

Editorial

Port activities and international environmental control in the Mediterranean

The constant growth of maritime traffic in the Mediterranean, the development of tourism along the coasts and the prospect of establishing “motorways of the sea” in Italy to alleviate the heavy volume of road traffic are phenomena that imply extensive work for port improvement and expansion, as well as the creation of new tourist ports. This raises a series of problems involved in the safeguarding of coastal zones. From a scientific point of view, port environments represent special ecosystems whose communities are capable of adapting in various ways to the alteration of chemical-physical parameters of waters. With regard to their ecological profile, these are particularly critical environments on account of the type of activities conducted in ports and their surroundings; moreover, they are also subject to the risk of further pollution from accidental causes. Since the adjacent coastal waters are inevitably affected by the nearby presence of ports, they can be considered as a transition zone between the natural environment and the area impaired by port activity. Coastal waters can thus be taken as a reference point to determine the limits within which port activities have repercussions on the surrounding marine environment. There is a need for in-depth scientific knowledge of the ecological characteristics of port areas, as well as adjacent marine zones, in order to identify both internal and external risk areas and to plan prevention and clean-up measures that can guarantee a reliable safety margin.

Port environment colonising mechanisms form part of the broader framework of the adaptive strategies of organisms in response to environmental unpredictability. Port communities are composed of species with varying degrees of opportunism; they offer a faithful reflection of the state of health of the ecosystem, as analysis of variations among the components of these communities allows identification of stress gradients ranging from the least to the most polluted areas. The species found in these areas react to the different types of pollution on the basis of their degree of adaptability

by developing detoxification systems, morpho-physiologic and genetic modifications which can be detected by means of specific analyses. Study of these responses is of considerable aid in establishing the degree of pollution and assessing the effectiveness of impact mitigation measures. The effects of alterations on the biological component can be determined through study of the structure of the biological communities, the response of individual organisms to environmental stress and modifications in the genetic arrangement of natural populations. Within this last context, a bulk of recent literature exists on experimentally-induced modifications of the genetic structure of species living in controlled contaminated mesocosms (the so-called evolutionary ecotoxicology). However, to our knowledge, no studies exist on population genetic structure based on samples collected directly in ports and adjacent marine environments.

Methods have been developed to detect the appearance of, and to forecast the potential impact of pollutants on organisms, populations and communities. The responses of organisms to stress are basically of two types, genetic and non-genetic. In responses of the genetic type, for instance to a pollution source, pollutants may change the genetic constitution of populations, either directly through mutagenic activity, or indirectly via population-mediated processes (i.e. selection, drift, bottleneck). The non-genetic responses involve phenotypic plasticity and physiological detoxification mechanisms. Population genetics and ecotoxicology therefore assume a predominant role in assessing the response and adaptation of organisms to port habitats. These approaches include the analysis of parameters which may range from molecular and cellular levels (biomarkers) to higher levels of the hierarchical organisation. In addition, the population level can be effectively used to monitor the environmental health in terms of modifications of population genetic arrangement. Port environments are subject to unpredictable conditions, due to the

occurrence of multifarious factors, such as the wide variations in physico-chemical parameters, the release of contaminants, water turbidity. The community is composed not only of typical opportunistic species but of other non-opportunistic species as well, which in different local situations have given rise to populations adapted to the peculiar unpredictable conditions. Therefore, single populations may be affected in terms of modifications of their genetic arrangement as compared to their counterparts living in the adjacent unpolluted, or slightly polluted marine environments. This is one of the most interesting aspects scientifically, dealing with adaptive strategies that some marine species may adopt in a relatively short time within these unpredictable environments. From a new scientific perspective, ports can be seen as confined laboratories where a very strong selection pressure acts on organisms.

From a strictly scientific point of view, ports thus constitute a veritable observation point from which the type and concentration of pollutants can be assessed on the basis of the reaction of the individual organisms and of their overall assemblage. Furthermore, by adopting this approach it becomes possible to test methodologies designed to identify sources of pollution and devise bottom clean-up campaigns as well as measures for general environmental quality improvement. Control of these ecosystems is a guarantee against further degradation and facilitates the introduction of more effective intervention policies that aim not only to eliminate pollution but also to perform reliable environmental impact assessment of proposed port structure expansion and modification. Biological analyses conducted in the framework of sustainable management of coastal zones allow the establishment of information and biomonitoring systems to identify and guide the necessary operations; they also facilitate assessment of the effectiveness of such operations over time as well as providing well grounded scientific support for environmental impact assessment.

From this perspective, international cooperation between the advanced service sector on the one hand and the public administration on the other is crucial in order to plan and fund interdisciplinary studies on the ecological characteristics of ports and other marine areas at risk, so that a general picture of the overall environmental situation in the various Mediterranean localities can be obtained. It is therefore desirable for scientific knowledge on port ecology to be coordinated in an international context, leading towards uniform imple-

mentation of the most recent biological and environmental impact assessment methods and assuring the training of qualified experts. Port activities, including those relative to the continually expanding tourist ports, form part of the management program drawn up for coastal zones recognised by the United Nations and by Agenda 21 (Rio de Janeiro Convention, 1992) as of primary importance for the life and development of a large part of the world's human populations.

The massive anthropic pressure on coastal areas calls for careful surveillance and prevention measures based on scientific knowledge of the problems involved. In a sea such as the Mediterranean, where political frontiers do not correspond to ecosystem boundaries, and where conservation has to be reconciled with multiple economic interests, international cooperation at all levels is a guarantee of greater safety. Cooperation has already begun among European Union countries and has given rise to innovative policies designed to reduce the dangers of pollution. Within this context a conference organised in Cagne sur Mer, Nice (France) in November 2004 by the *Université Internationale de la Mer* focused on the creation of new tourist ports and their impact on coastal marine ecosystems.

Control of port and adjacent marine ecosystems environmental quality must now be extended to cooperation with North African countries, above all in the field of research and professional training. The importance of closer interaction on these themes was one of the issues addressed in the international conference "Civil society and quality of life in the Mediterranean countries", organised in Tunis in October 2004 by the *Associations du Réseau Méditerranéens pour le Développement Durable* (ARMEDD). The conference expressed the desire to reinforce an information network linking countries bordering on the northern and southern shores of the Mediterranean in order to promote better coordination of efforts in terms of designing projects and mobilising resources to achieve successful results.

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