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Review

A horizon scan of biological conservation issues for 2026

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We present outcomes from our 17th horizon scan of issues potentially impacting global biodiversity conservation in the next decade. Issues are novel, or represent a significant step-change in impact, and are currently not well-known or understood within the conservation community. Our panel of 26 scientists, practitioners, and policymakers scored an initial list of 96 issues, discussed the highest ranked 35 issues at a workshop, and identified the 15 top-ranked issues. This year, technology innovations, including low-power optic artificial intelligence (AI) chips and tiny machine learning (TinyML) models, could revolutionize biodiversity monitoring. We highlight impacts from changes in land-use driven by appetite-suppressing pharmaceuticals and the unknown effects of mirror biomolecules. Highlighting these issues may increase awareness of any impacts on global biodiversity conservation.

Highlights

Our 17th annual horizon scan identified 15 emerging issues of concern for global biodiversity conservation.

The issues cover technological advances such as tiny machine learning (TinyML) and low power optical artificial intelligence (AI) chips that could revolutionize conservation monitoring.

One issue highlights an unanticipated change in the salinity of the Southern Ocean.

A 10-year retrospective shows that one issue we presented in 2016 (the rise of artificial superintelligence) has undergone a rapid development.

The 15 issues presented here are essential reading for anyone interested in global biodiversity conservation and potential future trajectories.

Horizon scanning for conservation

Horizon scanning is a systematic approach for identifying emerging and novel trends in any discipline [1]. Since 2009, we have used this method to anticipate emerging issues likely to affect biological conservation [2]. Here, in our 17th annual assessment, we identify issues against a backdrop of accelerated global investment in the development and application of novel technologies; record global cuts in funding for science, including biodiversity research and conservation, and development assistance; and heightened geopolitical instability. On a positive note, the recent United Nations Biodiversity Beyond National Jurisdiction Agreement, implemented in September 2025, is designed to protect marine life and regulate the high seas and deep seabed, which are beyond any single nation's control. The issues highlighted here reflect both risks and opportunities that could impact global biodiversity conservation in the next 5–10 years.

Identification of issues

Consistent with previous scans, our primary method for identifying emerging and novel trends that affect conservation was a modified Delphi technique. We applied this method to score submitted issues transparently, repeatably, and inclusively (e.g. [2,3]) [4] (see Figure I in Box 1). Twenty-three participants convened in person for the 2026 scan, with three additional participants online.

The issues

Use of TinyML to bring machine learning (ML) into remote environments

Tiny machine learning (TinyML) deploys AI models on ultra-low power, low-cost microcontrollers that can operate without an internet connection. TinyML systems can execute specialized tasks,

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Box 1. Horizon scanning methods

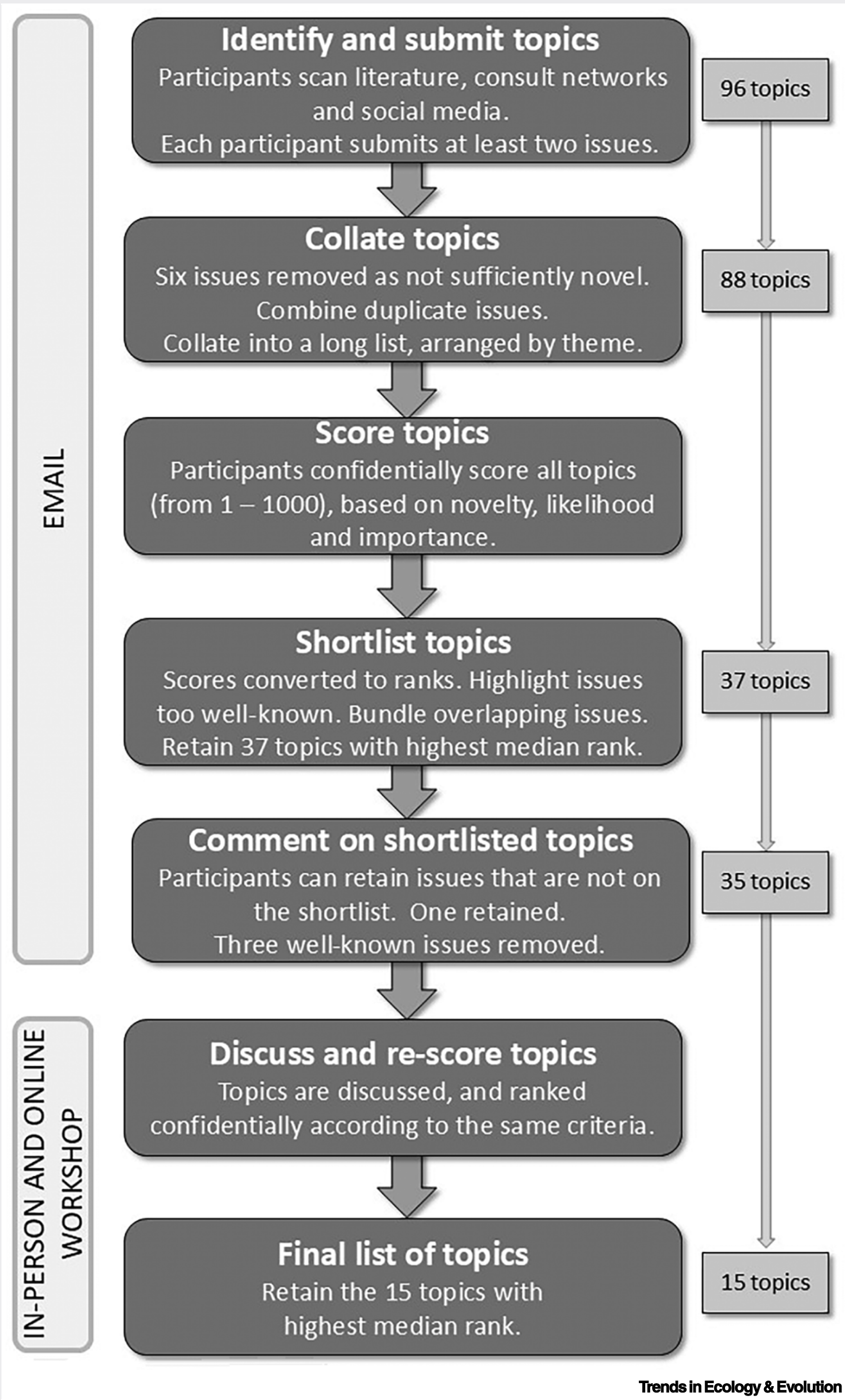

Figure I. Process for identifying and scoring issues submitted to the 2026 Horizon Scan.

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Figure I provides an overview of the process for identifying and scoring issues. This year, 26 scientists, practitioners, and policy makers participated in the horizon scan. Each participant submitted two to five issues, ideally novel and largely unknown, that might impact biological conservation in the next 5–10 years. Issues were gathered from participants' own research or by canvassing their networks through email, social media, and discussions. We consulted an estimated 700 people (with >10% from countries outside Europe, the USA and Canada, Australia, New Zealand, and Japan). We counted all direct interactions as distinct contacts, whereas we considered a single email or social media post that reached a larger target audience as a single contact unless more than one person responded.

Ninety-six issues were submitted to the process. Issues were initially assessed according to our criteria for inclusion (novelty and potential future impact). Six issues that focused on current geopolitical funding realignment were deemed to be outside the scope of this scan. In addition, two similar issues were each submitted by two individuals and were merged, yielding a total of 88 issues that we scored during the first round. To counteract scoring fatigue [53], participants were randomly selected to receive one of three differently ordered lists. Each participant scored each issue individually and confidentially from 1 to 1000 (low to high) on the basis of its novelty and potential impact on global biodiversity conservation in the next 5–10 years. Notes were added by participants and used to inform subsequent discussions. Scores were converted to ranks (1–88). We realized that another two issues, submitted by different people, were sufficiently similar to be combined before the second round. This year, one issue raised ethical concerns and another was covered in a previous scan. Both issues were replaced with the next highest ranked two topics. In addition, we found that three issues were too well known (>55% of participants had heard of each issue). However, we enabled participants to propose retention of the well-known issues or an issue ranked below 37 if they considered it sufficiently significant. One issue was retained, resulting in a set of 35 issues for discussion in round 2.

Participants were assigned four or five issues, none of which they submitted, to evaluate in more detail ahead of the workshop. Participants also brought notes on issues they submitted to the discussion. The workshop took place in September 2025, with 23 participants meeting in person and three joining online. All participants joined the online meeting to have the option of adding notes in the chat function as the workshop progressed. Participants discussed and debated each issue against the same novelty and impact criteria applied in round 1 and scored the issue from 1 to 1000 (low to high) at the end of its discussion. Scores were converted to ranks at the end of the workshop and the 15 issues with the highest median ranks were revealed.

such as image recognition or species-specific acoustic detection, on the microcontroller, rather than transmitting large data volumes for analysis elsewhere, with minimal data input. Paired with low-cost devices, which can function on batteries or solar power for extended periods, TinyML can run many tasks with minimal dependence on internet or energy infrastructure [5]. Current environmental applications include monitoring soil quality; detection of vector-borne diseases, such as mosquitoes that carry malaria; surveillance of poaching; and spatially precise visual detection of agricultural diseases to reduce pesticide use (e.g., [5–7]). Integrating AI models with sensors, drones, and other tracking devices may drive advances in agricultural efficiency and sustainability and transform ecological and environmental monitoring. However, in certain use cases, the computational and energy gains may be outweighed by insufficient storage of unprocessed sensor data. This limitation can restrict the ability to archive data, which in turn could hinder future analyses, impede the assessment of uncertainties, reduce opportunities for output validation, and constrain the potential for open and reproducible science.

Ultra-fast, low-power optical AI chips

AI currently demands large amounts of energy and water, and its growth is limited by power infrastructure. This has spurred the development of technologies that reduce energy use without compromising performance. Mainstream adoption of new photonic technologies (that use light instead of electricity) could achieve this goal. One recent advance is an optical chip that exploits both the phase and intensity of light to transfer data an order of magnitude faster than earlier designs without increasing energy use [8]. If commercialized, these chips would reduce energy and water use and the footprint of data-centers. Concurrently, new optical neural networks are processing wireless signals close to the speed of light, completing tasks in less than a microsecond with high accuracy and outpacing the best digital alternatives by two orders of magnitude [9]. Optical chips required for 6G connectivity are expected to reach the market in the next few years. Such advances could enhance ecological monitoring by enabling real-time observation of environmental changes and wildlife movements in remote areas with minimal energy use. Although optical chips may reduce the environmental impact of individual calculations, the wider adoption of AI could still raise overall environmental impacts such as chemical waste, greenhouse gas emissions, water use, and resource-extraction.

Digital twins transform modeling but bring complex trade-offs

Digital twins are computer simulations of real-world systems, objects, people, or processes that may aid decision-making and prediction of human behavior. Recent decreases in computation costs, ubiquitous low-cost sensors, extensive data, and developments in foundational AI models represent a step change in capability, enabling near real-time monitoring and optimization of emissions and resources at various scales. For example, NVIDIA's Earth-2 platform, which uses cBottle (climate in a bottle), is the world's first generative AI foundation model designed to simulate global climate at 1 km resolution. cBottle can be integrated with geographic information systems and adapted engines for smart-city control loops [10,11]. However, despite digital twins' promise for much improved synthesis of data and prediction to inform decision-making, their power consumption, cooling requirements, and land-use impacts are still likely to be substantial. Overreliance on digital twins might also lead to neglect of field observations and mechanistic understanding of environmental processes, and delays in decision-making if the system malfunctions. Simulated virtual economies may interact with real-world markets, affecting resource use in unpredictable ways [12]. Aside from the direct environmental impacts of the rapid expansion of this technology, the economic and environmental decisions that could result from such computationally complex algorithms may be unpredictable.

Emerging threats from fiber optic drone cables

The war in Ukraine has driven rapid development of drone technology, including deployment of fiber optic cables designed to avoid deliberate interference with a drone's electronic over-the-air signal. Ukraine and Russia now produce hundreds of thousands of fiber optic drones annually [13,14], and their use has spread to conflicts in Mali and Myanmar [15]. Fiber optic drones also serve non-military purposes such as infrastructure inspection and live broadcasting, with further applications likely. Each drone typically trails 5–20 km (sometimes more than 40 km) of high-tensile plastic cable that is typically abandoned after a mission or if the drone is destroyed. Layers of cable then accumulate on the ground or in vegetation [13]. Along the Ukrainian frontline, abandoned cable may total 2900 km per km of frontline [14], sufficient to kill birds, wild mammals, and livestock and impede wildlife movement [13]. Cables may persist for centuries and their degradation is likely to release microplastics and chemicals such as per- and polyfluoroalkyl substances (PFAS) [13]. Mitigation could include biodegradable alternatives for military and civilian applications, alongside post-conflict cleanup efforts to limit long-term environmental damage.

Tropical Forests Forever Facility as South-led conservation finance

The proposed, Brazil-led Tropical Forests Forever Facility (TFFF) is planned for launch at COP30. TFFF would establish a US$125 billion investment fund with returns financing annual, performance-based payments to tropical countries that maintain low deforestation (~ US\$4 ha^{-1}, inflation-adjusted, with steep penalties for forest loss and fire degradation) [16]. The initiative is framed as a fairer financial architecture, expanding Global South agency compared with externally imposed standards [17]. Predictable sovereign finance and a mandated minimum 20% allocation to Indigenous Peoples and local communities are intended to strengthen long-term stewardship and reduce deforestation pressures. Transparency requirements and grievance mechanisms aim to limit the diversion of resources or decision-making by powerful actors – and better align funds with conservation outcomes (TFFF 2025). Integrating forest conservation into investment frameworks mirrors broader financializaton trends in international forest governance, raising questions about who sets rules, bears market and reputational risks, and ensures accountability [18]. Because some definitions treat plantations as forests, investments may not always secure natural forest conservation. The net impact of the TFFF will depend on credible monitoring, equitable risk-sharing, verification of ecological performance, and ensuring that funding does not displace other efforts. Its success or failure could strongly influence conservation of tropical forest ecosystems in the coming decade.

Land use implications of appetite-suppressing pharmaceuticals

It is anticipated that without significant intervention, 1 billion people (12–14% of the predicted 8.3 billion global population) will be classed as obese by 2030[i]. This number could increase, with the UN predicting that the global population will peak at 10.3 billion in the mid-2080s[ii]. Increasing adoption of GLP-1 receptor agonist drugs to facilitate weight loss could affect land use through their influence on human caloric intake and dietary preferences. Sustained reductions in body mass among users of these weight-loss pharmaceuticals show it is a plausible pathway for lowering caloric demand [19], with studies documenting reduced consumption of processed foods, sugary beverages, refined grains, and beef [20]. Because beef and highly processed foods are land- and resource-intensive [21], sustained reduction of demand could slow pasture expansion and reduce cropland area. Although direct land use changes have not yet been documented, widespread and durable dietary shifts could reduce land conversion, irrigation, and agrochemical inputs, and create opportunities for restoration, rewilding, or carbon sequestration. Because the food trade is global, benefits are most likely to accrue at the production margin, where changes in demand influence whether new land is brought into agricultural use. The magnitude of these effects will depend on continued global expansion of weight-loss drugs, the long-term maintenance of associated dietary shifts and sustained weight loss, and global market responses to altered food demand.

Applying chemicals to influence the flowering time of plants

Exposure to a chilling period, or vernalization, is necessary for flowering and other aspects of many plants' reproductive development. Climate change is increasing winter temperatures and their variability. Severe weather, including early heat waves or late frosts that lead to changes in the timing of flowering periods relative to historic records, may reduce the activity periods of pollinators and their abundances. Moreover, severe weather could reduce seed yield. Understanding of the signals and signaling pathways involved in flowering in a few model and crop species [22] suggests that natural phenomena can also delay, pause, or reverse flowering, a process known as devernalization [23]. Screening of 16 000 compounds identified several devernalizers, substances that can delay flowering with almost no apparent toxicity to plants and greater specificity than existing approaches, such as heat treatment, in *Arabidopsis* [24]. Further understanding of devernalization mechanisms is necessary to optimize applications, which include altering the flowering time of rare species to coincide with activity of specialized pollinators; maintaining yields of winter crops, fruit trees, and leafy vegetables; or managing undesirable species without herbicides.

Global drying of soils driven by climate change

Soil moisture plays a critical role in water, energy, and biochemical cycles; climate regulation; and vegetation dynamics. New analyses and models highlighted a previously undetected decline in global soil moisture content of 1614 Gt from 2000 to 2002 and a further decline of 1009 Gt to 2016 (by comparison, Greenland lost 900 Gt of ice during 2002–2006). These changes are estimated to have generated a 10.78 mm rise in global mean sea level [25]. Decreases in soil moisture appear to be driven by declines in precipitation and a drier atmosphere and are likely to continue in a warming climate [25]. Reduced soil moisture will have major effects on natural terrestrial and freshwater systems. The reductions may also interact with anthropogenic expansion of vegetation cover to promote climate cooling, which may in turn both exacerbate the drying of soil through increased evapotranspiration and be limited by declining soil moisture [26,27]. Cascading impacts of changes in water availability for agriculture may exacerbate land-use change. Rates of water loss from soils have been greatest in central North America, central Asia, central Africa, and south of the Amazon basin [25].

Rapid acceleration of commercial soil inoculation with arbuscular mycorrhizal fungi (AMF)

The potential of soil inoculants derived from AMF to support agricultural sustainability by increasing crop plant fitness and soil health has been recognized for decades. The global market for soil inoculants is approaching US$1bn annually, driven in part by the desire to manage pests and diseases without the environmental impacts of synthetic fertilizers and pesticides [28]. However, a meta-analysis of laboratory and commercial inoculant trials [28] found that only 12% of commercial product trials indicated sufficient AMF hyphal colonization of the host plant to benefit crop growth. Benefits from commercial inoculants often result from associated additions of nutrients or other compounds rather than from mycorrhizal fungal associations. An independent meta-analysis of inoculant effects on soil communities found that AMF inoculants did not have the impacts on soil fungal biomass expected if inoculants were enhancing plant growth [29]. These results suggest that over 80% of the global annual spending on AMF inoculants is not meeting its objectives. The consequences of continued use of AMF inoculants on soil and plant diversity and ecosystem function are poorly understood [30].

Microbial conversion of plastic waste into food

Widespread plastic use has polluted terrestrial and aquatic environments extensively. Such pollution is expected to keep rising even with swift mitigation efforts [31]. In line with the waste hierarchy, preventing unnecessary plastic use – by avoiding, reducing, reusing, and recycling – can significantly reduce leakage into the environment. However, safe disposal and recycling remain limited in many regions due to insufficient infrastructure and collection incentives. A novel alternative is the conversion of plastic waste into edible microbial single-cell protein. For example, polyethylene terephthalate, a plastic widely used in water bottles and food packaging, can be chemically depolymerized and fed to specialized bacteria [32]. These bacteria are then harvested into a neutral-tasting, protein-rich powder suitable for human or animal consumption [33]. Further advances in microbial conversion could simultaneously reduce pollution, decrease pressure to convert natural areas into farmland, and improve food security.

Global seaweed declines

Marine macroalgae, or seaweeds, are polyphyletic and highly diverse. They include functionally dominant species in ecosystems such as kelp and fucoid forests, pelagic *Sargassum* rafts, rhodolith beds, and *Halimeda* bioherms. Collectively, macroalgae cover more area than that of all other coastal wetlands and coral reefs combined [34]. However, they have received little conservation attention despite the threats that ocean warming and unsustainable local levels of herbivory pose to seaweeds [35]. Recent exponential growth in seaweed aquaculture is also causing accidental introduction of novel pathogens and epiphytes. A knowledge base and biosecurity framework are lacking, hindering effective management and conservation efforts [36]. Ongoing climate change by the end of the century is projected to result in overall macroalgae range contraction with losses of >10% macrophyte species at 17–22% of localities [35]. Highly suitable areas for coastal seagrass and brown macroalgal beds are projected to decline by 78–96%, whilst expansions are anticipated in polar regions [35]. If realized, these growing threats to this understudied group of ecosystem engineers are likely to have far-reaching implications for marine biodiversity.

Changes in light penetration in the world's oceans

Enough sunlight penetrates the upper 200 m of the ocean to support photosynthesis. Minimal light penetrates to 200–1000 m depth and almost none below 1000 m. Estimates of light (490 nm) attenuation derived from the Moderate Resolution Imaging Spectroradiometer (MODIS) suggested that from 2003 to 2022 the depth of surface light penetration decreased across 21% of the world's oceans, and in some regions by ≥50 m [37]. However, changes in light penetration are spatially and temporally variable [37]. Such darkening has previously been recognized as a global concern for coastal seas [38], but this new evidence suggests that the phenomenon is also widespread across the open ocean. Changes in ocean circulation, sea surface temperature, sea ice cover [39], and increases in nutrient runoff and suspended particulates are possible causes of changes in light penetration. The extent to which oceanic primary productivity has changed, and may change further, is unclear, partly because phytoplankton also are responding to changes in ocean chemistry. Any major change in primary productivity will cascade throughout food webs, affecting both natural systems and human social and economic systems.

Unanticipated change in the state of the Southern Ocean

The surface salinity of the polar Southern Ocean has been declining since the 1980s [40] and models projected this trend would continue as the Antarctic ice sheet melted and fresh polar waters moved towards the equator. However, satellite observations show that since 2015, this trend has reversed [40]. Surface waters have become saltier, the stratification of fresh surface water above deeper saline layers has weakened, and open-ocean polynyas (areas of open water surrounded by sea ice) have re-emerged. These changes may already be contributing to the irreversible retreat of Antarctic sea-ice [41]. Rising surface salinity will also influence global ocean circulation and, by extension, the climate system, creating new challenges for understanding, modeling, and projecting environmental change. This growing uncertainty will make it harder for nations, particularly Small Island Developing States, often self-described as Large Ocean States, to plan for resilience, increasing adaptation costs, and compounding issues of climate justice. These shifts could also disrupt marine ecosystems and species distributions in the Southern Ocean and beyond.

Microbial collapse driven by deep sea mining

Threats to biodiversity from deep-sea mining for polymetallic nodules and rare earth metals have been recognized for many years. Although commercial mining is not yet underway, the International Seabed Authority has issued 31 exploration contracts covering 1.5 million km^2, and future commercial ventures are likely. Deep-sea floor polymetallic nodules attract greatest interest, but ocean ridge polymetallic sulfides and cobalt-rich crusts, some of which take millions of years to develop, are also being explored. Distinct microbial communities have evolved around these deposits and are crucial components of global biogeochemical cycles. These communities may be strongly impacted by mining, which can destroy microbial habitats, release heavy metals, and bury communities under extensive sediment plumes. Although data are limited and research results vary, changes in microbial communities, especially changes in their functional diversity, may persist for decades following disturbance [42]. Deep-sea extraction over large areas may also impact the water column, with sediment plumes disrupting marine life [43] (but see [44]). Deep-sea microbial communities are a poorly understood component of the biosphere. Currently, there is no mechanism for monitoring the extent of impacts from deep-sea mining on global biodiversity and biogeochemical cycles.

Balancing the potential of mirror biomolecules with the risks of mirror life

Biologists have generated chirally inverted versions of biomolecules such as RNA and proteins that do not exist in nature [45]. Potential applications of these 'mirror' subcellular components include long-lasting biomaterials and therapeutics that may resist enzymatic degradation and reduce immune recognition [46]. Mirror proteins and lipids exist in nature, but human-created forms may allow construction of mirror cells (those with all biomolecules chirally reversed). Mirror cells may illuminate the evolutionary origin of self-replicating biological systems and enable scalable production of useful mirror biomolecules. Yet the properties that make mirror cells promising also present biosecurity hazards. Although their potential pathogenicity is unknown, mirror cells could evade host immunity and existing antimicrobials [47], posing poorly bounded, high-consequence societal and ecological risks if they were to enter natural ecosystems or living hosts. The feasibility of generating mirror cells is uncertain given that chirally inverted versions of cellular functional components, such as those underpinning transcription, translation, and cell replication, have yet to be created. There have been urgent calls to consider and prevent the unprecedented potential risks of mirror life, but others argue against limiting research given the potential benefits [47].

Concluding remarks

The issues we present are evolving in the context of tumultuous geopolitical activity in countries on nearly every continent [48]. In this context, the combination of two of our horizon technological issues (the use of TinyML to bring ML into the field and ultra-fast low-power optical AI chips) may offer innovative solutions for cost-effective ecological monitoring over large areas. However, it remains uncertain whether these technologies will reach the regions that are both global biodiversity hotspots and at greatest risk of environmental degradation and funding cuts. As we noted, such real-world data may inform digital twin modeling. We also identified three critical aspects of global change that require extensive data collection over large areas: climate change driving global drying of soils, global seaweed ecosystem declines, and changes in light penetration in the world's oceans. Monitoring these changes, particularly with high resolution geospatial data, may be more challenging as global data infrastructure transforms and if the funding landscape changes further. Such data will be essential if initiatives such as the TFFF are to be effectively implemented to maintain and protect natural forests.

Given the current global political climate, it may seem surprising that none of our issues cover the impact of recent changes to funding priorities. These issues are happening now, rather than possibly emerging in the next 5–10 years, and are already widely discussed and well-known. Therefore, they do not meet the criteria for a horizon issue.

The effects of cuts in funding for global development aid programs could lead to gaps in developing economies that may be filled by diverting environmental budgets [49]. The loss of funds for on-the-ground data collection could increase reliance on monitoring via global high resolution satellite products, such as those from Planet, the US National Aeronautics and Space Administration, and the US National Oceanic and Atmospheric Administration. Yet several programs that sustain these products have also been terminated[iii] [50,51], and remote sensing is ineffective for detecting some threats to, and some aspects of, biodiversity. Elimination of diversity incentives in some geographies may also reduce inclusion of indigenous communities that often contribute to the effectiveness of conservation programs [52]. How these unpredictabilities and uncertainties will interact with the establishment of the TFFF and the ability for international oversight of deep-sea mining (two of our horizon scan issues) is unclear.

Horizon scanning aims to identify emerging issues, but can only ever be an exercise looking at what could plausibly happen in the future and discussing the likelihood and level of impact. Although it is not possible to determine whether an issue's identification in a horizon scan affected the development and impact of the issue, we look back at issues presented a decade ago and examine how some of them evolved (Box 2).

Box 2. Ten-year retrospective

Each year, we reflect on topics discussed at the horizon scan 10 years ago and examine whether and how those issues have materialized. Here, therefore, we discuss six issues identified in 2016.

Artificial superintelligence

We highlighted the potential applications of artificial superintelligence and questioned how environmental considerations were being addressed [54]. A decade later, global society is realizing the positive and negative potential impacts of artificial intelligence (AI). As AI is applied to an increasing number of conservation-related tasks previously carried out by humans, such as species identification, image and acoustic data processing, data analysis, and mapping, there is a risk that conservation funds disproportionately will be given to larger organizations that have the capacity to carry out research remotely [55]. The inequitable distribution of funds could lead to losses of local knowledge, diversity, and essential conservation field skills [55]. With technology advancing at an extraordinary rate, it is not surprising that three of this year's horizon scan issues build on AI technology: *Use of TinyML (tiny machine learning) to bring machine learning into remote environments; Ultra fast, low power optical AI chips; and Digital twins transform modelling but bring complex trade-offs.*

Ecological civilization policies in China

We suggested that ecological civilization policies incorporated by the Chinese government could have positive effects on environmental protection and conservation in China [54]. Ecological civilization in China has evolved considerably over the last decade and aims to balance economic growth with sustainability across several areas including environment and health; carbon emissions; and, in 2017, with the country-wide implementation of 'Ecological Conservation Redlines' (ECRs) [56]. These ECRs aim to protect key areas for species and areas that provide ecosystem services [57]. By 2018, ECRs had been delineated in 15 provinces (covering 0.61 million km^2 [57]) with plans to expand ECRs to at least 3.15 million km^2 [58]. Management is overseen by an Ecological Conservation Redline Institute that falls under the Ministry of Ecology and Environment.

Unregulated fisheries in the central Arctic Ocean threaten expanding fish stocks

Declining sea ice as a result of climate change was highlighted as a potential cause of unregulated fishing in the Arctic. An international agreement implemented in 2021 prevented unregulated fishing in the Arctic Ocean for at least the next 16 years. The signatories are Canada, Iceland, Denmark, Norway, USA, the Russian Federation, China, Japan, South Korea, and the European Union[iv]. This agreement, along with the newly ratified Biodiversity Beyond National Jurisdiction agreement, should ensure that the ban on unregulated fisheries in the Arctic Ocean continues.

Passive acoustic monitoring to prevent illegal activity

In 2016, we reported on the development of passive acoustic monitoring to detect illegal activities. We suggested that technological advances in low-cost digital recording devices, and the ability to download data from remote locations, could enable the detection of illegal activities such as logging and hunting, which are already being applied in some instances to detect poachers and manage protected areas and species [59]. Passive acoustic monitoring has developed quite rapidly, and this year we highlighted the potential impact of ultra-fast, low-power, optical AI chips. Ten years ago, we concentrated on the predicted challenges of interpreting and analyzing such large volumes of data. With the development of AI, these challenges are reduced and may be further minimized through TinyML systems, although resources for manufacturing the chips are still limited.

Increasing aquatic concentrations of testosterone

In 2016, it was unclear whether the human use of testosterone supplementation would persist [54] and what impact this would have. There has been a steady rise in the use of exogenous testosterone in the 21st century by both men and women. Sources of testosterone (and other sex hormones) in the aquatic environment are veterinary medicine, growth treatment in agriculture and aquaculture, and pharmaceuticals [60]. It is becoming clear that even low concentrations of these chemicals can have an impact on aquatic life [61].

Satellite access to shipborne automatic identification systems (AIS)

Satellite-based acquisition of AIS data has expanded over the past decade and remains a valuable tool. Yet in many regions, industrial fishing is not sufficiently recorded to accurately reflect fishing effort. AI-driven analysis of AIS data, along with newer data that include synthetic aperture radar and optical imagery, have contributed to a rapid advance in the ability to use near real-time remote sensing to observe the ocean. These tools make it possible to independently track fishing activity (movements of vessels as short as 15 m) and stationary activities such as extraction of some resources, providing a highly detailed picture of ocean use [62]. These innovations may also be pivotal to the BBNJ Convention, by allowing the detection of ships undertaking illegal activities in areas of the high seas.

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Declaration of interests

The authors declare no competing interests.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation for the workshop, it became apparent that two issues were prepared using generative AI. These issues were identified and reviewed, and were subject to a higher level of scrutiny during the workshop. Neither issue was ranked in the top 15 and therefore are not discussed in the article. The authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Resources

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