Marine Biotechnology and the Bioeconomy

Introduction

In 2010 the OECD’s Working Party for Biotechnology initiated work in the area of marine biotechnology. This work grew out of recognition of the potential for marine biotechnology to address global challenges such as food and energy security, population health, and to contribute to green growth and sustainable industries. Governments and private sector organisations around the world have begun to recognise this potential and are actively working to harness it. This short document gives a brief description of the challenges to development of marine biotechnology and provides some context for the current work.

Marine Biotechnology and Bioresources

Marine biotechnology can be thought of as the use of marine bioresources as the target or source of biotechnological applications. This broad understanding of marine biotechnology thus includes both traditional forms of marine biotechnology like aquaculture and modern forms such as bioremediation, production of biofuels and genetic modification of fish. The field has already yielded some notable and wide ranging advances in the fields of medicine, cosmetics, nutraceuticals, food production, and environ-industrial applications.

A diverse marine bioresource

The oceans have a long evolutionary history that, in addition to their great volume, provides the basis for great biodiversity. Life began in the oceans more than four billion years ago and they contain some of the most challenging environmental extremes found on the planet. The marine environment has enabled the evolution of organisms with unique structures, metabolic pathways, reproductive systems and sensory and defence mechanisms, and is a source of great biodiversity. As a result, marine bioresources are increasingly recognised as an important source of new materials, feedstock, bioactive compounds, and biological and biochemical systems and processes.

Untapped biodiversity

For a long time the marine environment and the extent of its wealth of bioresources remained uncharted and untapped, certainly by comparison to terrestrial resources. However this is changing as new advances in science and technology, in particular ‘omics technologies, are expanding our knowledge of the marine environment, and providing new tools to study marine organisms and ecosystems. Metagenomic sequencing, in particular, is now being used to study microbial ecosystems and to identify genes with new functions. Marine microbes seem to hold particular promise for marine biotechnology and are revealing new limits to biodiversity that previously imagined.
**Ecosystem services**

Within the oceans, marine bioresources provide a number of important ecosystem services for the planet and its inhabitants. Marine organisms: microalgae, fish and invertebrates, are a source of food for billions of people and livestock. The oceans are well known as regulators of global temperatures and filters of pollution. They are additionally sinks for carbon and nitrogen, and a source of oxygen and food.

Living in the ocean’s surface water, in easy reach of light, phytoplankton are estimated to produce half of the oxygen which human and animals breathe. In addition to this important function, phytoplankton have an important position in the food web and play an important role in carbon cycling: locking away carbon dioxide and nitrogen which is eventually deposited on the ocean bottom slowing the impact of global warming. These ecosystem services are a function of biodiversity. They are vital for proper functioning of the planet and need to be maintained.

**A shared resource**

Marine resources are a global resource and one whose well-being is crucial for the survival of the planet. The fitness of these shared resources can be positively influenced or negatively affected by the actions of many individuals, companies and countries. Most applications of marine biotechnology are predicated on access to marine resources which are distributed within a vast and complex shared ecosystem. Having appropriate policies in place to ensure protection and appropriate development of marine resources is thus a topic of interest for all countries, and indeed a global imperative.

**New work at the OECD ‘Challenges to Ocean Productivity’**

The current project will be broad in scope, focussing on the application of new science and technology (including ‘omics’) to ocean productivity. We will look at how we can derive value from marine bioresources -- given the breadth of marine biotechnology this is expected to touch on things like biosensors, bioremediation, biofuels, biodiversity, bioprospecting, and molecular aquaculture. We will also study how advances in genomics science can be developed to confer social and economic benefit, and ecosystem services. Finally we will turn to the challenges to ocean productivity: the tensions between the need to protect marine resources and the need and challenge to developing them. Our goal is to provide a broad base for identification of areas which could benefit from further policy work in order enable the field of marine biotechnology to contribute to social and economic wealth and national prosperity.

**References**


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