

# REPAMO: A French network for the surveillance of mollusc health

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## Summary

The REPAMO is a French Network for the surveillance of Mollusc diseases that notably meets the obligations of the European Directive 2006/088/EC. It is entirely funded by the French State. The coordination of this network entrusted to the Institut Français de Recherche pour l'Exploitation de la Mer since 1986 aims at monitoring the notifiable endemic diseases, detecting the emergence of exotic or new pathogens and ensuring a minimum level of surveillance of the general health condition of molluscs. Beside IFREMER, different partners are involved in the surveillance of mollusc health at the national level: the Departmental direction for territories and sea who are the local representatives of the competent authority and the producers who have the obligation to notify any suspicion or any abnormal mortality.

The network REPAMO thus relies on active and passive strategies. It collects and manages data related to laboratory tests and information concerning sampling that are recorded in a national not open accessible database (also named REPAMO) to respect confidentiality of some data. Results are analysed and edited at least annually under a report format which is sent to all the network partners.

The test results allow mapping the geographic distribution of targeted pathogens including notifiable ones and have highlighted certain spatio temporal trends in mortality outbreaks.

The network adapts its strategy according to the epidemiological context, the evolution of the production in terms of organisation, quantity and diversity of species, the evolution of the regulation and the knowledge of the diseases it deals with.

## Introduction

France is one of the first European country producing molluscs. This production relies on more than 3700 businesses (1). The REPAMO (French Mollusc Pathology Network) is the largest shellfish surveillance network in Europe (in terms of national coverage, total number of tests, number of people involved, and number of species monitored). It was set up in 1986 and is a surveillance network for mollusc health along the coastlines of France, living under farmed or natural conditions. This surveillance mission is carried out by the Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER). It fulfils some of the requirements of the European regulation (Council Directive (CD) 2006/088/EC dated 24 October 2006, 2).

The network functions independently, its funding being ensured entirely by the State. The 55,000 private leases and hundreds of thousands of tonnes of shellfish and natural populations are thus monitored only by public-sector agencies.

The objectives of this network are (i) to monitor the course of notifiable diseases affecting molluscs and present in France (*Bonamia ostreae* and *Marteilia refringens*) (ii) to detect the appearance of emerging or exotic diseases, and then follow their course (iii) to ensure a minimal level of surveillance of the general health of molluscs.

In response to this third objective, two strategies have been adopted.

The first one is active and is based on a routine monitoring of main mollusc species, main diseases and aims at describing the health status of these animals outside mortality outbreak. This monitoring can be planned in advance and since 2004, it has targeted one mollusc species and one disease for two years.

The second strategy to ensure a minimal level of surveillance of the general health of molluscs is passive and is based on the monitoring and investigations of increased mortality which can not be planned. According to the CD 2006/088, any increased mortality should be notified by the farmer to the competent authority. In the Directive, increased mortality is defined as “unexplained mortalities significantly above the level of what is considered to be normal for the farm or molluscs farming area in question under the prevailing conditions. What is considered to be increased mortality shall be decided in cooperation between the farmer and the competent authority” (2). This definition suggests the need of having a reference picture of the normal mollusc health situation.

After explaining how the network operates, we will present the types of data collected and give example of results obtained through the network. Lastly, taking into account huge mortality outbreaks that the French oyster production has faced since three years, we will draw some perspectives in order to have a network adapted to this new situation.

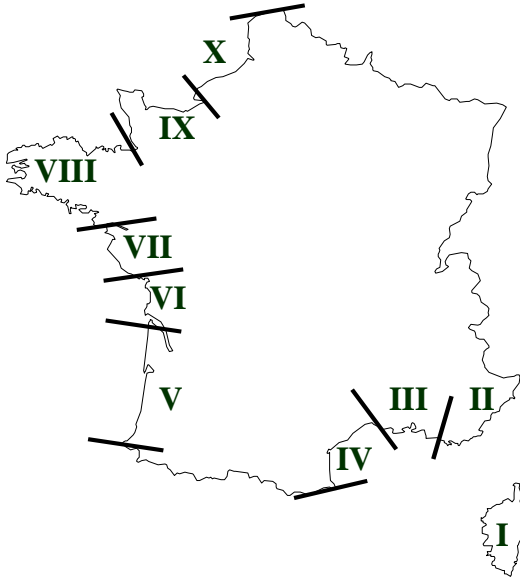
## Materials and methods

**Sampling:** A health zoning plan regarding diseases affecting flat oysters has been established for French coastal regions. The zones have been determined according to different criteria: frequency of transfers; hydrological coherence; administrative decision-making unit; data on production of the species; data on variations in the prevalence of infectious agents; compatibility with control activities. Ten production zones have been used as a starting point for sampling, and then adjusted for each mollusc species (Fig. 1).

The epidemiological unit may be a zone, a part of a zone, a cession or an oyster bed, or a wild population. All epidemiological units may be the subject of sampling, depending on the circumstances.

Sampling will depend on the objectives defined above. In order to monitor health status, a minimum sample of 30 individuals per epidemiological unit was defined in the first instance, for each species, age category, and for each major coastal zone. The minimum temporal frequency required for this sampling has been fixed at twice a year, at the end of winter and during the summer, because of seasonal physiological changes. Rises in temperature and the summer reproductive period correspond to a period of increased vulnerability in many molluscs, from which numerous infectious agents profit.

**Figure 1.** French mollusc production zones where REPAMO sampling campaigns are carried out for the surveillance of bonamiosis and marteliosis

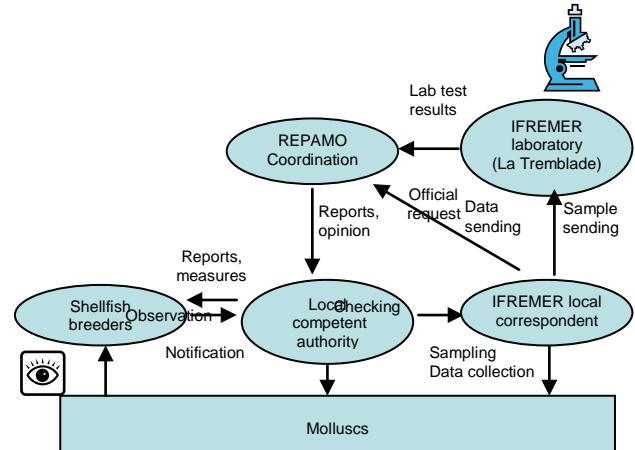


The study of abnormal mortality is adapted on a case-by-case basis. As a general rule, the greater the suspicion of infection, the more samples will be collected. The sample includes a minimum of 30 individuals.

**Operation:** The competent authority with respect to mollusc health is the Ministry of agriculture and locally the Departmental directions for territories and sea (DDTM), which calls upon IFREMER for its expertise in this area. The IFREMER coordinates the REPAMO network in response to the objectives fixed by the European

Commission, thus ensuring the surveillance of notifiable diseases, routine monitoring of the principal species of commercial interest and study of cases of increased mortality. In addition, IFREMER ensures the testing of all samples collected in the context of the network. If the test results so justify, it is the Prefect for the region who takes the decision to close a production zone.

**Figure 2.** Operational flow chart for the REPAMO network



The functional relationships between partners in REPAMO are presented in Figure 2. DDTM participate in estimating mortality and collecting samples for the REPAMO network. Within IFREMER 14 coastal units, including 11 coastal IFREMER laboratories, are involved in the activities of the REPAMO network. Within each coastal laboratory, a REPAMO correspondent ensures the collection of samples and background information (using standardized questionnaires), in the context of continuous monitoring and in cases of increased mortality. All test results are centralised by the IFREMER laboratory at La Tremblade. The network also benefits from the application of new diagnostic techniques and advances in knowledge on mollusc diseases achieved by the research team at La Tremblade.

**Data collection:** The data collected in the context of this network are of two types: the results of laboratory tests, and information concerning sampling collected through standardized questionnaires including estimated mortality rates, production conditions and environmental parameters. Data from the questionnaires and laboratory test results, are stored in the national REPAMO database. Some of this information is subject to confidentiality rules. Data on sampling sites can be transposed onto a geographical information system.

*Data diffusion:* Local authorities receive individualised reports. Monthly national bulletins and annual national reports are sent to all the partners of the network including representatives of shellfish breeders. In addition, annual meetings bring together all participants in order to standardise the methods used to collect data at a national level. This meeting includes general information on mollusc pathology, and more practical sessions aimed at ensuring the satisfactory operation of the network. Finally, efforts are made by IFREMER and the authorities to explain the work of the network to producers and thus increase their awareness of mollusc health.

## Results

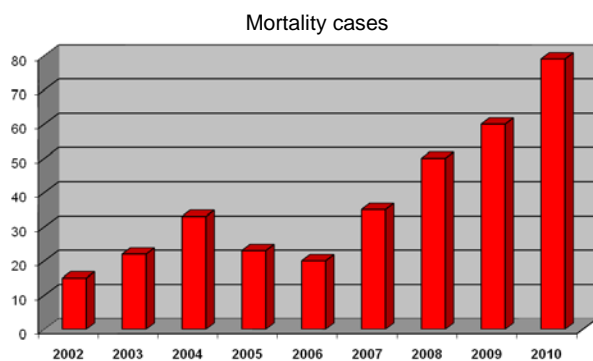
The network produces test results on between 2,000 and 4,000 shellfish a year. The number of tests carried out notably depends on the number of mortality cases notified each year. The number of mortality cases investigated by the network has particularly increased since 2008 (Fig. 3) reflecting the crisis affecting the French production of Pacific cupped oyster, *Crassostrea gigas*. The tests performed in the context of the network have allowed to determine the status of the ten zones regarding *Bonamia ostreae* and *Marteilia refringens*. These two protozoans have been detected in all the zones except in zone X. Test results have also in some cases made it possible to discover infectious agents that are associated with mortality (e.g. OsHV-1 and *Vibrio* strain in *C. gigas*) or to demonstrate the presence in France of infectious agents previously considered to be exotic (*Bonamia exitiosa*).

Network activities also permit the collection of isolates to test new diagnostic tools, and increase the availability of equipment to establish pathogen taxonomy (e.g. *Vibrio* strains, 3).

Moreover, the work of this network has highlighted certain trends in mortality outbreaks and notifiable diseases:

- potential spatial trends, with summer mortality occurring along the French coastline according to a South-North gradient (4).
- greater susceptibility of flat oysters *Ostrea edulis* to bonamiosis with age (5);
- presence of *Perkinsus olseni* in four clam production areas in France (6).

**Figure 3.** Number of mollusc mortality cases investigated by the REPAMO between 2002 and 2010



## Discussion

The REPAMO was set up in 1986, that means before the implementation of the first EU regulation related to aquatic animal health surveillance (Council Directive 91/67/EEC). Since that time, the context has changed. Close links with research are essential notably to improve the diagnosis of targeted pathogens; Local epidemiological studies are necessary to optimise the sampling strategy and enable a clearer understanding of the results generated by the network. Shellfish production is developing rapidly, and the numbers of live animals shipped within, and outside, the EU for re-immersion are constantly growing, as is the share of hatcheries (in addition to natural capture) in the production of spats. In this context, the network also needs to evolve, by applying an appropriate strategy to prevent the propagation of serious mollusc diseases in all French coastal regions through the transfer of infected animals, as has happened in the past.

In the summer of 2008, 2009 and 2010, severe mortality events in cultured Pacific oyster were reported from France and other main European producing countries. The available evidence suggests that infection with the Ostreid Herpes virus type 1, and especially the variant OsHV-1 $\mu$ var, is a necessary cause but may not be a sufficient cause (7). The network REPAMO was highly involved in the epidemiological investigations carried out to better understand this crisis.

## Acknowledgements

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