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Towards a scientific mediation of man-induced environmental impacts from novel approaches to legal action-The example of tropical coral reefs

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Highly biodiverse environments are more susceptible to rapid climatic changes and to misuse of natural resources, both resulting from increasing human interference. Shallow water coral reefs and primary rainforests are associated with the livelihood of billions of humans living under tropical latitudes, and projected habitat destructions may cause massive population shifts within the next few decades. Along with humanitarian crises, the disappearance of many thousands of marine species will be matched by drastic microbial shifts, with the emergence of pathologies at pandemic proportions leading to biodiversity collapse. In addition, invaluable chemical information will be lost, marine natural products - especially from biodiversity hotspots - and they provide crucial models for the development of new drugs in major pathologies, e.g. cancer, neurodegenerative and cardiovascular diseases, as well as inspiring anti-inflammatory and anti-pain molecules, a highly active area of biotechnology.

The major anthropic impacts and the target spots at which they affect natural equilibria are examined, and the corresponding suppressive or corrective actions already proposed at individual and at collective levels are summarized. With the exception of social sciences, researchers often fail to be adequately consulted regarding the consequences of economic development, prompting for the habilitation of their role "as a medical doctor at the bedside of an ailing environment", using diagnostic tools, prescribing a treatment and being capable of predicting the evolution of the fitness of e.g. the biodiversity component.

Technological advances in molecular sciences, in multi-scale imaging and in systems biology can be (i) adapted to provide accurate real-time assessment of the health status of an ailing biome, and (ii) combined into a "performance" index where weak spots are indicated (e.g. identification of individual stress factors and their level of interference). A useful metaphor is that of DNA amplification which has tremendously helped forensic scientists in solving criminal cases. The "inventors" have created a tool that a skilled technician can use "to present irrefutable evidence" and that judges can trust to enforce legal action. Environmental lawyers could make mandatory the use of such tools whenever a potentially impacting activity (industrial, urban) is planned.

Functional genomics must be at the heart of this approach, including transcriptomics and metabolomics applied to both the selected sentinel models and to their associated microorganisms. In addition, time-lapse imaging (from satellite to microscopic scales) can offer the visual approach often decisive in communication to media. Finally, ecotoxicological monitoring of crucial metabolic parameters (photosynthesis, respiration etc.) on sentinel organisms under experimental stress can offer a complementary indication of the fitness of host organisms and of its possible evolution. A theoretical model applied to coral reef biomes under stress is discussed, from sampling procedures to the management of huge bodies of environmental data.

Biography

Stephane LA BARRE is a Senior Research Scientist at the French Centre National de la Recherche Scientifique. He obtained his MSc Degree from Auckland University, New Zealand, and his PhD at James Cook University, Townsville, Australia, before entering CNRS in 1984. He spent two years (1990-1991) as research scholar at University of California San Diego working on synthetic peptides with late Murray Goodman, and on marine natural products with late John Faulkner. His multi-disciplinary career includes marine chemical ecology, natural products chemistry of terrestrial and marine organisms and polymer chemistry. He is currently the administrative coordinator of the research cluster BioChiMar (Marine Biodiversity and Chemodiversity), and he is promoting research on new analytical tools to evaluate and predict environmental changes on coral reefs diversity, both biological and chemical. He is now editing a textbook on marine natural products, targeted to an academic readership.

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