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The scientific diving challenge in Europe

The littoral and the coastal zones are, and will continue to be, of considerable significance when tackling the challenging issues of human demographic growth; rapid urbanisation and industrial rates; increasing tourism, recreation and coastal zone development and degradation; water scarcity; increasing demand and over-exploitation of living and non-living resources; conflicting uses of the coastal environment (e.g. marine farming, nearshore wind turbines, nearshore fisheries, angling, leisure SCUBA); uncontrolled release of contaminants or pollutants which produce chemical, biological and physical disorders in the environment; stormwater discharge and effluent discharge; erosion and sediment transport as a result of poor land management or of extreme meteorological events; planned short-, medium- and long-term major expansion measures (traffic, ports); the effects of global warming; and threats to the underwater cultural heritage.

It is widely recognised that observatories and efficient monitoring systems need to be established and maintained in order to understand and evaluate the impacts of developing pressures, both natural and anthropogenic. The challenge is to assess not only the impacts on the ecosystems, but also how these impacts could further affect society and the economy. Increasingly the demand is involving policy makers and managers in order to develop scenarios in a predictive way that could help society to adapt, for example, through Marine Protected Areas design, Integrated Coastal Zone Management, resource and transport regulation.

The last decade has seen more sophisticated sensors being attached to more sophisticated landers, gliders, autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs). These have seen tremendous and significant advances in their ability to map, measure and understand an increasing number of marine environments. However, there is a continuing need to further develop intelligent monitoring systems based on the combination of existing scientific diving skills and capabilities with developing technologies. The use of such technologies is more limited in both the littoral and nearest coastal waters (the depth range of 0 to 50–60m) where most of the biodiversity lives (and is endangered). This 'layer' is the most sensitive to pressures, is where the effects of the climate changes will be the greatest and needs to be rapidly and efficiently managed. This depth range is where scientific diving is best employed as a research tool, even though technical advances are providing the capability to dive deeper and longer.

Scientific diving remains an essential research tool for marine science for many reasons. The visibility of biotopes and organisms decreases quickly with the depth and colour change, and beyond 10m depth ground-truthing operations are essential to validate air/satellite photos. In addition, the resolution of current remote methodologies for obtaining seabed pictures is often too low in quality to capture sufficiently relevant minute objects in biology and ecology (sonar pictures rarely go under 1m resolution). Diving can also geo-reference target objects to near centimetric positioning and is of particular use in environments with restricted access.

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Jean-Pierre is currently the head of unit 6540-DIMAR, where his research interests concern mainly marine biology, biodiversity, population genetics and evolution. He has been scientific diving since the late 1970s and was the leader of the first scientific diving expedition exploring the Antarctic coast of Terre Adélie in 1987. He was involved in the establishment of the French regulation for scientific diving and at a European level, initiated a pan-European network of scientific divers which recently (2008) became a panel of the Marine Board of the European Science Foundation. Jean-Pierre is the current chairman of this European Scientific Diving Panel (ESDP).

Scientific diving is a highly productive, cost-effective research tool that supports underwater science and archaeology through: efficient and targeted sampling (photographing, filming, mapping, measuring and collecting animals, plants, sediments, etc.); quantitative survey and/or observation; *in situ* measurement, impact studies, ecological analyses; evaluation of new techniques; mapping underwater areas; profiling subtidal geology/geochemistry; and the accurate deployment/retrieval of underwater apparatus.

The relative efficiency of SCUBA diving compared with other underwater means has been demonstrated by reduced damage to experimental apparatus and the targeted biotopes, and *in situ* sampling by divers delivers far better results than when using surface-deployed techniques. Moreover, scientific diving cannot be ignored as a means for obtaining good physico-chemical data. For instance, in trials divers will check, monitor and evaluate benthic lander performance. Another example is diver deployment supporting the accurate and repeatable location of data-loggers that, in turn, produce temperature/depth profiles of very fine scales.

Biodiversity and coastal ecology are not only local issues. Most problems are also relevant at regional and/or continental scales. There is, therefore, an increasing need for scientific divers (researchers, engineers or technicians) to be more mobile and attempt to cooperate and to operate together under water in different countries. However, it remains increasingly difficult to use diving for observation, collection or a means of experimenting in all the coastal waters of Europe. This is because some countries have no rules and others are setting up national regulations for scientific diving that ignore any pan-European requirements.

There is a need to recognise basic diving instructions and the competence level attained by an individual diver reciprocally among countries. However, increasingly this issue is being made easier through the establishment of the European Scientific Diving Panel (ESDP) of the Marine Board of the European Science Foundation. The aim of the ESDP is to provide networking opportunities and facilitate the exchange of knowledge and best practices in the field of scientific diving. It also works to promote scientific diving as an effective and productive research and management tool.

The objectives and tasks of the ESD panel are to:

- Emphasise the secure practice of scientific diving; the best methods of observation and monitoring of the littoral and coastal environment; the calibration and standardisation of the necessary methods; and the management of the collected data;
- Gather, manage and make information from each European country and make it available for all;
- Facilitate a pan-European framework that encourages sectorial best practice;
- Encourage training on specific scientific and technological issues;
- Promote links with industry (e.g. sensors, real-time communication for field data transfer, underwater positioning);
- Promote interdisciplinary research in the marine environment;
- Organise workshops to prepare and to deliver a 'vision document' directed to policy-makers; and
- Disseminate the findings in ways that highlight the effectiveness of scientific diving as a research tool.

As the European scene for scientific diving becomes more structured, links with other international bodies with similar interests (such as the American Academy for Underwater Science) will start to create a feasible proposition for a coordinated global observation network based on a relatively cost-effective methodology.