control these relationships.

Despite consensus on cumulative risk of harm to ES and human wellbeing from both biodiversity loss and climate driven pressures[7,8], the absence of detailed information to describe and quantify specific impact pathways imparts uncertainty in the scale and nature of this risk. Current environmental governance is strongly influenced by demands for certainty in ecological prediction to minimise administrative risk for decision-makers. In response, the high degrees of uncertainty associated with ES research means that this knowledge is commonly excluded from the application of precaution. An inability to integrate uncertainty within decision-making means that diffuse, broadscale and sometimes 'slow onset' changes to ES for which impacts are experienced widely, yet unevenly and asynchronously across the planet pose a particular challenge for consideration in decision-making. As a result, the corresponding threats to human rights for broad spectrums of society are also excluded from consideration, even when international human rights law mandates the prevention of these impacts[4,5].

In rejecting uncertainty, ES research and more significantly, decision-making is biased toward a limited set of ES which are most readily described. This bias reduces the focus of decision-making to a scale at which quantification is possible and an exclusion of values that challenge quantification. This favours a reductive approach to environmental assessments of risk,

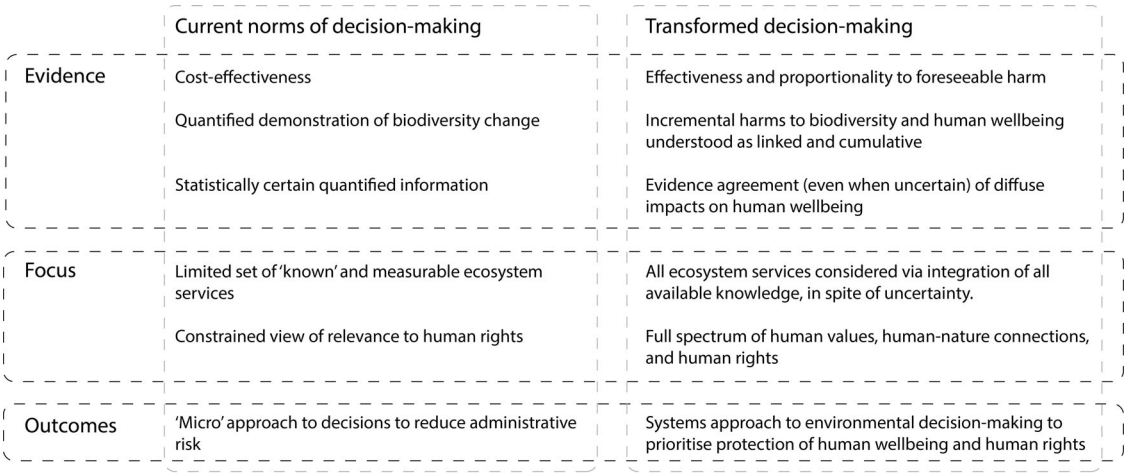

Fig. 1 | Terms of reference for precaution under current and transformed paradigms of decision-making.

focused on components of biodiversity that can be measured and 'traded' via compensation and offsets[18]. At this micro-level, while uncertainty exists, particularly in relation to predictions of ecological recovery, it is reduced to degrees tolerable to decision-makers involved in the implementation of policy. Assessment of risk (and acceptability) is based on a hierarchy of mitigation that, while constrained by 'palatable' operational interpretations of biodiversity, commonly does not reflect risk to the ecological system, ES, and therefore the human wellbeing of wide sections society. This, in turn, leads to a failure of decision-making to comprehensively consider and balance the diverse human rights that may be at stake, thereby neglecting the protection of the most vulnerable human rights holders who are usually most dependent on ES[4,5].

The bias described above is the norm in environmental decision-making despite the demonstrated capacity of novel ES approaches to synthesise all available evidence irrespective of 'type' (i.e., qualitative, quantitative) and associated uncertainty, for a comprehensive indication of risk of harm to ES. Such techniques can be used to compile the best available scientific evidence[19] and, when embedded into cumulative assessment undertaken at an appropriate scale to capture risk to ES, can evidence risk to human wellbeing. Techniques include asset and risk registers[20], logic-chain development[21], and bow-tie modelling[22] in addition to methods of evidence agreement[19], and can incorporate quantitative and qualitative information to demonstrate key points of risk to biodiversity and ES within the system. To date, there are numerous examples where ES have been described using incomplete scientific understanding of their ecological basis and appraised in terms of their sensitivity to support mandated conservation measures (e.g., MPAs[23,24]) for ecosystem recovery. These examples show how novel ES approaches can begin to reveal which and whose human rights may be at foreseeable risk of infringement and appropriate precautionary measures to prevent environmental harm. In doing so, such methods can identify points for ES protection and support managers to use this information in decision-making.

Revamping the application of the PP

Recent international legal developments offer an opportunity to refocus the application of the PP on how biodiversity loss impacts human wellbeing. These developments call on public authorities for the timely prevention of "foreseeable infringements of human rights" arising from biodiversity loss[2,25]. We argue that ES research, particularly recent advances in the development of risk-based approaches[11,21], can indicate foreseeable harm and through the synthesis of all available knowledge, move the focus of the PP to a systems view of biodiversity that protects the wellbeing of global societies.

A transformed application of the PP will change decision-making practices in three ways:[25] 1. Uncertain quantification of harm to ES and human rights does not justify disregard for ES evidence; 2. Foreseeability of any harm to human rights justifies preventative action to effectively conserve biodiversity (and ES); and, 3. Proponents of any activity or policy that poses a foreseeable risk to ES need to provide evidence of acceptable risk from both an environmental and human rights perspective, beyond reasons of cost-effectiveness[6] (Fig. 1). This transformation centres around legal arguments about how ES research can be used as an evidence base to understand that a much broader set of human rights may be threatened by foreseeable negative impacts on biodiversity than what is usually considered in decision-making. In building a picture of the system using all available knowledge, novel ES approaches can provide a complementary evidence base for the protection of human rights historically ill-considered in decision-making, such as those of Indigenous Peoples and local communities[26,27]. While ES research is currently constrained in its ability to pinpoint specific affected rights-holders and quantify the exact impacts of ES degradation, it can highlight longer-term vulnerabilities often overlooked in decision-making, thus offering evidence to protect vulnerable groups, including children[5] and future generations[28].

Crucially a transformed application of precaution will expand the understanding of risk within environmental decision-making beyond the constraints of quantified cost-benefit analysis. It will also clarify the responsibility of decision-makers to identify "effective and proportionate measures to prevent environmental harm" through a more comprehensive assessment of risk to human rights. This revamped application of the precautionary principle, by taking a systems view based on all available knowledge, supports authorities, as required by international human rights law[4,5], in balancing all human rights at stake, and can enable the most vulnerable to be prioritised in decision-making[4,5].

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Competing interests

The authors declare no competing interests.

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