Foraminiferal assemblages: tools for assessment of shrimp pond conditions.

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Introduction

Since 10 years development of shrimp culture in New Caledonia have been restricted by vibriosis inducing significant shrimp mortalities. Triggering of diseases is the result of loss of equilibrium induced by a lot of environmental parameters including rearing practices. Minimizing impact of disease by improving health of shrimp could be a satisfactory solution. Nevertheless, this way requires a good knowledge and control of biogeochemical parameters at water-sediment boundary and their inter site variability and also development of reliable and simple bio indicators

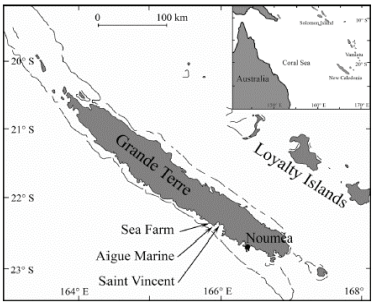

Figure 1 : Location map of the study area

Results

Foraminiferal colonization patterns and behaviour in shrimp ponds.
51 species were identified at 10 stations from 8 shrimp ponds of 3 shrimp farms in New Caledonia (figure 1). Two species, *Ammonia tepida* and *Quinqueloculina seminula,* dominated assemblages. A few days after the filling of the ponds, the pioneering species *A. tepida* and *Q. seminula* grew, *A. tepida* being the more powerful colonizer at the very beginning. Their high reproduction rates led to increasing numbers of living specimens and accumulations of empty tests during the first ten weeks. This initial growing stage is followed by stabilization, related to higher oxygen demand (and drop of redox) and/or consumption of living foraminifera by the shrimps. Consistently with previous studies, *A. tepida* appeared as the most tolerant species to organic accumulations, but its relative abundance dropped when the settlement of lab-lab created low-oxygen conditions. Conversely, *Q. seminula* was able to climb inside the lab-lab up to the oxygenated layer, and its relative abundance increased (figure 2).

Foraminifera abnormalities as tools of assessment of reduced conditions in shrimp ponds bottom. A number of studies mention increased abnormalities in foraminifera tests from polluted environments (named Foraminiferal Abnormality Index [FAI]), but the observations, generally based on a relatively small proportion of abnormal tests, are somewhat contradictory. Moreover similar features, with equivalent proportions of abnormal tests may be observed in areas subjected to natural ecological stress. The proportion of abnormal tests (figure 3) could exceed 80%, and was often higher than 50% in shrimp ponds. FAI appeared to be positively related to the quantity of Easily Oxidized Material (EOM), native, reactive, organic matter associated with reduced inorganic species *sensu* Avnimelech *et al.* (2004) deposited on the bottom of the ponds and to the Sediment Oxygen Demand, and negatively related to Redox (figure 4).

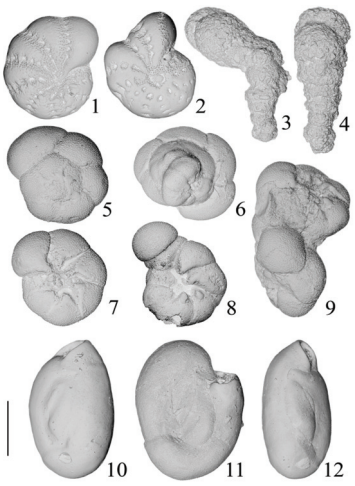

Figure 3 :

1: *Elphidium excavatum*, normal test;

2: *Elphidium excavatum*, abnormal test;

3: *Caronia exilis*, normal test;

4: *Caronia exilis*, abnormal test;

5: *Ammonia tepida*, spiral side, normal test;

6: *Ammonia tepida*, spiral side, abnormal test;

7: *Ammonia tepida*, umbilical side, normal test;

8: *Ammonia tepida*, umbilical side, abnormal test;

9: *Ammonia tepida*, complex abnormal test;

10: *Quinqueloculina seminula*, normal test;

11: *Quinqueloculina seminula*, abnormal test with the last chamber making less than half a whorl;

12: *Quinqueloculina seminula*, abnormal test with the last chamber making more than half a whorl.

Scale bar = 100 µm.

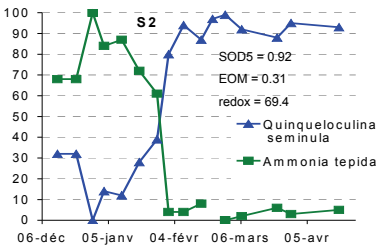

Figure 2 : Variations with time of the relative abundance of *Ammonia tepida* and *Quinqueloculina seminula* in the total assemblage at station S2.

Conclusion

These studies were carried out in shrimp ponds with extreme characteristics from oligo to hyper eutrophic conditions from the western coast of New Caledonia. Although a total of 170 samples only 51 species were found in shrimp pond bottom showing that adverse conditions prevailed comparing the higher species richness in inlet channel and/or tidal salt marsh. The assemblages were dominated by two pioneering species *Ammonia tepida* and *Quinqueloculina seminula*. *A. tepida* appeared as the most tolerant species to organic accumulations, but its relative abundance dropped when the settlement of lab-lab created low-oxygen conditions. Conversely, *Q. seminula* was able to climb inside the lab-lab up to the oxygenated layer, surviving in good conditions and increasing its relative abundance.

The results allow us to infer that a very high proportion of abnormal tests is a potential indicator of a high accumulation of native organic matter, leading to a high Sediment Oxygen Demand. These studies suggest that foraminifera should help to better management of aquaculture ponds.

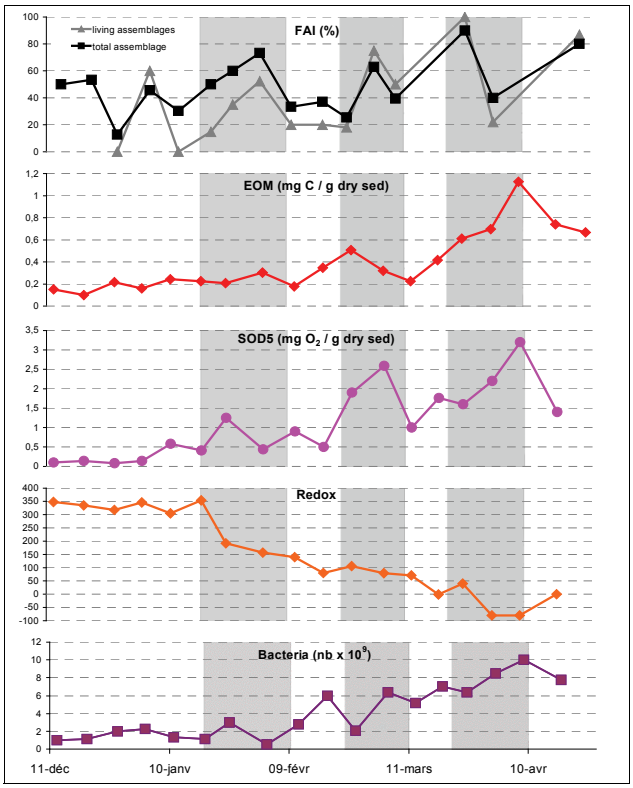

Figure 4 : Changes in physico chemical parameters and density of bacteria with time, compared with changes in FAI at station S2 ; shadows indicate the main peak of FAI values, the grey curve is for living assemblages and the black one for total assemblages

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