# Horizon scan of global conservation issues for 2011

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**This review describes outcomes of a 2010 horizon-scanning exercise building upon the first exercise conducted in 2009. The aim of both horizon scans was to identify emerging issues that could have substantial impacts on the conservation of biological diversity, and to do so sufficiently early to encourage policy-relevant, practical research on those issues. Our group included professional horizon scanners and researchers affiliated with universities and non- and inter-governmental organizations, including specialists on topics such as invasive species, wildlife diseases and coral reefs. We identified 15 nascent issues, including new greenhouse gases, genetic techniques to eradicate mosquitoes, milk consumption in Asia and societal pessimism.**

## Why is horizon scanning needed?

Horizon scanning is the systematic search for incipient trends, opportunities and constraints that might affect the probability of achieving management goals and objectives. Explicit objectives of horizon scanning are to anticipate issues, accumulate data and knowledge about them, and thus inform crucial decisions.

The importance of foresight has long been recognized. During the 6th century BC, the Chinese general and author of *The Art of War*, Sun-tzu recognized both the necessity of anticipating future events on the basis of diverse sources, as well as the cost effectiveness of these insights, writing 'The means by which enlightened rulers and sagacious generals moved and conquered others, that their achievements surpassed the masses, was advance knowledge,' and 'no rewards are more generous' [1]. Similar principles apply when the aims of foresight are to address environmental quality and human health rather than to conquer neighbouring armies. For example, with respect to human health, horizon scanning has been used to identify both new [2,3] and potentially obsolete technologies [4]. The method is regularly used in business to identify new market opportunities [5]. It also continues

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to be used in the military to identify potential conflict zones, as well as relevant science and technology that will provide military advantage [6].

Horizon scanning has not been widely applied by the conservation community [7,8]. Occasionally, it has been used to identify policy options related to the conservation of biological diversity [9], to describe possible future scenarios of environmental and social change, and to consider how those changes might affect conservation objectives and one's ability to achieve them [10]. Nevertheless, the use of horizon scanning has been recommended by science advisors and policy makers as a mechanism by which future research and policy needs can be anticipated [11] (http://www.bis.gov.uk/assets/bispartners/goscience/docs/g/10-669-gcsa-guidelines-scientific-engineering-advice-policy-making.pdf), [12] (http://www.dni.gov/nic/PDF_2025/2025_Global_Trends_Final_Report.pdf).

## How were the issues identified?

Our aim was to identify technological advances, environmental changes, novel ecological interactions and changes in society that could have substantial impacts on the conservation of biological diversity (henceforth biodiversity; defined here as the full range of life on Earth and the ecological and evolutionary processes that support it), whether beneficial or detrimental. In 2009, a group of professional horizon scanners and conservation scientists, including several authors of the present paper, developed a list of 15 issues that met these criteria [13]. The exercise was repeated in 2010. The group did not make predictions of the specific impacts of the issue on biodiversity. We believe that each issue is sufficiently important to warrant new research, policy consideration and sometimes preemptive, cost-effective action that might decrease the probability of undesirable consequences and increase the probability of desired outcomes.

The list of issues developed in 2009 was well received. Of the 15 issues identified in 2009, there have been significant developments in at least three. The ability to synthesize artificial life has improved with the synthesis of a bacterial genome containing ~1.1 million base pairs [14]; the invasive lionfish (mainly *Pterois volitans*) reached the Lesser Antilles in July 2010 and so has now colonized all subregions of the Caribbean Sea; and high-latitude volcanism became global news with the eruption of Eyjafjallajökull in Iceland during March and April 2010, although the eruption might not have been severe or long lasting enough to have had serious or detectable ecological effects. (The latter issue, of course, is likely to be coincidental rather than an indication of remarkable prescience by the authors.)

We considered whether the previous horizon scan overlooked issues that, in hindsight, should have been included. For example, the list did not highlight oil spills in deep ocean waters, as exemplified by the Deepwater Horizon oil-rig explosion in April 2010. However, oil spills, such as the Ixtoc 1 oil spill at 50 m in 1979, have been occurring sporadically for several decades. Accordingly, oil spills would not have met the general criteria for horizon-scanning issues.

The authors of this current assessment include professional horizon scanners and specialists in subdisciplines of conservation science. The specialists are affiliated with universities and other organizations that have broad missions, including conservation. Each author, independently or in consultation with colleagues, identified and summarized one to four emergent issues that they felt were relevant worldwide or that might affect species, ecosystems, or regions of global interest. We estimate that at least 158 people were involved in the consultation. The resulting set of 71 issues was circulated to all contributors, who independently scored each issue on a scale from 1 (for well known or poorly known but relatively unimportant issues) to 10 (for poorly known but potentially important issues). Contributors were also asked to indicate, with a yes or no, whether they were aware of each of the 71 issues. The 35 issues that received the highest mean scores were retained. Participants were invited to reinstate issues if they thought those issues merited further discussion; two issues were reinstated. The 37 retained issues were assessed at a workshop in Cambridge, UK, in September 2010. For each issue, two participants were selected by WJS in advance to provide an independent, critical assessment. After discussion, each participant again ranked the relative importance of each issue, this time on a scale from 0 to 100. Scores were converted to ranks and the 15 issues with the highest mean rank are presented below. The methods used are described in more detail in Reference [15].

The issues we discuss here are not presented in priority order. We do not describe in detail the relevance of each issue to environmental management and quality, or conservation of biodiversity, but emphasize that, in several cases, it might be desirable to evaluate more fully the probability of undesirable or beneficial outcomes.

## The issues

### *Environmental consequences of increasing milk consumption in Asia*

In many Asian countries, the demand for dairy products has grown substantially in response to marketing by food companies and wider cultural change [16,17]. Newborn humans are able to metabolize lactose, but the production of lactase, the enzyme that digests lactose, falls dramatically post-weaning, especially in populations that do not traditionally consume dairy products; lactose intolerance is widespread in these populations. Humans can develop tolerance to milk proteins, however, by habitually drinking milk or consuming dairy products during childhood. Consumption of dairy products among the 1.3 billion residents of China might increase rapidly if lactose intolerance does not remain a culturally maintained norm. The consequences of changes in land use to accommodate more dairy cattle and support infrastructure for an expanded industry could be many fold, including: greater emissions of methane and nitrous oxide (both greenhouse gases associated with cattle [18,19]); further clearance of tropical forests to grow food for cattle; loss or changes in composition and structure of natural vegetation; and intensification of inputs and reduced water quality [18].

### *New greenhouse gases*

Long-term monitoring at Cape Grim Research Station (Tasmania, Australia) has documented a rapid increase in concentrations of two relatively unfamiliar greenhouse gases since 1978. Although their impact on incoming energy, expressed as the radiative forcing effect (the consequences on the irradiance entering the troposphere), is presently far less than the combined effects of the gases regulated by the Kyoto Protocol, they could have the potential to increase global temperatures. Nitrogen trifluoride ($NF_3$) has an estimated global warming potential 17 000 times that of carbon dioxide over 100 years, and remains in the atmosphere for ~550 years [20]. Its concentration increased at a rate of 11% per year to 0.454 parts per trillion in 2008. Sulfuryl fluoride ($SO_2F_2$), has a warming potential 4780 times greater than carbon dioxide as a greenhouse gas over 100 years, and remains in the atmosphere for ~36–40 years [21]. Its concentration increased at a rate of 5% per year to 1.53 parts per trillion in 2008. Both $NF_3$ and $SO_2F_2$ are substitutes for other gases regulated under the Kyoto or Montreal Protocols. $NF_3$ is a substitute in the electronics industry for perfluorcarbons (PFCs) and is a by-product of manufacturing plasma-screen televisions and other goods, whereas $SO_2F_2$ is a crop fumigant that has replaced methyl bromide to preserve fresh produce.

### Increases in productivity of polar oceans driven by loss of sea ice

Dramatic changes in ice cover are occurring, including the collapse of the Larsen B ice shelf in Antarctica, and rapid decreases in the extent of both multi-year and summer sea ice in the Arctic. Sea ice reflects solar radiation, whereas ocean water absorbs large quantities of heat. Reducing ice cover alters physical and biological conditions in marine systems and generally increases primary production, at least initially. There is uncertainty about the net effect of losing ice cover over large areas of ocean [22]. Exposure of 24 000 $km^2$ of open water around the Antarctic Peninsula from the loss of ice shelves and coastal glaciers has caused a large increase in pelagic and benthic biomass during the past 50 years [23]. Newly established communities of organisms on the seabed and in the water column have a standing biomass of ~900 000 tonnes of carbon, and are storing an estimated 3 500 000 tonnes of carbon per year (equivalent to 60–170 $km^2$ of tropical rainforest), of which approximately a fifth is deposited to the sea bed. Greater increases in biomass might have occurred in the Arctic, where losses of ice cover have been more substantial than in Antarctica (a decrease of 3 600 000 $km^2$ in September sea-ice extent between 1980 and 2007 [24]. Such changes in biomass and carbon assimilation will affect marine food chains.

### Biological impacts of perfluorinated compounds

Many perfluorinated compounds are used in manufacturing and other industries. These persist in the environment because the carbon–fluorine bond is strong and not degraded by most natural processes. The two compounds that have received the most attention from toxicologists and regulators in recent years are perfluorooctanoic acid (PFOA; used to make fluoropolymers, such as Teflon) and perfluorooctanesulfonic acid (PFOS; used in the semiconductor industry and to produce stain-resistant coatings and fire-fighting foams). These compounds are lipophobic and hydrophobic and bind to proteins in the blood rather than accumulating in lipid [25]. They have been detected in tissues of fishes, birds and marine mammals around the world and were recently recognized to function as endocrine disruptors [26]. Accumulation of PFOA appears to be associated with a 200% increase in probability of thyroid disease in humans [27]. Knowledge of the effects of these compounds on other biota, particularly their sublethal effects in combination with other pollutants, is rudimentary.

### Expansion in mining for lithium used in rechargeable batteries

The production and use of electric cars is promoted by many governments. Some countries, such as Spain, have set targets for the number of vehicles produced or sold, and the industry is subsidized in the USA, UK, China and Japan. These policies, combined with increases in the use of mobile technologies and storage systems for renewable energy, have led to a rapid rise in demand for rechargeable batteries. Most electric cars currently use lithium-ion batteries. The unexploited reserves of concentrated lithium of the world are mainly in shallow saline lakes in the high-elevation Andean deserts of Argentina, Chile and Bolivia. Species that inhabit the lakes (including microbes) are little studied, although they are important sites for three flamingo species, including the globally threatened Andean Flamingo (*Phoenicoparrus andinus*) [28] (http://www.birdlife.org/datazone/speciesfactsheet.php?id=3772). The Salar de Uyuni salt flat in Bolivia, which contains almost half of the known lithium reserves, is currently exploited on a small scale by a Bolivian state corporation; however, more intensive extraction is planned [29] (http://www.miningweekly.com/article/bolivia-advances-lithium-project-2010-07-30). The potential environmental and social impacts of a large increase in extraction of lithium, including the installation of mining and transport infrastructure, are poorly understood. Financial analysts anticipate intense competition for lithium between the mobile electronics and automotive industries by 2015 [30] (http://www.meridian-int-res.com/Projects/Lithium_Microscope.pdf). Competition will increase the price of lithium, which might stimulate exploitation of new lithium resources that currently yield little or no profit. It might also drive the development of new battery technologies.

### Genetic techniques to eradicate mosquitoes

The mosquito *Aedes aegyptii* transmits dengue, yellow fever and chikungunya viruses to humans, especially in tropical urban and suburban areas [31–33]. A range of modifications of the genome of the species that could lead to its eradication are being developed, including a strain that has healthy, fertile males but wingless females [34,35]. If release of this strain reduces disease transmission, the development of transgenic strains might be attempted for other mosquito species, and for other flying insects that are thought to have negative impacts on human health. The potential impacts of such releases on conservation are unclear. Little is known about the ecological role of particular mosquito species as food for insectivorous species, or in regulating populations of other species by transmitting disease or reducing the fitness of individuals [36,37].

### Nitric acid rain

Following their identification as sources of acid rain, sulfur dioxide emissions from coal-burning power plants were reduced in Europe and the USA during the 1970s and 1990s, respectively, and in China in recent years [38]. Regulation of sulfur dioxide emissions from international shipping is underway [39]. Oxides of nitrogen emitted by human activity also dissolve in precipitation to form an acid, nitric acid, which is toxic to animals, and can leach nutrients, mobilize aluminium in the soil and cause eutrophication. Even sporadic acid deposition events can reduce the viability of fish populations, such as those of Atlantic salmon (*Salmo salar*), by affecting the juveniles [40]. Control of emissions of oxides of nitrogen from vehicles and agricultural fertilizers is limited. By the end of 2010, 11 European countries are expected to exceed the emissions limits for oxides of nitrogen set by the European Union, some by >40% [41] (http://www.eea.europa.eu/highlights/europe-to-exceed-air-pollutant/nec-directive-2009-preliminary-data). There is evidence of widespread reduction in species richness in grasslands across Europe, possibly linked to the acidifying effect of nitrogen deposition [42]. Acid rain linked to industrial emissions of oxides of nitrogen has recently been reported in the Niger Delta region of Nigeria [43], although the environmental impacts of the rain have not been quantified.

### Substantial changes in soil ecology

Large-scale functional shifts appear to be occurring in soils worldwide. Global soil respiration rates have been increasing by 0.1% per year since 1989, apparently in response to increases in global air temperature [44]. An estimated 98 billion tonnes of carbon are now emitted by soils each year, an amount that is 20–30% higher than previous estimates. However, it remains unclear if this represents a net loss of carbon to the atmosphere [45,46]. If the emissions are from plant roots, they could be balanced by $CO_2$ absorption during photosynthesis. However, if they result from increased microbial action, there will probably be a net release of carbon to the atmosphere, possibly exacerbating climate change. Evidence of long-term changes in soil carbon in the temperate soils of the UK is inconsistent: a steady drop in soil carbon content between 1978 and 2003 [46] does not appear to have continued to 2007 [47] (http://www.countrysidesurvey.org.uk/pdf/reports2007/CS_UK_2007_TR9-revised.pdf).

### Denial of biodiversity loss

Dyson [48] argued that growing denial of drivers of long-term threats to human quality of life and health, such as climate change and HIV, are predictable social and political phenomena. The social responses to HIV/AIDS, such as reduction in use of condoms among many people over time, indicate the potential scale of denial of scientific evidence and that many people change their behaviour only when it is probable that they will experience serious, immediate impacts. The character of social responses to climate change is similar, with the proportion of people denying the scientific evidence now increasing, at least in the USA [49] (http://people-press.org/report/556/global-warming). On the basis of measurable behavioural responses to threats, social psychologists suggest that denial is expected to increase both in extent and intensity as scientific evidence of a threat from phenomena such as climate change or biodiversity loss accumulates [50]. In such a landscape of manufactured uncertainties [51], risk perceptions and individual behaviours are subtlety amended. Dickinson [50] argued that when a new dogma threatens an individual's self-esteem, actions to prevent the occurrence of the new problem might be expected to be small, whereas actions that exacerbate the new problem will become increasingly common. The denial of climate change, which is a threat potentially experienced directly by individuals, indicates that it is even more probable that more remote and tenuous problems, such as the prevention of biodiversity loss, will engender a strong denial response. The link between reductions in biodiversity and individual consumption behaviours of manufactured goods and food is complex. Nevertheless, such behaviour combined with aspirations worldwide, frames the intentions and actions regarding conservation outcomes [52].

### Protected area failure

Many protected areas were established to conserve specific systems (e.g. rare land-cover types) or species, but some of these areas are failing to meet the aims stated for their establishment [53–56]. To date, the protected status of most protected areas has been retained even if long-term conservation of their primary targets is in question. However, in the first systematic review of protected area downgrading (a decrease in legal restrictions), downsizing (a decrease in area) and degazetting (loss of legal protection for the entire protected area) (PADDD), Mascia and Pailler [57] identified at least 89 instances of PADDD in 27 countries since 1900. With growing pressures from the intensification of agriculture, human population growth, pollution, resource extraction and climate change [58–60] the number of failing protected areas, or ones perceived to be failing, both on land and in the sea, will probably increase dramatically.

### Re-emergence of rinderpest

Two major viral diseases, smallpox in humans and rinderpest in cattle, have been eradicated by mass vaccination programs. It appears that global eradication of the *Morbillivirus* rinderpest was achieved very recently [61,62] (http://www.fao.org/ag/againfo/resources/documents/AH/GREP_flyer.pdf). Comprehensive vaccination programmes have now been halted for both diseases. However, pathogens that cause both diseases have closely related wild relatives that could mutate and spread rapidly through a naïve population of humans or livestock that has no population-level immunity to infection. This process is illustrated by the 20-fold increase in the incidence of human monkey pox (a disease closely related to smallpox) in the Democratic Republic of Congo from the 1980s to 2006–2007, 30 years after smallpox vaccination ceased [63]. Closely related pathogens of the rinderpest virus include canine distemper (carried by dogs), peste des petits ruminants (carried by sheep and goats) and measles in humans. There is therefore a possibility of a re-emergence of rinderpest. The last major rinderpest pandemic, during the

1890s, is said to have killed 90% of the wild buffalo of Kenya, and other ungulate species in sub-Saharan Africa were severely affected, including wildebeest and giraffe [64]. A link between rinderpest in cattle and ecosystem processes and features, such as fire and tree cover, was documented following eradication of rinderpest from the Serengeti [65]. A new, widespread outbreak of the disease could affect habitats of species and ecosystems throughout Africa, Latin America, the Indian subcontinent and much of Europe. Negative impacts on humans and agriculture might be severe given the large increase in human populations since the last outbreak.

### *Climate governance*

The only global agreement with specific targets to control greenhouse gas emissions, the Kyoto Protocol, expires at the end of 2012. Failure of negotiating parties to reach agreement on a successor means that it is now almost inevitable that any new agreement will take effect some time after the Kyoto Protocol expires. It is possible that a global agreement is not feasible [66]. Nevertheless, local efforts to reduce emissions will probably continue in many countries. Under a global agreement, there might be opportunities to optimize or target emission reduction mechanisms, particularly those designed to reduce deforestation or enhance carbon storage in natural systems, which might also benefit native species [67]. Without an overarching global agreement, it is unclear which mechanisms will be available to ensure that the probability of persistence of native species increases rather than decreases in response to climate change mitigation. Projected environmental outcomes are known to differ according to whether power within a governance framework operates at the local, national or international level and the relative influence of the state or the market on society [68]. There has been no previous attempt at climate change mitigation that involves global carbon markets but lacks global coordination.

### *Transformation of oceans and domestication of marine species*

The way that humans view and use the sea might be changing dramatically, from a perceived wild space that provides resources to an intensively managed space that is 'farmed' [69,70] (http://www.conservationmagazine.org/2009/04/taming-the-blue-frontier/). Use of the oceans to generate energy, produce food and mitigate climate change is advancing rapidly. Increasingly common forms of marine industry include deep-sea fish farming, marine renewable energy generation, floating server plants and extraction of rare metals from sea water. Aquaculture is expected to supply 50% of the quantity of aquatic sources of human food by 2015 [71]. Already the abundance of large predators has been reduced in most oceans, with more dramatic declines in intensively used areas, such as the North Atlantic [72,73]. Shallow sea beds are extensively trawled [74]. The rate of infrastructure construction, especially for the production of renewable energy, is accelerating. Although none of these individual issues is highly novel, these rapid, simultaneous developments across multiple sectors will probably have a dramatic impact on the oceans and the species that they support.

### *Vegetation change facilitated by earthworms in North American forests*

European earthworms, especially *Lumbricus rubellus,* have colonized previously earthworm-free temperate and boreal forests in eastern North America [75]. Earthworms affect the composition and structure of the soil ecosystems. As detritivores, they affect primary producers by changing soil characteristics, plant–herbivore interactions, and flow of nutrients, water and carbon. The depth of litter in forests colonized by earthworms is rapidly reduced, with mixing of litter and humus into deeper horizons of the soil and reduced availability of nitrogen and phosphorus in upper soil horizons. Earthworms alter the soil food web and cause declines in the abundance of forest herbs, woodland salamanders and other native species. Earthworms can also facilitate invasion of forests by non-native plants, such as the European buckthorn (*Rhamnus catharthicus*) [76]. Earthworm invasion leaves a tree-ring signature in sugar maple (*Acer saccharum*), leading to the discovery that trees in invaded areas are more sensitive to drought [77]. Transformation of large areas of North American forests is underway and the long-term consequences remain unclear.

### *Hydraulic fracturing*

The threat to environmental quality posed by open-cast mining of oil sands has been widely highlighted, but comparatively little attention has been paid to the threats arising from hydraulic fracturing to extract natural gas from organic-rich shale basins. It is estimated that 50 $km^3$ of natural gas could be recovered from US shale basins [78]. Depending on site conditions, hydraulic fracturing at a single horizontal well might require pumping of 8000–38 000 tonnes of water-based fracturing fluids at high pressure into the bedrock. The pumping creates fractures that enable the subsequent flow of gas out to the wellhead [79] (http://prochemtech.com/Literature/TAB/PDF_TAB_Marcellus_Hydrofracture_Disposal_by_Recycle_1009.pdf). These reserves are usually far below any aquifers and wells can be effectively sealed to prevent leakage. Nevertheless, there have been cases of pollution of both surface water and aquifers, and of gas leakage. Fracturing fluids contain several toxic chemicals, including naphthalene, butanol, fluorocarbons and formaldehyde, which are considered carcinogenic and are linked to numerous human illnesses [80]. Hydraulic fracturing is exempt from the US Safe Drinking Water Act and therefore unregulated by the US Environmental Protection Agency. Gas companies are not required to disclose the composition of fluids, which could result in less effective treatment by wastewater plants [80]. The high quantities of water required for fracturing are typically extracted on-site from groundwater or nearby streams, and this could affect aquatic ecology and public water resources. The growth of this industry across the USA and elsewhere is considerable. For example, some 710 wells were drilled into the rich Marcellus shale in Pennsylvania in 2009, with projections of 1700 new wells in 2010, 2200 in 2011 and a steady increase in the number of new well per year to 3500 in 2020. The spatial reach of each well is limited so a high density of wells, access roads and pipelines, is needed for comprehensive gas extraction, creating a footprint that is already affecting large areas of natural landscapes. Over 30% of the 8900 $km^2$ of forests under the jurisdiction of the state of Pennsylvania have already been made available for natural gas extraction, with growing pressure for more land to be released [81] (http://marcellus-coalition.org/wp-content/uploads/2010/05/PA-Marcellus-Updated-Economic-Impacts-5.24.10.3.pdf).

## Conclusions

As with the 2009 horizon-scanning exercise [13], the 15 issues discussed above cover a wide range of topics that relate to the major drivers of environmental quality and biodiversity loss: land-cover and land-use change, pollution, invasive species and climate change. Issues associated with pollution are prominent, but there are also issues associated with new technologies and societal change. The effects of some issues will probably be at the local or regional level, whereas others will undoubtedly have global impacts.

Which issues are identified in a horizon-scanning exercise depends to some extent on the composition, interests and expertise of the group involved. The 15 issues presented here were judged to be the most novel and potentially the most significant. The other 20 issues also considered in detail during the workshop, and the remaining 36 that were evaluated by the group but did not receive relatively high scores were considered relevant but poorly known (and thus suitable) by one or more of the participants. Among the 71 issues, those with highest scores were new technology (*c.* 23%), climate change (*c.* 18%) and societal change (*c.* 14%). The topics with the highest scores changed during the process of discussion. The highest-ranked topic areas in the final 15 were pollutants or the extractive industry (*c.* 27%) and societal change (*c.* 20%), followed by climate change, change in use of land or sea, and invasive species or disease (two issues, *c.* 13%, each).

Group discussion and assessment is probably as effective a way as any to refine the set of issues. This does argue, however, for a fairly frequent horizon-scanning process that incorporates a review of previously proposed issues (at least those that received relatively high scores) to consider whether the importance of those issues might have changed. There might also be genuinely important issues missing because no-one raised them at all. A degree of turnover in the composition of the group (and filling of any gaps in major areas of expertise) is thus also desirable.

Often the most sensible response to the identified issues is to assess how the issue develops. If it appears that the effects of the issue on environmental quality and biodiversity are increasing gradually, there might be time for research and policy development. Another response is to improve the science needed to predict the probability of different impacts. Diacu [82] argues for improving the science to predict events or phenomena such as pandemics, rapid climate change and tsunamis. If it is probable that the effects of the issue will increase rapidly then immediate consideration of the policy options might be appropriate. In itself, identifying a list of issues is, of course, unlikely to drive any direct policy responses. At best, the list might initiate a complex chain of interactions that could ultimately result in policy developments, largely through the re-focused attention of researchers and conservation NGOs.

It is this shift in focus and attention, to track research and better understand the issues identified, that we advocate here. Not all identified issues will ultimately have undesirable global effects; some might turn out to be entirely unimportant. However, these are issues that organizations should review, and decide whether to ignore, watch or develop research or policy responses to them.


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