# 3.6 Pearl oyster health: experiences from the Philippines, China, the Persian Gulf and the Red Sea

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## ABSTRACT

Available information, based on field and literature survey, on pearl oyster health in the Philippines, China, the Persian Gulf and the Red Sea, are compiled in this paper. While the case studies presented here are limited, the collected information, nevertheless, represent the currently available knowledge. There are some similarities in the abnormalities experienced by the countries particularly shell damage due to heavy fouling, clionid sponge and *Polydora* infection as well as presence of unidentified parasites, inclusion bodies and rickettsia-like organisms. Some farm management practices are discussed.

## THE PHILIPPINE EXPERIENCE

The Philippine Pearl Oyster Industry is based primarily on the gold- or silver-lip pearl oyster, *Pinctada maxima*, along with the winged pearl oyster, *Pteria penguin*, for round, half-round and three-quarter shells and other shell products (Ladra, 1994;

Ladra, 1997). Pearl farming used to be a minor mariculture activity in the country has now grown to be the eighth dollar earner for the fishery sector.

There are at least 30 registered marine pearl farms in the Philippines, with areas covering 1–242 hectares/licensee and occupying a water area if more than 2 000 ha (BFAR, unpublished data). The farms are located in the provinces of Masbate, Sulu, Zamboanga, Tawi-tawi, Guimaras, Davao, Palawan, Quezon, Pangasinan and Samar. The best culture sites can be found in the southern part of the country in Suu, Tawi-tawi and Basilan.

The industry is involved in collection, production and trade. In Bulacan Province, for example, more than 2 000 workers are involved in the jewelry trade; in Cebu Province, there are about 49 mother-of-pearl (MOP) costume jewelry operators and shell-craft processors. Revenue generated from pearl oyster products has increased tremendously from US$9 million in 1991 to US$12 million in 1994 (Table 3.6.1) and to US$15 billion in 2005 (Table 3.6.2).

During the early 1990s, the Pearl Oyster Industry experienced growing mortality losses, as well as shell deformity problems, to the extent that some formerly productive sites have become unworkable.

With the support of the South Sea Pearl Industries of the Philippines[1], the BFAR and collaborating agencies[2], took an initiative to undertake a preliminary assessment of the pearl oyster health problems was conducted in 1996. The assessment involved farm visits, interview with pearl farmers and examination of pearl oyster specimens (gross examination of shell abnormalities and histological examination).

The case-histories presented by the various farms visited under the Pearl Oyster Health Initiative revealed patterns of disease and mortality which matched several of the scenarios of pearl oyster health problems in other countries. Notably, many farmers were reporting high losses shortly after arrival of wild MOP shell stock at the farm site. Plates 1-3 show some characteristic abnormalities observed from Philippine pearl oysters.

Wild oysters collected from deep water (> 60 feet) and raised directly to the surface undergo pressure changes that are assumed to have some impact on physiological functions. In addition, rapid changes in ambient temperature result from transfer from deep to surface waters. Problems with heavy fouling (e.g. encrusting and sessile invertebrates) of oysters collected from shallower waters are also common. These fouling organisms can overgrow the complete shell, including the lips and hinge, impeding feeding and growth. Cleaning of heavily fouled oysters requires removal from the holding system and air exposure which, if not conducted under shaded/ conditions can also be physiologically taxing. Transportation to off-site areas for de-

TABLE 3.6.1
**Revenue from pearl oyster products (in US$, 1991–1994)**

| Commodity | 1994 | 1993 | 1992 | 1991 |
|---|---|---|---|---|
| Raw shells | 359 030 | 422 506 | 3 014 745 | 898 456 |
| Jewelry | 3 601 226 | 1 775 983 | 1 656 835 | 1 997 930 |
| Shell blanks | 2 970 000 | 1 788 258 | 1 250 497 | 1 103 037 |
| Processed shells | 172 429 | 176 914 | 731 954 | 95 060 |
| Pearls | 5 585 906 | 3 278 042 | 1 473 726 | 3 780 000 |
| Shell button | – | 2 929 646 | 9 453 210 | 9 103 837 |
| **Total** | **12 689 590** | **10 371 349** | **9 453 210** | **9 103 837** |

[1] "Coron Development Corporation, Guian South Sea Pearl Farm, Hikari South Sea Pearl Corporation, Sommaco South Sea Pearl Corporation, Sea Queen, Tawi-Tawi Pearl Farm.

[2] Philippine Council for Aquatic and Marine Resources Development (PCAMRD), Technology Application and Promotions Institute (TAPI) both of the Department of Science and Technology of the Philippines; Canada's Department of Fisheries and Oceans (DFO-Canada), Thailand's Aquatic Animal Health Research Institute (AAHRI) and Canadian Executive Service Organization (CESO).

TABLE 3.6.2
**Philippine export data (cultured pearl and mother-of-pearl and products) for 2005**

| Product | Exporting country | Weight (kg) | FOB value (Philippine pesos) | FOB value (US$) |
|---|---|---|---|---|
| **Cultured pearl Unworked** | Hong Kong | 100 | 19 211 428 | 371 320 |
| | United States of America | 27 | 9 471 247 | 183 060 |
| | Switzerland | 13 | 12 727 597 | 246 000 |
| | Japan | 8 | 9 833 828 | 190 069 |
| | **Total** | **148** | **51 240 100** | **990 450** |
| **Cultured pearl worked** | Hong Kong | 744 | 255 731 281 | 4 865 482 |
| | Japan | 332 | 127 437 447 | 2 463 121 |
| | Australia | 275 | 159 615 969 | 3 055 070 |
| | United States of America | 119 | 110 051 239 | 2 127 079 |
| | Switzerland | 34 | 29 751 172 | 575 033 |
| | Others | 53 | 28 514 732 | 551 135 |
| | **Total** | **1 557** | **707 101 840** | **13 666 920** |
| **Shell buttons** | China PR | 36 000 | 1 955 704 | 37 800 |
| | Japan | 6 886 | 5 975 589 | 115 458 |
| | Hong Kong | 674 | 615 685 | 11 900 |
| | Korea | 525 | 336 298 | 6 500 |
| | Germany | 350 | 783 679 | 15 147 |
| | Others | 261 | 903 365 | 17 499 |
| | **Total** | **44 096** | **10 570 320** | **204 304** |
| **Mother of pearl unworked** | Hong Kong | 316 731 | 8 114 619 | 156 840 |
| | China | 54 619 | 6 818 370 | 131 876 |
| | Korea | 52 524 | 8 105 513 | 156 664 |
| | Japan | 19 300 | 2 672 973 | 52 050 |
| | Italy | 10 100 | 827 811 | 16 000 |
| | Others | 39 507 | 843 622 | 15 919 |
| | **Total** | | **27 382 908** | **529 259** |
| **Mother of pearl worked** | Hong Kong | 15 010 | 1 823 254 | 35 240 |
| | Thailand | 13 200 | 134 623 | 2 602 |
| | Germany | 2 836 | 3 404 891 | 65 810 |
| | United States of America | 2 604 | 1 936 302 | 37 425 |
| | Spain | 1 453 | 591 988 | 11 442 |
| | Others | 3 060 | 4 110 549 | 79 449 |
| | Total | 38 163 | 12 001 607 | 231 068 |
| | **Grand total** | | | **15 622 601** |

fouling would be the ideal situation for farm management, but involve more exposure of the pearl oysters to air/shallow holding as well as time and transportation expense.

The problem of heavy fouling experienced in the Philippines and its effect on shell quality and survival is a situation similar to that described from the Persian Gulf as well as elsewhere. This problem shows no host-specificity and applies to both *P. maxima* and *P. penguin*.

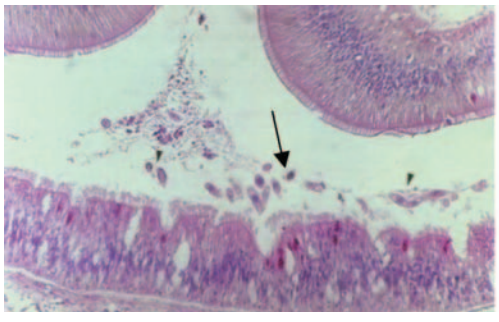
Biomineralization problems similar to those described from French Polynesia were also reported at certain Philippine pearl farms, both in *P. maxima* and *P. penguin*, however, the extreme examples demonstrated by *P. margaritifera* were not observed.

In addition to the above information, collected through farmer interviews, gross examination of shells provided the following observations:

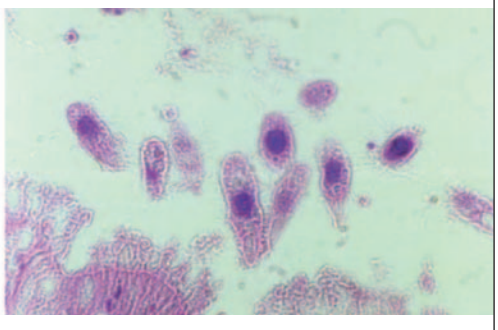
a) heavy fouling: mollusc encrustment as well as multi-taxa fouling, particularly in *P. penguin*;
b) shell damage due to clionid sponge;
c) blisters at the adductor muscle attachment of *P. penguin*;
d) *Polydora*-related tunnel damage to inner shell;
e) mantle recession in *P. maxima* and
f) inner shell discolouration.

**PLATE 3.6.1**

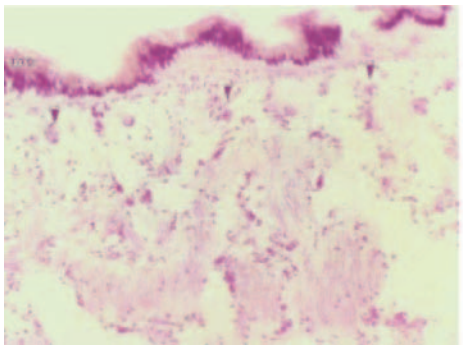
**Some examples of abnormal conditions observed in Philippine pearl oysters**



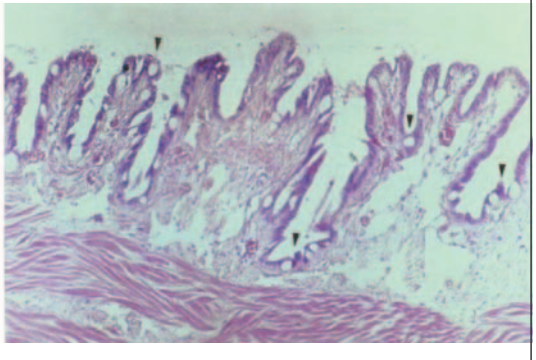
Unidentified ciliates (arrow) in the stomach of *Pinctada maxima* (200 x, H&E)



Unidentified ciliates in the stomach of *Pinctada maxima* (1000 x, H&E)



Unidentified ciliates (arrow) in the mantle of *Pinctada maxima* (200 x, H&E)



Vacuolation in the mantle epithelium of *Pinctada maxima* (200 x, H & E)

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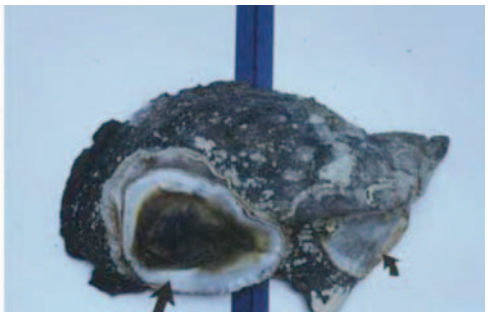
Preliminary analysis of histological sections collected showed the presence of inclusion bodies in digestive tubule epithelia; rickettsia-like organisms (RLO) in the kidney, digestive tubules, and gills of *P. maxima*; parasitic ciliates in the mantle, stomach and intestine; vacuolisation of the mantle epithelium; and extreme metaplasia of the digestive tubules indicative of starvation. The significance of the infectious organisms and the various histopathologies observed on pearl oyster health was not pursued, due to very low prevalence. However, these observations provide a useful base-line reference for ongoing monitoring of pearl oyster health in the Philippines.

With respect to the mortalities reported by some of the farms, it is likely that no single factor is responsible. There was no evidence of mortality patterns indicative of spread of an infectious agent, as most farmers reported patchy mortalities throughout their holding systems and with negligible correlation to size/age. Thus, it is possible that the mortalities are due to the cumulative effects of pressure and temperature changes, heavy fouling and stress due to defouling, transportation method and transfer to open waters. A further assessment and long term studies on the health situation of cultured pearl oysters in the Philippines is necessary.

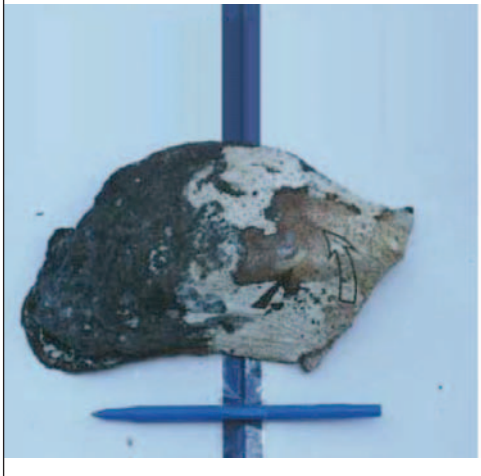
## PLATE 3.6.2

**Some examples of abnormal conditions observed in Philippine pearl oysters**

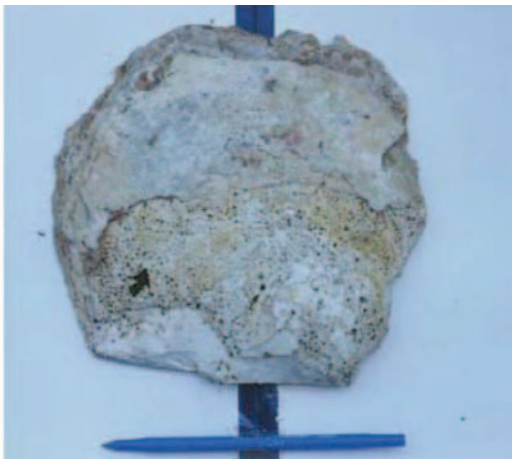
Multi-taxa fouling on *Pteria penguin*



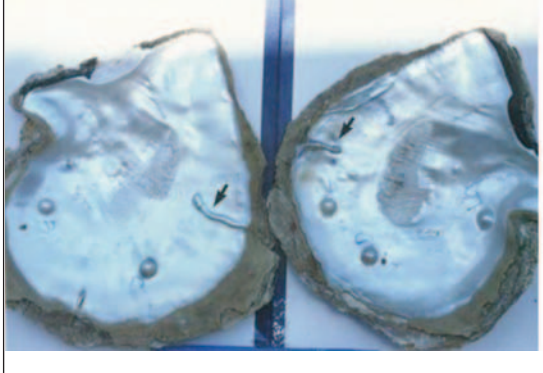
Mollusc encrustment on *Pteria penguin*



Boring sponge on *Pteria penguin*



Boring sponge on *Pinctada maxima*



Mud tunnels caused by *Polydora* sp. on *Pinctada maxima*

Mud tunnels caused by *Polydora* sp. on *Pteria penguin*

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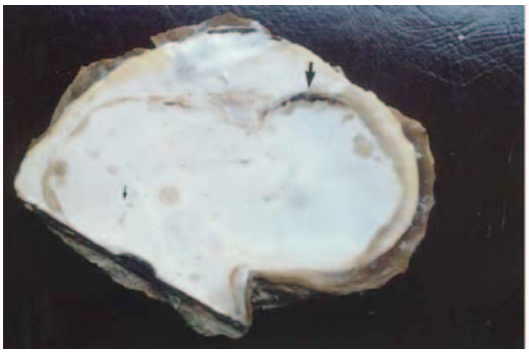
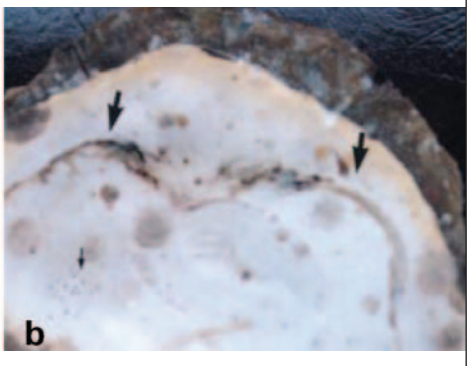
## PLATE 3.6.3

**Some examples of abnormal conditions observed in Philippine pearl oysters**



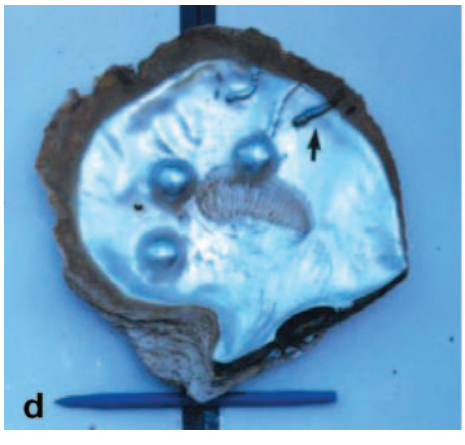
Shell of *Pinctada maxima* showing erosion of inner surfaces (arrows) probably related to chronic mantle retraction; thin arrows show complete penetration by boring sponge.




Shell of *Pinctada maxima* showing erosion of inner surfaces (arrows) probably related to chronic mantle retraction; thin arrows show complete penetration by boring sponge.


Dense multi-taxa fouling in *Pteria penguin*

Extensive shell damage due to clionid boring sponge in *Pteria penguin*




Dense multi-taxa fouling in *Pteria penguin*

Extensive shell damage due to clionid boring sponge in *Pteria penguin*

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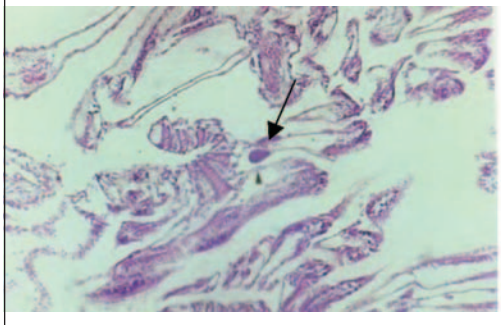
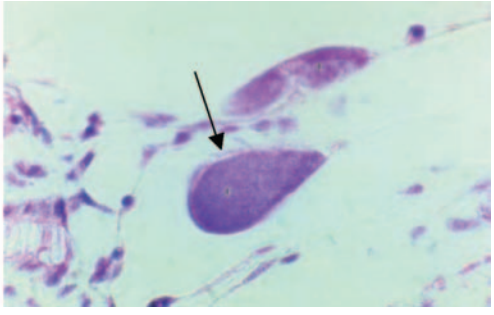
## PLATE 3.6.4

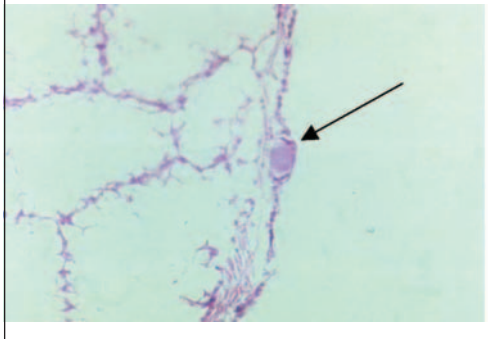
**Some examples of abnormal conditions observed in Philippine pearl oysters**



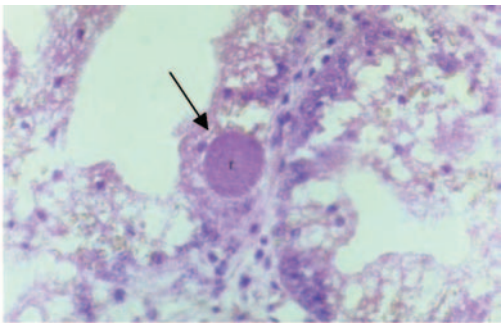
Rickettsia-like organisms (RLO, arrow) in the gills of *Pinctada maxima* (200 x, H & E)



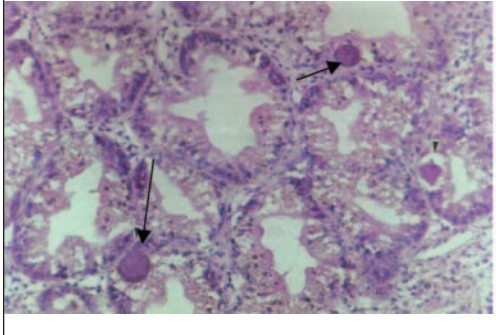
Rickettsia-like organisms (RLO) in the gills of *Pinctada maxima* (1000 x, H & E)



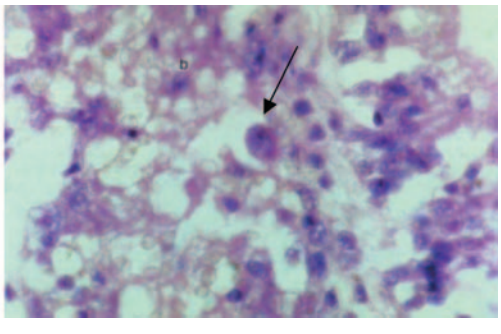
Rickettsia-like organisms (RLO, arrow) in the kidney of *Pinctada maxima* (200 x, H & E)



Rickettsia-like organisms (RLO) in the digestive tubules of *Pinctada maxima* (1000 x, H & E)



Inclusion bodies in the digestive tubule epithelia of *Pinctada maxima* (arrows, 800 x, H & E)



Inclusion bodies in the gills of *Pinctada maxima* (arrows, 800 x, H & E)

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