

ENVIRONMENT/ECOLOGY

Scanning the horizon for nascent environmental hazards

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In retrospect, it becomes evident that many environmental and conservation problems could have been detected or prevented at their early stages. However, in most cases, the early warning signs of such environmental issues are neglected; thus, the chance to take timely action is lost and heavy damage often results. Some of these cases have been identified by the European Union [1]. For example, the UK government failed to foresee public concern about genetically modified crops and the potential damage caused by foot and mouth disease; the latter resulted in billions of pounds of losses in animal husbandry [2]. Based upon governmental future-planning projects, [3] established Globe Conservation Horizon Scanning (GCHS) to systematically monitor nascent environmental and conservational issues that may affect society in the near future since 2010 to identify problems that may exert a significant impact on the environment and biodiversity in the near future, and the surveys have addressed pressing research and policy issues [3, 4]. The environmental problems identified by GCHS include ones that have not yet been noticed by society as a whole—not even by the scientific world. GCHS thus serves as an early warning system that could reduce the probability of sudden future confrontations with the consequences of environmental problems. Such early warnings with respect to emerging environmental problems are crucial for social stability and sustainable development [1].

The strength of science relies not only on its novelty but also on its ability to solve real problems. Horizon scanning is a brainstorming method that assembles the intelligence and expertise of specialists across international borders toward identifying imminent environmental hazards. In modern society, many people are pressed for time, and that is especially true of officials and professionals. Thus, those individuals probably have time only to glance at concise, conspicuous information. The short titles used in documents prepared by GCHS and their brief descriptions of environmental problems meet those criteria, and accordingly GCHS reports often appear as headlines in the media. Many issues anticipated by previous GCHS studies have now come into being. [2] urged for greater dissemination of the results of GCHS studies and for more investment in GCHS [3]. The methodology adopted by GCHS is straightforward and may be easily applied at the regional, country, or local level. However, for the following reasons, there are restrictions on the broader application of GCHS methodology.

First, the readership of the outcomes of GCHS is limited. Our world is flooded with information. People avoid information they believe to be of no use to them to avoid drowning in the sea of information. Access to scientific journals is largely restricted to scientific circles—even among journals with high impact factors. This problem may be surmounted by rephrasing and

publishing GCHS results in the public media, but that depends on the selections and interests of editors.

Second, language problems hinder the dissemination of GCHS findings. Most important discoveries and theories are reported in English. However, under one-fifth of the world's population speaks English, and even fewer individuals can read English. The people who really need GCHS information may not be able to read it: these important future studies become lost in the great excess of information. Translation of the outcomes of GCHS studies into different languages would help people who lack understanding English to interpret the results of those studies, but such work depends on the availability of scientists with appropriate linguistic skills and there is an inevitable time lag. Even in a large country like China, GCHS is just beginning to emerge in Chinese journals dedicated to conservation [5]. Of course, it is not surprising that decision makers and conservationists at the regional or country level have not made use of those GCHS results in their decisions.

Third, and most importantly, the scale and focus of horizon scanning differ at the global, regional, and country level. GCHS focuses on problems relating to the global environment and biodiversity; however, most users of government services and enterprises tend to care more about matters that affect their own environment and interests in their own countries—most of which are at the more local level. In most cases, the impact of GCHS results is not appreciated as much as it should be at the regional or country level. Thus, we would recommend that more regional- and country-level conservation horizon scans be conducted under the GCHS framework, particularly in developing countries.

Each country in the world is a sovereign state and administrative entity.

Each one faces unique environmental problems owing to its social economic status and geographic location. Therefore, it is unsurprising that problems identified by GCHS may be not relevant at a particular regional or country level. Some environmental problems may begin as local issues, but then they may suddenly exert profound impacts on the wider environment and biodiversity. For example, the serious problem of smog caused by heavy air pollution in northern China and the Yangtze River delta was not foreseen by most people. If China had carried out environmental horizon scanning and identified this problem, such large-scale air pollution may have been prevented. Other conservation issues may also have been stopped, such as—among many others—the functional extinction of the Yangtze River dolphin (*Lipotes vexillifer*) and South China tiger (*Panthera tigris amoyensis*) and the endangerment of the finless porpoise (*Neophocaena asiaeorientalis*). The golden apple snail (*Pomacea canaliculata*) would not have been able to invade and spread wildly in southern China. The pollution of the country's soils by heavy metals could also have been averted given early warnings. Those environmental and conservation issues had time lags that ranged from several years to several decades, and they developed from marginal problems into major ones.

GCHS is a useful tool for implementing multilateral environmental agreements, such as the Convention on Biological Diversity (CBD) [6], Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) [7], and Convention on International Trade on Endangered Species of Wild Fauna and Flora (CITES) [8]. If conservation horizon scanning is conducted at the regional or country level, the issues identified could help CBD, IPBES, and CITES implement their commitment to the international society and achieve their conservation goals.

GCHS methodology could be further refined when used at the regional

or country level. First, there is the question of the survey interval. Currently, GCHS is conducted every year. One year is rather short since new environmental issues with great potential impact may not emerge on the local scale within such a brief period. If horizon scanning at the regional or country level is carried out every year, it could be difficult for the participants to properly identify potential medium- or long-term environmental hazards, which may not be known or noticed by most people. 'Medium term' and 'long term' are somewhat imprecise concepts: medium- and long-term issues that have been identified may not undergo much change over the space of two years at the regional or country level.

Second, at the regional or country level, conservation horizon scanning should probably not be confined to issues that are unknown or poorly known among most people. Some known conservation issues are real problems that demand serious action at the regional or country level. The outcome of regional- or country-level horizon scanning should include nascent issues and existing issues.

Third, to broaden the scope and introduce fresh expertise, the participation of international experts should be encouraged when conducting regional- or country-level conservation horizon scanning. In contrast to GCHS, regional- or country-level conservation horizon scanning can promote the participation of local communities and indigenous peoples. Using local language in conservation horizon scanning may help to communicate conclusions among decision makers, scientists, the media, and practitioners. Therefore, when conducting regional- or country-level conservation horizon scanning, it is necessary to decide the following: How often should the scanning be carried out. Should known environmental issues be considered in the horizon scanning? How many problems should be identified in the scanning? If the methodology were standardized, conservation horizon scanning could lead to an early warning system tailored for regional or national environmental and conser-

vation issues. Furthermore, timing horizon scanning could also be integrated into standard environmental and conservation practices, which could help provide appropriate information for policy makers.

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