IMPACT

UNDERSTANDING CURRENT THREATS TO EUROPE'S SHELLFISH INDUSTRY

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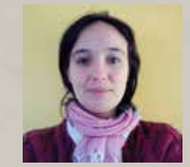
Impact Objectives

- Gain a greater understanding of bivalve diseases and what causes them to emerge and spread in a bid to ultimately develop innovative solutions and tools for their management and prevention
- Improve the sustainability and competitiveness of the European shellfish industry

Understanding current threats to Europe's shellfish industry

__Dr Isabelle Arzul__ and __Estelle Delangle__ discuss the current issues facing the European shellfish industry and how projects such as __VIVALDI__ and the __EU Reference Laboratory for Mollusc Diseases__ are working to find the solutions

Dr Isabelle Arzul



Estelle Delangle

What research is being completed at the EU Reference Laboratory for Mollusc Diseases (EURL) in Europe and why is this work important?

IA: Considering the importance of shellfish production in Europe and the vulnerability of this sector against diseases, it is necessary to implement an efficient system for the detection and surveillance of these diseases. The EU Reference Laboratory for Mollusc Diseases (EURL) aims at harmonising and improving surveillance and diagnosis for the main diseases of molluscs in Europe. Located at La Tremblade, in the middle West coast of France, it coordinates a network of around 23 National Reference Laboratories. Activities of the EURL include: assistance to the European Commission in the preparation and improvement of the EU legislation; assistance to the Member States in the detection and characterisation of pathogens of molluscs; development and validation of sensitive, specific and relevant diagnostic tools; and organisation of inter-laboratory comparison tests.

Your latest project VIVALDI (PreVenting and mItigating farmed biVALve DIseases) aims to increase the sustainability and competitiveness of the European shellfish industry. What are the current problems with and greatest threats to the European shellfish industry?

IA: The European shellfish industry currently faces recurrent mortality outbreaks, such as mortality of cupped oysters associated with the virus OsHV-1 or the bacteria *Vibrio aestuarianus*, mortality of clams and cockles associated with parasites of the genus *Marteilia* or *Mikrocytos*. The frequency of these events seems to increase and new pathogens emerge. Disease emergence is difficult to explain and to anticipate, especially in a context of global change.

It is proposed to take a 'global shellfish health approach'. Can you explain what this is and why it is a valuable approach to adopt?

IA: For many years, we have investigated interactions between shellfish and their pathogens without taking into account microbial communities (microbiota) hosted by the shellfish, that can also contribute to protecting bivalves against diseases or conversely to the development of diseases. VIVALDI wants to decipher complex interactions between host, pathogen and microbiota in order to identify potential indicators of the health status of the animals under environmental conditions.

Microbiota profiles could indeed be indicative of good health or bad health status and could be used as a tool for the early detection of any imbalance that can subsequently lead to disease and mortality.

A key part of VIVALDI is working collaboratively with industrial partners. Why is it important to take such an approach?

ED: In the case of VIVALDI, industrial partners are mostly the end-users of our innovative developments, including hatcheries, nurseries and producers. As a consequence, we have included a union representing nurseries in our consortium, and many partners have very strong relations with the local producers in their countries. This close link is indispensable if we want our outcomes to make a difference beyond pure science.

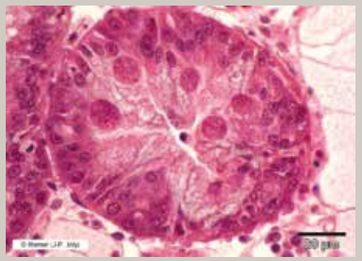
Another key part of VIVALDI is to better understand how stakeholders are organised in the different EU countries, because interactions and dialogue between different stakeholders impacted by shellfish diseases, such as the public decision-makers, the industrials, the local producer and the scientists, could be much improved if they knew each other better. If we want our research project's outcomes and the potentially resulting disease management measures to make a real difference, we need to know what the stakeholders' perceptions and expectations are.

Supporting sustainable growth in aquaculture

Disease is the biggest threat to the European aquaculture industry. In an effort to keep the shellfish production competitive and sustainable, the __VIVALDI__ project is combining European research resources to better understand shellfish diseases and improve communication among the vast groups of stakeholders

One of the world's fastest growing animal food production sectors is in desperate need of protection. Aquaculture, the farming of marine animals for food, is an increasingly important contributor to the world's food supply and there are serious threats to the industry in Europe. Marine-water aquaculture consists of farming a variety of aquatic food sources such as marine molluscs, finfishes and crustaceans.

For European countries, the production of shellfish, animals like oysters, clams, scallops and mussels, is a hugely important component of the aquaculture industry. According to Dr Isabelle Arzul, a marine pathologist based at the Institut français de recherche pour l'exploitation de la mer (Ifremer), Europe represents nearly 2 per cent of the world production in weight and 3.5 per cent in value. 'The shellfish industry accounts for 48 per cent of the aquaculture production in weight and 28 per cent in value. The total sales volume for the shellfish sector in the EU is estimated to 660,000 tonnes. This results in an estimated turnover of €1.2 billion in 2012, with France and Spain being the main shellfish producers in the EU.' This industry has massive potential for growth and diversification, but also some serious challenges to overcome in order to realise this potential, namely the threat of disease.



Histological section of a flat oyster showing the presence of parasites Marteilia refringens in the digestive gland

Collection of hemolymph from a young cupped oyster

The European shellfish industry has suffered from slow growth over the last couple of years and is specifically hampered by infectious diseases of bivalve crops. Shellfish production is already a labour intensive process and losses to disease outbreaks hamper producers in three ways: the direct loss of animals; indirect losses from decreased productivity resulting from costly management efforts; and losses due to trade restrictions placed on exports. Arzul says that since 2008 the cupped oyster spat has suffered from significant mortality attributed to both the disease OsHV-1 and environmental factors. 'Mortalities were considerable, particularly in seed stocks resulting in a shortage in the shellfish supplies and pushing some farmers to financial ruin. The French annual production dropped from 120 000 tonnes to 80 000 tonnes per year.'

The nature of shellfish production contributes to its vulnerability to disease. Shellfish are grown in open natural environments – the sea – that make containment of pathogens virtually impossible. There are also no available treatment or vaccination options making disease prevention a critical step. In order to achieve prevention, however, industry stakeholders and researchers must first understand bivalve diseases and what causes them to emerge and spread in farmed regions. The VIVALDI (PreVenting and mItigating farmed biVALve DIseases) project has been established to improve the understanding of bivalve diseases and develop innovative solutions and tools for their management and prevention.

A MULTI-TALENTED TEAM

The VIVALDI project is a consortium of 21 partners spanning 10 countries, whose goal is to improve the sustainability and competitiveness of the European shellfish industry. Arzul, who is the scientific coordinator of VIVALDI, says that in order to better detect pathogens, to avoid their introduction and spread, the partners will be focused on understanding pathogen diversity and bivalve-pathogen-environment interactions. 'Our work will evaluate the risks of introduction and spread of pathogens and we will model pathogen spread depending on environmental factors.' One of the priority areas for the team is to identify best practices to mitigate the impact of diseases.

The data obtained by VIVALDI researchers will help to contextualise the global changes in the development and emergence of diseases, and therefore contribute to improving husbandry practices. Through both sampling and monitoring studies conducted in the field, and experimental approaches carried out in laboratories, VIVALDI employs a variety of individuals, all with unique skillsets, and brings them together to share knowledge and improve understanding.

Working across such broad topic areas necessitates a diverse team. 'These studies require a wide range of complementary expertise including pathology, genetics, immunology, epidemiology, aquaculture, modelling or social sciences,' explains Arzul. For example, understanding oyster microbial communities requires next-generation sequencing techniques and the geneticists and bioinformatics experts needed to acquire and analyse the data, while the approaches to modelling the transmission and spread of pathogens requires epidemiologists and specialised IT engineers. Perhaps most surprising, is the innovative plan to incorporate social sciences into the project. 'We have also included sociological approaches, in order to better understand the perception of the stakeholders facing shellfish diseases,' highlights Arzul.

Communication with stakeholders is a very important aim of the project due to the international stage on which the industry operates and the importance of shellfish movements in disease mitigation. She believes that 'better communication between different regions producing shellfish all over the world is essential to control the impact of diseases.'

OVERCOMING KEY CHALLENGES

One year into the project and the team has overcome a number of challenges. They are starting to see the early results from the intensive sampling efforts that took place at the project's key European sites. Samples of bivalves, micro-invertebrates, sediment and water for example, are all now ready to be analysed and used in a variety of laboratory experiments. The diversity of different viral and bacterial pathogens is currently being assessed among the member countries, and risk models are being developed that will assess the risk of pathogen introduction and spread in designated farms or areas.

The early results of surveillance experiments demonstrate a key finding: that it is possible to detect viruses in water using passive sensors. Arzul explains the importance of these sensors: 'Surveillance of mollusc diseases has for many years relied on the detection of pathogens in molluscs, whereas such innovative tools could be very useful to establish the temporal identity card of mollusc farming areas and will help farmers better manage their shellfish stocks with regards to diseases.'

The VIVALDI team has also overcome a number of the challenges associated with coordination and communication across such a large and diverse group. The team has been able to harmonise and follow-up the sampling efforts in the different sites and coordinate the subsequent exchanges of data. They hope to see partners publish together and not limit publications of their results solely to their corners of the project.

MAINTAINING MOMENTUM

Communication between research groups is, however, only one organisational challenge, as the group also deals with a large variety of industry partners and stakeholders. Because one of the main goals of VIVALDI is to better identify and understand the organisation of the stakeholders concerned with bivalve disease, a first survey has been carried out. Results of this survey have identified the main players and qualify their involvement in disease management. As the team learns to communicate the important results outside of academia, these survey efforts will help to reveal the best channels to disseminate key results.

The VIVALDI team is looking to build on the success of the past year on a number of fronts. Tests of the passive sensors for pathogens are scheduled to move out of the lab and into the field this year. The results of large-scale microbiome sequencing efforts will begin to take shape. To stay up-to-date with the project, keep an eye out for the World Aquaculture Forum in Montpellier, France in August 2018. Here, the team plans to organise a workshop to convey the progress realised so far and discuss the expectations of these results with the largest possible panel of different stakeholders concerned with shellfish diseases.

Project Insights

FUNDING

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BIOS

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