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Country report from France

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General remarks on the Manila clam fishery

In 1972, France underwent an oyster (*Crassostrea angulata*) crisis and urgently needed to diversify its aquaculture. Thus, Asari clam (*Ruditapes philippinarum*) was introduced at that time for aquaculture purpose, concomitantly with the introduction of Pacific oyster (*Crassostrea gigas*). All Asari clam adults and spat originated from the same area (Puget Sound, WA, USA). After a promising start and the implementation of a national Research & Development program, Asari clam culture rapidly faced a series of concomitant handicaps: firstly, in spite the fact that cultural practices were optimized and locking points addressed, leasing ground availability was limited during the 1980s' due to certain reluctance from oyster farmers to share their leases and/or diversify their activity; secondly, mortality events in the parks probably due to the spat quality, diseases and/or zootechnical errors and/or predation by triggerfish; and thirdly economical competition with Italian production rapidly increased, exacerbated by the occurrence of neonaturalized Asari clam populations and the resulting professional fishing. Meanwhile, European vs national regulations, concerning minimum legal shell length of clams devoted to the market, were unfavourable to France due to contrasted rules between the Mediterranean Sea and the Atlantic Ocean; eventually, several diseases impacted drastically clam populations. At the end of the 80's in Northern part of Brittany (France), mass mortality occurred due to brown ring disease, later related to a prokaryote (*Vibrio tapetis*).

Presently, the French production remains limited to 2 – 3000 metric tons, mainly based upon professional fishing on neonaturalized populations located in two sites (Arcachon bay and Morbihan Gulf). In Arcachon bay, a comprehensive population dynamics study demonstrated the concomitant effects of fishing activity and environmental characteristics on the population dynamics. A management model was developed to assess various scenarios mainly based on conservation measures (*i.e.* fishing area, and/or fishing licences number, and/or fishing period). Implementation of those recommendations has provided some encouraging results. However, Asari clam fitness remains poor: a genetic impoverishment due to population isolation was argued by fishermen, but transplant experiments demonstrated that these bivalves kept their plasticity, at least in terms of growth and condition index. Thus, several environmental factors were investigated as possible key parameters explaining low clam performances. Again, pathologies were pointed out and particularly the high pressure exerted by the protist *Perkinsus* sp. (perkinsosis). Moreover, a new pathology was discovered in 2005 in Arcachon bay, the brown muscle disease. Although the etiological factor has not been confirmed, viral origin is suspected.

A meta-analysis comparing Asari clam characteristics in Arcachon Bay with the international literature pointed out that their reduced condition index in this bay was likely resulting from combined unfavorable factors (e.g., diseases, trace elements). However, 30% of the condition index variability among sites at the worldwide level was explained by food availability (chlorophyll *a* concentration). A comparative morphometric studies on four populations of the French Atlantic coasts, using conventional shape analysis, also revealed significant relationships between morphometric ratios and environmental parameters (chlorophyll *a*

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concentrations and seawater temperature).

Eventually, marine ecologists and state managers as well, must deal with conflictual goals: on one hand Asari clam is an important exploited bivalve in France, on the other hand, the species remains an exotic species which needs careful attention (e.g., European regulations on invasive species).

Basic information on fishery

Geography and geomorphological characteristics: Asari clam fishing is mainly operated on muddy tidal flats, often covered by *Zostera* beds.
Fishing method: By hand, clam dredge, hydraulic dredge
Fishery management: Shell size regulations, fishing closed season, fishing areas, limited licenses
Standing stock assessment: Statistical survey by local fisherman's associations with scientific assistance: not exhaustive (few areas are investigated)

Basic information on aquaculture

Environmental characteristics: Most of the production is from fishery. Asari clam is mostly done on tidal flats.
Culture methods: Smaller part of the national production is bottom culture by seeding, using spats from hatchery.

Major constraints and countermeasures

Habitat degradation: No, except seagrass (Asari clam habitat) that is declining.
Overfishing: Not obvious.
Diseases and parasites: Yes, Large prevalence of *Perkinsus olseni* and rather high intensity. *Vibrio tapetis* is still occurring in the north of the country while brown muscle disease is endemic of Arcachon Bay.
Climate change: Change of food environment is considered to be associated with sea level rise.
Economic aspects: Relatively low price despite low production. Rough competition within Europe.