Pearl Oyster Health Surveillance Network
*Pinctada margaritifera* in French Polynesia

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1. From REPANUI …
REseau de PAthologie NU1 (large in Tahitian)
(Pathology Network)

1.1 Introduction
The pearl oyster *Pinctada margaritifera* pathology surveillance network was put into action in 2003, by the Pearl Oyster Agency and Ifremer. It answered a health necessity due to an outburst of concession numbers (10 in 1980 / 2,745 in 2000), to a doubling of density of oysters to an hectare in a few years and to a large increase of oysters transfers between atolls (0 in 1980 / 105 in 2000). The mortality episode of *P. fucata* in 1997 in Japan, did of course play a role in this strategic choice. Its management and functioning are, since 2008, under the responsibility only of the Pearl Oyster Agency.

Aims of this network were to :
• Evaluate the health situation in Polynesia ;
• Watch the evolution of current infectious agents ;
• Rapidly detect exotic pathogenic agents ;
• Prevent their spread and eliminate their source.

1.2 Materials and Methods
Detection of infectious agents occurs through the histological study of different organs of *P. margaritifera* and other bivalve species (*Pinctada maculata, Saccostrea cucullata, Chama* sp., *Lithophaga* sp., *Arca avellana*, *Arca ventricosa, Monia* sp. and *Isognomon* sp.). Samples are taken in 6 atolls or islands of French Polynesia, in 2 sites per island, at the rate of 30 bred pearl oysters and 5 other bivalves per site. After fixation in the Davidson and treatment in preparation for inclusion in paraffin, tissues are cut 3 µm thick coloured with haematoxylin-eosin before being observed in photonic microscopy.

1.3 Sampling
The number of analysed animals during this period of time is 3,455 *P. margaritifera* and 713 other molluscs.

For comparison, 214 pearl oysters from wild populations of remote, inhabited atolls were subject to sampling as well.

1.4 Results
Three infectious agents, non pathogenic, were regularly identified : Gregarines protozoa, Rickettsia-like bodies and Parasitic granuloma (*Tylocephalum* sp).

These infectious agents are diagnosed in all the monitored sites, at relatively stable levels, in space as well as in time. Gregarines are present in 60% to 90% of oysters. Rickettsia-like and parasitic granulomas fluctuate between 5% and 15%.

Wild population of pearl oysters is, on average, a lot more infected by *Tylocephalum* sp.

Other molluscs studied present infection levels generally weaker or even nil, depending on species, for some agents. *Chama* sp. and *Monia* sp. distinguish themselves by their high levels of rickettsia-like.
Comparisons between breeding and wild fauna are to be taken with caution. The exploitations monitoring does not allow to estimate prevalence levels due to the non random sampling mode which favour oysters with no economical value, having rejected the graft or presenting any defect. Listed infectious agents have a marked tropism for certain organs. Gregarines are preferentially found in the epithelium of the intestine, rickettsia-like in the digestive gland and parasitic granulomas in the digestive gland, gills, gonad and visceral mass.

1.5 Discussion
After a year of launch and five years of observation, the pearl oyster pathology network “REPANUI” has allowed to draw up an evaluation of the health situation, to control missions logistic, to acquire solid competencies in diagnostic and to make up a hierarchical referential. A real collaboration was born between administrative agencies (Pearl Oyster Agency, Fisheries) and research institutes (Ifremer), made a reality by gathering equipment and staff within a technological platform. On this basis, other aims assigned to the network are still to be reached. Some structural modifications are therefore necessary due to the type of sampling, the restriction to six atolls and to the absence of professionals involvement outside sites pilots. Impossibility to estimate prevalence of current infections, lack of flexibility and reactivity and the inefficacy of the current alert system led us to design the “PERSANE” network.

2.2 Implementation
Creating a health unit having to travel regularly to about thirty islands and atolls as well as having to intervene anytime in case of suspicion impose, in the Polynesian context, to dispose of an aircraft. Advantages offered by general aviation compared to public transport in the framework of our approach are various : flexibility of days and hours, inter-insular links without return via Tahiti, permanent seats availability, possibility of urgent interventions, accessibility to airfields not open to public aerial circulation and ability to carry freight prohibited on commercial lines. The financial study of the project brought up an economy of 30% on transports and 60% on mission fares.

A new sampling strategy based on a random draw for monitoring and a risk analysis for health surveillance has been retained. It allows to estimate the prevalence rate of known infections as well as to maximise chances of exotic pathogenic agents detection. In order to best promote missions and to conduct efficiently surveillance, a screening by quantitative PCR is planned. It will be conducted by way of field equipment, developed for extreme conditions, giving an answer in 30 minutes. A certain number of samples (particular controls, suspicious cases, doubts) will be brought back to the laboratory of Tahiti to undergo an histological analysis, reference method of O.I.E.

2.3 Field trips
Each week field trip allows to control four or five islands or atolls. Six missions twice a year are planned. In addition to these systematic passing, occasional tasks can be launched anytime in case of doubts. The Pearl Oyster Agency health team then goes on the field in the 24 hours following the alert in order to conduct an epidemiological study; necessary samples and to take the first conservatory steps. If the suspicion is confirmed by histology, samples are sent to a laboratory of reference.

2.4 Intervention Team
The team is multidisciplinary. It gathers diverse health competencies (pathologist, epidemiologist, vet) and technics (logistician, topographer, professional diver, professional pilot). As a result, the Pearl Oyster Agency is totally self-sufficient. Planes are rented bare fuselage and must be operational in the 24 hours following the request for the intervention team. Society POL’AIR holds a fleet of two P68, a B1900 and a B350 (both requiring the same turboprop qualification) and has been chosen. In case of unavailability of the Pearl Oyster Agency pilot, POL’AIR is committed to make one of their pilot available.
2.5 Expected Results

The PERSANE network will start on July 1st 2009. It was conceived to minimise financial and economical loss following a major pathologic episode. It regards intervention on all based suspicions within 24 hours, identifying the pathogenic agent within 5 days, assuming this one is referenced, and obtaining confirmation from the laboratory of reference 10 days at the latest after the alert, in order to put in place health policy measures.

2.6 Health Risks Analysis

A health risks analysis has been carried out during second semester 2008. Based on the methodology proposed by O.I.E., it allowed to quantify, in four successive steps : emission assessment, exposition assessment, consequences assessment and risk estimation.

A preliminary step was necessary and was subject to a bibliographic study and experts opinions : identification of dangers. Few data have been published regarding pathogenic agents of Pinctada margaritifera. If strong suspicions are about certain protozoan, non detected in French Polynesia until now, agents a lot more ubiquitous, being able to acquire a strong pathogenicity during disturbance of environmental conditions, are potentially to fear. Just to remind us the mortality of 80% of hollow oyster spats, in France, in summer 2008, caused by Vibrio splendidus and OsHV-1 which were not listed by O.I.E.

The risk of pathogenic agent introduction into an isolated sector like French Polynesia is linked to the importation of contaminated molluscs, being about animals transported passively (fixed onto ships hull, contained in ballast waters…) or to food commodity not intended to be re-immersed (seafood). As well, its assessment must take into account potential frauds and behaviour at risk such as the lack of grafted materials disinfection, the breeding of fish for aquaria domain, fishing domain, diving domain…

Diffusion of pathogenic agents within a lagoon, then from an atoll to another is linked to oyster transfers as well as numerous water system factors (currents, tides…) and environment factors (salinity, temperature, predation…).

In this context, declaring immediately an abnormal mortality results from statutory obligation as well as civil duty of each pearl producer. For the country, assuring sustainable production of Tahitian pearl goes through among others, health policy measures at the borders and the ability to detect and eliminate infectious sources straight after their outbreak. To that end, the epidemiologic surveillance network PERSANE is going to be unfolded in French Polynesia in second semester 2009.