

Interactions between scientists, managers and policy makers in the framework of the French MediOs project on *Ostreopsis* (2008-2010)

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Abstract – The main goal of the multidisciplinary MediOs project was to acquire and analyze pertinent scientific knowledge in fields as diverse as ecology, biology, chemistry, epidemiology or socio-economics concerning the occurrence of species belonging to genus *Ostreopsis* (toxic benthic dinoflagellates) in the Mediterranean. The economic impact of *Ostreopsis* was estimated, based on the intensity and frequency of blooms. Results obtained allowed science-based recommendations concerning the management of risk, with suggestions to optimize environmental surveys, to initiate a food risk survey, and to structure actions at the national level.

HAB / *Ostreopsis* / Monitoring / Managers / Policy makers

INTRODUCTION

In order to cope with the new phenomenon of *Ostreopsis* development, the French Ecology Ministry (Ministère de l'Écologie, du Développement Durable, des Transports et du Logement – LITEAU III program), the Alpes-Maritimes province (Conseil Général des Alpes-Maritimes) and the local water

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agency (Agence de l'Eau Rhône Méditerranée Corse) funded the multidisciplinary project MediOs: "Development of the toxic dinoflagellates genus *Ostreopsis* on the North-Western Mediterranean coast: highlighting the risk areas and initial assessment of environmental, health and socio-economic impacts". The project was undertaken between 2008 and 2010 and allowed the creation of a network of French researchers in ecology, biology, physiology, chemistry, medicine and economics. Interactions with managers and policy makers were an important part of the project, from local (*i.e.* municipalities) to national (*i.e.* Ministries) levels. After overcoming differences in working and communication processes and the variety of distinct interests, exchanges were fruitful and constructive. MediOs scientists actively participated in the common interest, by reporting contaminated sites, making recommendations for an official monitoring program and acting as experts for the French National Health Agency. The project had also a socio-economic perspective, with the first estimation of the potential economic impacts of *Ostreopsis*, accounting for future trends.

This manuscript aims to underline the role of the different interactions between scientists, managers and policy-makers, summarizing mostly from the scientists' point of view and addressing issues often overlooked in the scientific literature.

INTERACTIONS BETWEEN MEDIOS AND THE FRENCH MONITORING PROCESSES

The French National Health Agency (Direction General de la Santé – DGS) has maintained a sanitary and environmental monitoring program since 2006 (Tichadou *et al.*, 2010). Local health care agencies and professionals (*i.e.* doctors, pharmacists) and beach professionals (*i.e.* beach managers, coastal rescue) were notified, at the beginning of each summer season, with environmental (*i.e.* evidence of benthic microalgal blooms) and health (*i.e.* intoxications and/or other diseases) criteria related to the presence of *Ostreopsis* spp. Health care and beach professionals had to report to the "Poison Control Centre" of Marseilles each suspected microalgal development. When a potential benthic microalgal bloom was recorded, the abundance of *Ostreopsis* had to be quantified. At present, there is no European or international official maximum abundances threshold of *Ostreopsis* spp. in the water or on macroalgae. The DGS (via regional agencies) uses empirical thresholds since 2007, based only on planktonic *Ostreopsis* cell concentration. The threshold of "Warning" was 4,000 cell/L, while the "Alert" threshold was 30,000 cell/L (Tichadou *et al.*, 2010). In 2007 and 2008, every time the "Alert" threshold was exceeded, an Emergency Committee (EC, composed of doctors of national and regional Health Agencies, environmental experts – including MediOs scientists –, managers and policy makers) was solicited for a conference call, and assigned with the responsibility of possibly limiting beach activities or temporarily closing impacted sites. Following the experience of the first two summers (with too many EC solicitations unassociated with health cases), the thresholds were increased in 2009 to 30,000 cell/l (Warning) and 100,000 cell/l (Alert; Tichadou *et al.*, 2010).

During the summers of 2008 and 2009, research activities linked to MediOs project allowed us to monitor *Ostreopsis* abundances in several potentially impacted sites. Each time the empirical planktonic threshold was exceeded, authorities were notified and the subsequent EC solicited. It was agreed during

these EC that, in the absence of an institutional monitoring, MediOs researcher would have (exceptionally, as this is not a task normally assigned to scientific research laboratories) quantified *Ostreopsis* abundances in the impacted areas.

Since 2010, after the end of MediOs fieldwork, a significant decline in *Ostreopsis* excess thresholds notification was recorded. Since this year, an institutional environmental monitoring program was set-up but was limited to only 2 sites per French coastal department along the Mediterranean coast, sampled twice a month in summer.

Concerning the seafood monitoring, the DGS and/or its local representatives initiated two French meetings on *Ostreopsis* (Marseille, September 2008; Paris, November 2008); scientists of MediOs project were invited as experts in order to contribute to the development of new research projects. The Paris meeting was initiated following the Ifremer results obtained within MediOs project: during summer 2008, palytoxin (and mainly a derivate of this molecule) was found in large quantities in the digestive tract of the edible sea urchin *Paracentrotus lividus* (Amzil *et al.*, 2009). As a result of these two meetings, two projects have been funded by « Ministère du Travail, de l'Emploi et de la Santé » :

1) an Ifremer project with the aim of investigating the possible contamination of filter-feeding organisms (mussels) and sea-urchins in Marseilles and Villefranche-sur-Mer. Mussels, as well as sea-urchins, in fact concentrated *Ostreopsis* toxins and a correlation was found between the amount of toxins in organisms and the concentration of *Ostreopsis* in the field (Amzil *et al.*, 2012);

2) an ANSES (French National Agency for Food Safety) project, in partnership with the Oceanographic Laboratory of Villefranche, with the aim of studying the possible accumulation of toxins in the food chain, via specific toxicity tests and chemical analyses. Studied organisms comprised shellfishes, crustaceans, echinoderms and fishes; several organisms, belonging to all sampled groups, contained palytoxin and derivatives (Trotreau *et al.*, 2011).

RECOMMENDATIONS TO OPTIMIZE THE MONITORING PROCESSES

At the end of the MediOs project, scientists put forward several recommendations in order to improve the monitoring processes, including new sampling procedures, the implementation of seafood monitoring as well as the set-up of a real statutory instrument.

Sampling procedures and monitoring thresholds: Our studies within MediOs showed that high concentrations of *Ostreopsis* in the water are ephemeral and linked to currents and hydrodynamic conditions. Even if planktonic concentrations are more easily measurable than benthic abundances, they are more variable in time and space. It is therefore necessary to perform also benthic abundances quantifications, more conservative and more representative of the realistic “risk” evaluation of a site. This implies revising the thresholds for Warning and Alert of *Ostreopsis* that should be based on benthic abundances.

Implementation of seafood monitoring: The DGS sanitary and environmental monitoring is mostly intended to limit the risks of direct contact or inhalation of cells, cell fragments or toxins of *Ostreopsis*. But food intoxications cannot be excluded, as palytoxin and derivatives have been found in several Mediterranean edible marine organisms (Aligizaki *et al.*, 2008; Amzil *et al.*, 2009). Based on observations in tropical areas, poisoning due to palytoxin and derivatives can be severe and may lead to death (see synthesis in Tubaro *et al.*, 2011).

European Food Safety Authority (EFSA) recommends that toxin level in shellfish should not exceed 30 µg of palytoxin and analogues Ostreocine-D per kg (EFSA, 2009). In France, such a recommendation is taken into account by Ifremer (Institut français de recherche pour l'exploitation de la mer) within the REPHY monitoring network for organisms in aquaculture areas. But *Ostreopsis* potential poisoning could also concerns natural organisms regularly collected during recreational fishing or by local professional fishermen (*i.e.* sea-urchins, shellfishes, crustaceans, fishes, etc...). How can the whole French Mediterranean coast be monitored in order to be considered safe for these activities? What organisms should be targeted? How often? At the moment there are few scientific bases to answer these questions, but the risk has to be clearly identified and a food monitoring should be set up in the next future.

Establishment of a statutory instrument: The vision of the danger of *Ostreopsis* varies among managers and policy makers. Some of them believe that the existing or potential health problems do not require the establishment of an important monitoring activity; however, others believe that environmental monitoring implementation should progress quickly with an increase in the number of sites and in the sampling frequency. Tichadou *et al.* (2010) identified 47 cases of poisoning in relation to the contact or inhalation of *Ostreopsis* in the Provence-Alpes-Côte d'Azur (PACA) region from 2006 to 2009. This corresponds to an average of 12 poisonings per year, with a relatively quick recovery, results that do not support the establishment of a heavy and expensive monitoring. Nevertheless a real risk of mass poisoning exists: several hundreds of intoxications (including swimmers, walkers or residents) were recorded in Spain in 2004, in Italy in 2005 and in Algeria in 2009 (Mangialajo *et al.*, 2008; Vila *et al.*, 2008; Illoul *et al.*, this issue). Such mass intoxications are infrequent because they require a combination of circumstances: a large marine surface area suitable for *Ostreopsis* development, a bloom of this species which induce a large proportion of planktonic cells, an off-shore wind bringing sea spray towards the coast and finally a large number of people on the waterfront. Most of the time, mass intoxications are not dangerous for contaminated people, but they can easily clog hospital emergency facilities, inducing a potentially dangerous delay in the treatment of other patients. For this reason, in order to avoid mass intoxications, an adequate monitoring should be implemented. The French current institutional environmental monitoring (already presented above) is based on a "memo" ("note de service" in French) edited each year by the DGS. This "memo" may not be as authoritative as necessary for a delicate subject dealing with health problems related to natural toxins. A national or international (*i.e.* European) legislation with well-established standards would be more appropriate. A first step in this direction is given by EFSA (see above, with toxins thresholds), however a regulatory instrument linked to *Ostreopsis* urgently need to be developed.

POTENTIAL ECONOMIC IMPACT

In addition to health impact, managers and policy-makers must take into account the potential economic impact of *Ostreopsis* in order to decide the level of monitoring to be established.

During MediOs project, the Provence-Alpes-Côte d'Azur (PACA) region was selected as a reference for the evaluation of potential economic impact

of *Ostreopsis* development. The economy of this region is strongly linked to the sea, through fishing, aquaculture, ports and above all recreational beach tourism. Tourists spend 11 billion Euros in the region each year, mainly during the summer. The estimation of the impact of *Ostreopsis* in the framework of MediOs project was based on surveys conducted among beach users and businesses in the immediate vicinity of beaches, as well as on information about *Ostreopsis* available on the Internet (Internet being the main source of information for holidaymakers and tourists coming to the region for the first time). The information obtained was then crossed with the economic data available, to estimate the magnitude of the potential economic impact of *Ostreopsis* (Soliveres & Hoareau, 2011). Three different scenarios have been proposed:

1) The same situation than observed in 2008/2009. Blooms are recorded only in not-very productive areas and no business had to stop activity: no significant impact on the regional economy is recorded and the phenomenon remains less known and less frequent than the invasions of jellyfishes (that have not reduced the attractiveness of the region);

2) An amplification of the phenomenon. In addition to the blooms recorded in the scenario 1, a big bloom occurs and an important touristic beach has to be closed, together with a high-profile media event occurring in the middle of the summer: a negative impact at the regional scale may be recorded and business losses could reach several hundred thousand Euros;

3) A repetition of (at least) the scenario 2 every year, associated with an alarmist communication in the media could lead to a drop, although slight, in tourism. In the PACA region, even a slight drop in tourism may be associated to a significant economic loss, reaching tens of millions Euros.

The estimate of the potential economic impact of *Ostreopsis* development is obviously in favor of implementation of an important health and environmental monitoring at the French level.

CONCLUSION

Needs concerning basic and applied knowledge on *Ostreopsis* developments are increasing with the number of actors involved in the problem. For example, managers in charge of the quality of recreational waters need different information than those in charge of seafood safety (the ones dedicated to recreational fisheries food and the ones dedicated to exploited resources). It is also obvious that through the important increase of actors, actions around *Ostreopsis* are not always cooperative. A priority for dealing with this new phenomenon is to set up a National Steering Committee on *Ostreopsis* (NSCO), bringing together actors from the environment, health, coastal management, crisis management and communication. NSCO would guarantee a coordination of actions, taking into account the needs of all managers involved and giving guidelines for basic and applied research in France.

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