

CIESM Congress Panel P3 – Blue Biotechnologies

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summary by Henry Nicholls

The marine realm has always been an exciting place for exploration but it is only within the last decade, particularly with the advent of metagenomics, that scientists have started to reveal the immense genetic wealth that lies beneath the waves. In 2007, the J. Craig Venter Institute described more than five million entirely novel genes collected from around 150 samples from waters around North to South America. Since these genes came from the most abundant microorganisms, this is almost certainly just a minute fraction of the genetic diversity out there.

It is understandable then that there should be considerable excitement in the biotechnological innovations that could come from this vast, largely untapped resource. But there are also plenty of hurdles to overcome before its full potential can be realised. This panel session aimed to explore some of the opportunities and the challenges of blue biotechnology in the Mediterranean.

Milton da Costa, professor at the University of Coimbra in Portugal, and current President of FEMS, began the proceedings with an illustration of the extraordinary variety of different habitats and biodiversity that the Mediterranean has to offer: geothermal areas where the water temperature is around 100°C; saturated brines at depths of 1,000-2,000 m; submarine hot springs with their associated biological communities; the sea floor where temperatures are considerably higher than they are in other oceans; and the water column above it. In addition, associated terrestrial environments, such as sand dunes and salt pans, are likely to harbour a wealth of biodiversity. Da Costa outlined the potential to translate this wealth into antibiotics, pharmaceuticals, cosmetics, detergents, food additives, bioremediation and enzymes with industrial promise.

Monia El Bour followed on with specific examples of this applied potential taken from her experience as a marine bacteriologist at INSTM in Tunisia. In particular, she presented case studies where marine organisms or biological substances derived from them have been used to clear up pollution or combat fouling organisms. In addition to such bioremediation, she gave other examples clearly illustrating how marine biotechnology may be used to yield energy, improve the productivity of aquaculture and assist with food preservation.

As emeritus professor at the Weizmann Institute in Israel and also the founder of several biotechnology companies, biochemist Haim Aviv brought a wealth of business experience to the session. He stressed the immense benefits of combining an entrepreneurial spirit with science, not only in terms of the value to local economies, living standards and public health, but also through its ability to stimulate the pace and scale of scientific research. In order to give basic research the best opportunity to

translate into viable commercial applications, it is crucial to wear a business hat from the outset, he said. In particular, Aviv stressed the importance of several key considerations: to identify the market potential of your product; to be convinced of the uniqueness of the end-product and your ability to protect it through patents; to be satisfied that you have a reasonable chance of success; to have thought through the regulatory constraints that might slow down progress; to attract considerable financial resources, either through national governments and/or venture capitalists; and to manage projects ruthlessly, subjecting each to a constant assessment of progress.

In spite of all the opportunity, however, there are legal uncertainties that can hamper biotechnology research and development. Andree Sontot, a political scientist at the “Institut National de la Recherche Agronomique” in Paris, helped to clarify the existing legal framework as it applies to the Mediterranean. According to the United Nations Law of the Sea, for example, a coastal state can lay claim to an “exclusive economic zone”, a belt of water that extends 200 nautical miles offshore. Where neighbouring states face a large expanse of ocean, there is little dispute over who has ownership over which bit of water. But in a closed sea like the Mediterranean, there are large areas to which several different states could stake a legitimate claim. Who, if anyone, should benefit from the intellectual and commercial value of marine resources found floating in such murky waters?

In addition, all CIESM members are party to the Convention on Biological Diversity, which should give them the right to expect some kind of benefits in exchange for granting a foreign party access to their marine genetic resources. The problem is that many states have yet to embrace the CBD into their own national legislation and unless they do the obligation to provide benefits in return for access is not enforceable. Consequently, there is considerable variation in the legal implements that can be brought to bear on different regions of the Mediterranean.

In this situation, Sontot considered three scenarios. It would be possible to keep things as they are, with uncertainty over who owns what and over which law applies where. But this, Sontot suggested, would be “very dangerous”, leading to a cycle of frustration and mistrust in which states begin to put up barriers to others accessing their genetic resources. In such a situation, academic research would suffer whilst those with the resources to identify legal loopholes and finance legal procedures should they have to would benefit. Alternatively, international negotiations currently under way are attempting to clear up some of the conflicts between different legal tools. But, warns Sontot, “do not expect anything to materialise soon”. A final option would be for stakeholders to take action, increasing the understanding of others’ concerns, improving transparency, cooperating to forge workable guidelines for access and benefit sharing of marine genetic resources.

We returned from coffee to open the session up to questions from the floor. For the next 90 minutes, the discussion showed no sign of letting up as several important themes began to emerge.

There was a strong sense in which CIESM members feel joint ownership of the Mediterranean and would like to pursue the potential of blue biotechnology in the region in a collective manner. There were several concrete suggestions put forward as to how CIESM might usefully foster this cooperative spirit, particularly productive collaborations between the North and the South. It was agreed that it would be useful to have an inventory of the different expertise that different member states bring to the table, their research capacity and industrial investment in biotechnology to date. This would help to inform which partnerships between different CIESM member states would be particularly fruitful and identify where there are opportunities to be taken. “The more interactions you have between the North and the South and the Black Sea, the better people will collaborate, come up with good ideas, do good research, some of it economically valuable”, said da Costa. This should induce governments to pay more attention to the importance of Mediterranean marine biodiversity in all its forms, he added.

There was a lot of discussion about how to encourage an entrepreneurial mindset amongst academics. “Science research education is probably the best education you can get if you want to be an entrepreneur,” said Aviv. “You have to prioritise your programmes, you have to mobilise resources, you even have to do market yourself.” Nevertheless, he said, it would be incredibly helpful to identify incubator programmes to accelerate commercially promising research in the region. For example, CIESM might be able to help identify 50 such projects, allowing a business mindset to feed into them from the outset, possibly through a small advisory team of experts familiar with both science and business. Those that are successful would help to sell the idea to scientists, the people, and governments, thereby attracting more funding.

As an illustration, Aviv suggested that each incubator programme might need between \$1 and \$2 million of seed money, with those projects showing the greatest promise receiving subsequent injection of something like \$5 to \$10 million. In the current economic climate, there was clearly concern about where the funds for this kind of investment might come from. Aviv noted that the increasing amount of red-tape surrounding marine (and other) exploration is a disincentive to venture capitalists. “If you make it too restrictive, I am afraid there is no chance of getting capital into it”.

For Sontot, however, it is clear that regulations have to tighten. “It will happen”. But, she added, the cooperative spirit amongst CIESM member states presents a rather unique opportunity to work out how to realise the potential of genetic resources in a way that benefits all the parties involved, from developing countries to venture capitalists.