Capacity Building in the Surveillance, Diagnosis and Management of Disease issues of Pearl Oysters

ACWA

AQUACULTURE COUNCIL OF WESTERN AUSTRALIA

Australian Government

Fisheries Research and Development Corporation

Project No. 2007/316

Disclaimer

The authors do not warrant that the information in this document is free from errors or omissions. The authors do not accept any form of liability, be it contractual, tortious, or otherwise, for the contents of this document or for any consequences arising from its use or any reliance placed upon it. The information, opinions and advice contained in this document may not relate, or be relevant, to a readers particular circumstances. Opinions expressed by the authors are the individual opinions expressed by those persons and are not necessarily those of the publisher, research provider or the FRDC.

The Fisheries Research and Development Corporation plans, invests in and manages fisheries research and development throughout Australia. It is a statutory authority within the portfolio of the federal Minister for Agriculture, Fisheries and Forestry, jointly funded by the Australian Government and the fishing industry.

Table of Contents

Acknowledgements....4
Non Technical Summary....5
Background....7
Need....7
Objectives....8
Methods....8
Results and Discussion....9
Overview of Pinctada species....10
Pearl Disease Diagnosis....11
Pearl Disease prevention....13
Industry session with key outcomes....13
Benefits and adoption....13
Further Development....14
Planned Outcomes....15
Conclusion....15
References....16
Appendix 1: Intellectual Property....
Appendix 2: List of Participants....
Appendix 3: Workshop Agenda & Presentations....
Appendix 4: List of Acronyms:....
Appendix 5: Workshop Evaluation....
Appendix 6: Summary of the issues discussed the current status and the outcomes....
Appendix 7: French-Australian Science and Technology Programme Final report....

Acknowledgements

The author wishes to acknowledge the following organisations for providing funding for this project:

- Fisheries Research and Development Corporation
- French-Australian Science and Technology Programme
- Batavia Maritime Institute; and
- Abrolhos Pearls WA Pty Ltd**;**

In addition, the author would like to thank Dr Fran Stephens for her tireless effort in coordinate the workshop program and the presenters from Tahiti and all the Australian State jurisdictions that produce pearls. A special thank you is also extended to Jenny Shaw for facilitating the two day workshop, and to all the presenters and industry participants.

2007/316 Capacity Building in the Surveillance, Diagnosis and Management of Disease issues of Pearl Oysters.

PRINCIPAL INVESTIGATOR: Dan Machin

ADDRESS: Aquaculture Council of Western Australia
PO Box 55
Mt hawthorn WA 6915
Tel (08) 9340 5055 Fax (08) 9340 5099

OBJECTIVES:

Aims of the project were:

- Build Australia pearl oyster disease diagnosis and management capacity.
- Foster international collaborative research efforts in Pearl oyster diseases.
- To capture the understanding of disease processes and management issues that affects pearl oysters in the Indo-Pacific region.
- To improve understanding of disease, sustainability, biodiversity and biosecurity issues that affects the pearl oyster aquaculture industries in these regions.
- Build online knowledge network for pearl oyster diseases.

Non Technical Summary

OUTCOMES ACHIEVED TO DATE

The aim of the workshop program was to identifying knowledge gaps, and opportunity for research collaboration between the State and French Polynesia.

The development of research collaboration between the key researchers in pearl aquaculture in Australia and French Polynesia;	Achieved. (Refer to Appendix 5: French-Australian Science and Technology Programme Final report)
The compilation of a list of organisms and management diseases that affect pearl oysters in the Australian and Pacific region;	Achieved – See Table 1
The identification of the methods used to diagnose and identify pathogens, and of the research directions aimed at improving current diagnostic techniques;	Achieved
The website collection and exchange of knowledge to identify similarities and differences between the two regions.	Achieved http://www.aquaculturecouncilwa.com/conferences-seminars-and-workshops/Pearl-Oyster-Health

The Pearl oyster technical workshop was held at the Batavia Coast Marine Institute, Geraldton, Western Australia over 2 days from 8-9 October, 2007. Scientists and departmental officers from IFREMER's laboratory in Polynesia, the Fish Health Unit of Dept. of Fisheries Western Australia, Northern Territory, Queensland, New South Wales and pearl industry/farm representatives attended the workshop.

The workshop enabled Australia to establish linkages within Australia and the NACA regional pearl research centre and share knowledge and experience in pearl health management. See the following website for details: http://www.aquaculturecouncilwa.com/conferences-seminars-and-workshops/Pearl-Oyster-Health

Table 1: List of disease agents of *Pinctada margaratifera* in French Polynesia and *Pinctada maxima* in Australia.

French Polynesia	Western Australia	Comments
Gregarines in intestine	Gregarines in digestive gland	Very high prevalence in FP, very low prevalence in WA. Species probably different. In FP may have been spread by industry.
Ricksettsia-like organisms in gill and digestive gland	Rickettsia-like organisms in gill, digestive gland and palp	Prevalence probably similar but not reported in palp in FP
Tylocephalum-like metazoan	Tylocephalum-like metazoa	Seem to be similar parasite, similar prevalence
	Ancictrocomid in upper gastrointestinal tract lumen	Common in WA, not reported in FP.
	Ciliate in digestive gland	Occasionally seen and causes pathology in WA. Not reported in FP
	Haplosporidia sp. in digestive gland	Seen on rare occasions in WA. Not reported in FP
	Viral-like inclusions in digestive gland	Moderate prevalence in the north of WA. No viral-like inclusions or diseases currently seen in FP.
	Oedema syndrome with high mortality	First reported in late 2006. Cause uncertain at present

KEYWORDS: Pearl Oyster, Workshop, aquaculture, Disease, Management.

Background

Pearl oyster aquaculture is a relatively recent and rapidly growing industry that provides much needed employment and income generation in remote regional areas of Australia. In Western Australia the aquaculture industry is based on the gold-lipped pearl oyster, *Pinctada maxima*, in the tropical north and the black-lipped pearl oyster, *Pinctada margaritifera* in the more temperate areas. Expansion of black-lipped pearl aquaculture industry has been targeted by AMWING and the Batavia Coast Maritime Institute, because the region centred on Geraldton and the Houtman Abrolhos islands is ideally suited to this species. Tahiti already has a well-established and successful black pearl industry that has experienced considerable expansion since the early 1980s. Intensification of culture in Tahiti resulted in disease and production problems, and in 2002 IFREMER, the French National Institute for Marine Research in collaboration with the Pearl Aquaculture in Tahiti, set up a diagnostic and research laboratory in Tahiti. It is expected that intensification of the industry in Australia could result in similar problems and there is considerable scope for understanding and avoiding disease and carrying capacity problems that occurred in Polynesia when the industry expanded.

IFREMER is an OIE (International Organisation for Animal Health) reference laboratory for several internationally significant diseases of oysters. Their laboratory in Tahiti is well-equipped and undertakes histological techniques as well as being a leader in the field of molecular biology of disease agents and diagnosis of diseases in oysters. The Fish Health Unit of the Department of Fisheries in Western Australia is an FAO/NACA regional resource centre for aquatic animal diseases. One of its major roles has been to assist the pearl aquaculture industry to develop 'high health' hatcheries and disease surveillance protocols that aim to minimise disease problems in the industry. Their laboratory regularly undertakes histological and bacteriological testing of pearl oysters. It also has an electron microscope and the capability to research, develop and use molecular diagnostic tools. Both the Western Australian and IFREMER laboratories recognise the potential benefit to their research of a collaborative arrangement and the benefits of extending this the other organisations in the region. It is currently not possible to know whether disease agents in each country are the same or different species and alliances between aquatic health research laboratories are needed to address these issues. The ability to diagnose novel pathogens is important internationally and the development of rapid diagnostic tools is a goal of the *P. margaritifera* industry (AMWING) as well as the IFREMER and Western Australian laboratories.

Need

Disease and fish health management underpin maximizing growth and survival of pearl sector. Given the recent pearl oyster disease events the need to build our knowledge and capacity in this area has been heightened.

Objectives

The objective of the workshop was to review the present state of knowledge of the pathogens and health issues of pearl oysters and related aquaculture practices within Australia and Tahiti.

Aims of the project were:

- Build Australia pearl oyster disease diagnosis and management capacity;
- Foster international collaborative research efforts in Pearl oyster diseases;
- To capture the understanding of disease processes and management issues that affects pearl oysters in the Indo-Pacific region;
- To improve understanding of disease, sustainability, biodiversity and biosecurity issues that affects the pearl oyster aquaculture industries in these regions; and
- Build online knowledge network for pearl oyster diseases.

Methods

The pearl oyster technical workshop was held at the Batavia Coast Marine Institute, Geraldton, Western Australia over 2 days from 8-9 October, 2007. Scientists and departmental officers from IFREMER's laboratory in Polynesia, the Fish Health Unit of Dept. of Fisheries Western Australia, Northern Territory, Queensland, New South Wales and pearl industry/farm representatives attended the workshop (see appendix 2 for a list of workshop participants).

The event enabled Australia to establish linkages within Australia and the OIE reference laboratory regional pearl research centre. Tahiti research have strong linkages with IFREMER who have considerable expertise is molluscan disease diagnosis and management.

Results and Discussion

The workshop was a mix of presentations, laboratory sessions on histopathology and practical demonstrations on sample preparation and post mortem of pearl oysters (see appendix 3 for the workshop's agenda and presentations).

The following were made presentations:

- Dr Fran Stephens of Western Australia,
- John Humphrey of Northern Territory,
- Rafidah Jamaludin, Queensland, and
- Angelique Fourgousse, Tahiti each gave a 10 minute overview of Australia and Polynesian pearl oysters industries.

Special topic on Oyster Oedema Disease (OOD) was given by John Creeper and Brian Jones from DoF, Western Australia and Ben Madin, epidemiologist from AusVet Animal Health Services.

Other diseases and pathogens of pearl oysters were presented by John Humphrey of NT and Angelique Fougerouse and Jean-Claude Cochin for French Polynesia.

See Appendix 3- a copy of the agenda and the presentations. The presentations are also available on "Pear Oyster Health" website http://www.aquaculturecouncilwa.com/conferences-seminars-and-workshops/Pearl-Oyster-Health. The presentations were e-mailed to workshop participants on 14 December 2007.

Overview of Pinctada species

Queensland

Rafidah Jamaludin gave an overview of the past, present and future outlook of the pearl oyster industry in Queensland. The Pearl oyster industry in Queensland contributed $0.3M) compared to Western Australia ($150 M) and Northern Territory ($18M), respectively.

Western Australia

Fran Stephens gave an overview of structure, zoning and disease control strategies based on species and presence of disease especially OOD and/or other etiological agents.

Northern Territory

John Humphrey presented a map for the establishment of pearl oyster disease control zone based on zoogeographic information, natural range, epidemiological data, historical movement and genetic data to be used in making a semi-rational reason for translocation and to be used in formatting future policy.

French Polynesia

The findings from the French Polynesia survey on diseases of *P margaritifera* were based on 30 islands and 4 atolls. They observed rickettsia-like bodies within connective tissue and digestive gland of *P magaritifera*, Chlamydias in *Sarcosstrea, Gregarines* in *P maculatta,* kapi kapi and *Sarcostrea* and the cestodes *Thylocepahalum* and *Bucepahalus*. The incidental and significant finding was the unintentional transfer of *Anemone*. *Anemone* have stings and cause problems if not destroyed.

Pearl Disease Diagnosis

FRDC pearl oyster disease survey 1994-1996

John Humphrey presented his disease survey (FRDC final report 94/079) carried out in 1994-1996 where 4500 oysters were examined on 22 locations for wild caught and farmed oysters. Significant findings include boring molluscs, larval *Thylocephalum* like cestode, papovavirus in Queensland, rickettsia large and small form, gregarine like protozoan, all with no disease association. *Anicistrocomid* a copepod, and the fungus *Thraustochytrid* was also detected. *Haplosporidium* (which had not recurred since its first outbreak) and ciliates which cause collapse of the digestive gland were the two agents associated with disease. Incidence of tumours was low. Environmental effects on oyster health include *Trichodesmin* bloom.

Oyster Oedema Disease

- A case definition for Oyster Oedema Disease (OOD) was presented. Other than an initial high mortality of 90% and a blistering and lifting of epithelial cells there were no other signs. The lack of published physiological studies on osmoregulation and excretory function in oysters was highlighted. Under TEM virus like particles were seen in damaged cells. Based on the presence of these particles a PCR test was successfully developed but the source of the DNA being detected had not been determine. *In-situ* hybridization will be carried out next to determine if the PCR signal is associated with the epithelial lesions seen on histology of OOD positive shells.
- Epidemiological studies carried out by AUSVET concluded that the incident is typical of a propagating infectious disease with variability in mortality rates however, there was some query on the soundness of the transmission trial and a repeat may be carried out. Biosecurity gaps which cause the disease spread were identified such as there was no protocol for Divers, free movement of small boats between leases, no agreed protocol for cleaning vessels and no protocol (or requirement) to notify mortalities.

Review of histology slides on OOD and other pearl oyster diseases/ findings.

- The oedema, and other inconsistent findings in OOD cases were shown, eg. the excessive diapedesis in the digestive gland and some dilation in kidney tubules.
- The normal histology and tips on what to look for in the organs of pearl oyster and artefacts was highlighted. Usually, A*nistrocomis* or ciliates are found in the style, gregarine in the 2nd portion and rectum, metacestodes in the mantle, and RLO's .
- A tour of the Batavia aquaculture facility was provided.
- Practical sessions on collection, preservation (break the edge of the shell), post mortem techniques and health and safety issues of handling formalin etc were taught.
- Images of histopathology of key disease agents can be found at http://www.aquaculturecouncilwa.com/conferences-seminars-and-workshops/histopathogy

List of disease agents of *Pinctada margaratifera* in French Polynesia and *Pinctada maxima* in Australia.

French Polynesia	Western Australia	Comments
Gregarines in intestine	Gregarines in digestive gland	Very high prevalence in FP, very low prevalence in WA. Species probably different. In FP may have been spread by industry.
Ricksettsia-like organisms in gill and digestive gland	Rickettsia-like organisms in gill, digestive gland and palp	Prevalence probably similar but not reported in palp in FP
Tylocephalum-like metazoan	Tylocephalum-like metazoa	Seem to be similar parasite, similar prevalence
	Ancictrocomid in upper gastrointestinal tract lumen	Common in WA, not reported in FP.
	Ciliate in digestive gland	Occasionally seen and causes pathology in WA. Not reported in FP
	Haplosporidia sp. in digestive gland	Seen on rare occasions in WA. Not reported in FP
	Viral-like inclusions in digestive gland	Moderate prevalence in the north of WA. No viral-like inclusions or diseases currently seen in FP.
	Oedema syndrome with high mortality	First reported in late 2006. Cause uncertain at present

Pearl Disease prevention

Summaries of discussions on disease surveillance, biosecurity issues and movement controls, use of anaesthetics and disinfection and hatchery protocols were as in Table 1 (Appendix 6)

Industry session with key outcomes

A concurrent industry session between farmers and consultant pathologists was held. These were the pathologist's key findings and action plans.

- On farm observation reporting and develop on farm spreadsheet to flag warning of disease and sent out to industries (In preparation).
- Provide non-*P maxima* industry with latest FRDC proposal for *P maxima* for its consideration and support.
- Update on OOD PCR (Polymerase Chain Reaction) research.
- Circulate information sheet on appropriate use of sterilizing agent / disinfectant for plant and equipment.
- Update industry on lesson learnt from OOD experience – spread of disease through boats, divers, technicians etc.
- Provide "high health hatchery" requirements and certification procedure eg for *P maxima* hatchery has to be reviewed annually for certification.
- Develop proposal for *P maxima* surveillance project 10 year after the previous one.
- Develop proposal for *P margaritifera* surveillance project under the *P maxima* project.
- Further consider knowledge management issues for example succession planning and capture knowledge of retiring scientist eg Judith Hallinger and John Humphrey
- To get funding for proposals other than FRDC for future projects such as Seafood CRC, with industry support. Funding from state departments is not forthcoming.
- Coordinate a reciprocal workshop in Tahiti in 2008.
- Create a website and online forum. See http://www.aquaculturecouncilwa.com/conferences-seminars-and-workshops/Pearl-Oyster-Health and http://acwanet.ning.com/group/pearloysterhealthmanagement (in prep.), respectively.

Benefits and adoption

The PI had a 63% response rate to the post workshop survey. The respondents indicated that they were 82.85% satisfaction with the workshop. The survey respondents stated that the highlights were:

- Exchange of scientific information with peers and colleagues
- Meeting the French fish pathologists and researchers
- This meeting was a wonderful opportunity to get in contact with Australian colleagues involved in the same activity and to be able to compare the ways different regions resolve similar issues.

- The opportunity to share international pearl aquaculture experience
- Roundtable discussion on OOD utilising knowledge from all sources.
- The great opportunity to get that many industry people into the room at the one time. The up to date nature of the information presented.
- Overview of the OOD problem. -Talks on the French Polynesia oyster aquaculture. -Talks on the WA and NT oyster management issues.
- Comparing notes on what's going on with the pearl industry (production, zoning, health and disease etc) in other states and French Polynesia.
- OOD meeting on the second morning. Informal discussions between sessions
- the diversity and expertise of the participants

Further Development

Research Collabouration

It was agreed that Australian researchers would benefit from visiting French in 2008 to further explore the development of research collaboration Australia and French Polynesia. Refer to Appendix 5: French-Australian Science and Technology Programme Final report of this visit.

Workshop

The respondents made the following comments on what areas that could be covered in any future workshop on pearl oyster disease and health management:

- More time might have been spent discussing disease and disease control.
- Histology sections were of interest to pathologists but too detailed for non-pathologists.
- Practical on farm husbandry to minimise and control disease.
- Hatchery and oyster production in Tahiti were not very detailed.
- I would have thought a little more time on biosecurity for leaseholders, aquatic disease spread and management practices to reduce the impact of disease or increase the chance of understanding it.
- Future research on OOD.
- Would like to know what's going on with pearling industry in abalone.
- For me, some further practical work with histopathology would have been interesting and useful.

The respondents made the following comments on the subject of future workshops

- Request future presenters pre identify formal reference sources that may be used to complement the answers to potential questions from the floor
- Try and create more industry involvement on disease issues/feedback on problems. More examples of oysters with problems & discussion of problems.
- A little more time on biosecurity for leaseholders, aquatic disease spread and management practices to reduce the impact of disease or increase the chance of understanding it.
- Inviting a researcher from the Japanese pearl oyster industry could be beneficial.
- Get the big industry people (ones with vertical hold on all lines e.g. Kailis?) to talk on jewellery fashion and marketing.

- Get speakers from Japan and China pearl industry
- A presentation by industry (P.maxima & P margaritifera) on their perspective. Particularly as there were OS and interstate participants

Planned Outcomes

The aim of the workshop program was to identifying knowledge gaps and opportunity for research collaboration between the State and French Polynesia.

The development of research collaboration between the key researchers in pearl aquaculture in Australia and French Polynesia;	Achieved. (Refer to Appendix 5: French-Australian Science and Technology Programme Final report)
The compilation of a list of organisms and management diseases that affect pearl oysters in the Australian and Pacific region;	Achieved
The identification of the methods used to diagnose and identify pathogens, and of the research directions aimed at improving current diagnostic techniques;	Achieved
The website collection and exchange of knowledge to identify similarities and differences between the two regions.	Achieved

Conclusion

The aim of the workshop program was to identifying knowledge gaps, and opportunity for research collaboration between the State and French Polynesia.

The Pearl oyster technical workshop was held at the Batavia Coast Marine Institute, Geraldton, Western Australia over 2 days from 8-9 October, 2007. Scientists and departmental officers from IFREMER's laboratory in Polynesia, the Fish Health Unit of Dept. of Fisheries Western Australia, Northern Territory, Queensland, New South Wales and pearl industry/farm representatives attended the workshop.

The workshop enabled Australia to establish linkages within Australia and the NACA regional pearl research centre and share knowledge and experience in pearl health management. See the following website for details: http://www.aquaculturecouncilwa.com/conferences-seminars-and-workshops/Pearl-Oyster-Health

References

No references were used in the preparation of this report.

Appendix 1: Intellectual Property

It has been identified that no new intellectual property was developed from the workshop.

Appendix 2: List of Participants

Industry		Affiliation
Cropp	Derek	Aquaculture Consultant
Liddon	Sam	Pelsaert Pearls
Warden	Steve	Pelsaert Pearls
Glazier	Geoff	Pelsaert Pearls
Davidson	Murray	Abrolhos Pearls WA Pty Ltd
Madin	Ben	Ausvet Animal Health Services
Bray	Chris	Olympus Microscopes
Brown	James	General manager, Cygnet Bay Pearls
Machin	Dan	Aquaculture Council of WA (ACWA)
Blinco	Trevor	Chairman, ACWA
Barnard	Roger	R&D manager MG Kailis

Government Agency		Affiliation
Cochin,	Jean-Claude	Head of the pearl oyster group at IFREMER
Corbeil	Serge	Animal Health Laboratory, CSIRO
Creeper	John	Dept of Fisheries WA
Fougerouse	Angelique	IFREMER, French Polynesia
Shaw	Jenny	Dept of Fisheries WA
Humphrey	John	Dept of Business, Industry and Resource Development, NT
Jamaludin	Rafidah	Dept of Primary Industries, Queensland
Jones	Brian	Dept of Fisheries WA
O'Connor	Wayne	Dept Primary Industries NSW
Beer	Andrew	Central west College of TAFE
Cheah	Michael	Central west College of TAFE
	Ryan	Central west College of TAFE
Birrell	Jill	Dept of Fisheries WA
Chatfield	Kylie	Dept of Fisheries WA
Crockford	Melanie	Dept of Fisheries WA
Howard	Amber	Dept of Fisheries WA
Stephens	Fran	Dept of Fisheries WA

Appendix 3: Workshop Agenda & Presentations

To open the presentation please double click on the *Presentation icon*

Day 1 Monday 8 October

ITEM	Presentation Icon
09:30 Welcome and Introduction. Dan Machin, EO Aquaculture Council of Western Australia	
Overview of *Pinctada spp*. aquaculture in Queensland	 T:\ACWA Presentations\Pearl C
Overview of *Pinctada spp*. aquaculture in Western Australia	 T:\ACWA Presentations\Pearl C
Overview of *Pinctada spp*. aquaculture in Northern Territory	 T:\ACWA Presentations\Pearl C
Overview of *Pinctada spp*. aquaculture in French Polynesia	 T:\ACWA Presentations\Pearl C
Pearl Disease Diagnosis	
Pathogens and disease issues - John Creeper, Brain Jones.	 T:\ACWA Presentations\Pearl C  T:\ACWA Presentations\Pearl C
Pathogens and disease issues in French Polynesia- Angelique Fourgerouse and Jean-Claude Cochard	 T:\ACWA Presentations\Pearl C
Hatchery in French Polynesia	 T:\ACWA Presentations\Pearl C
Discussion	
Pearl Disease Prevention	
13:30 Disease surveillance	
14:00 Biosecurity issues and movement controls	
14:30 Use of anaesthetics, disinfection etc. Discuss protocols	
15:00 Afternoon tea	
15:20 Hatchery protocols. Overview of *P. maxima* high health hatchery protocol.	
16:00 Knowledge and database gaps: Itemise further discussion and action plans eg. swap histology slides	
19:00 Welcome Drinks and Dinner for participants.	
Day 2 Tuesday 9 October	
09:00 Recap of discussion and action plans – any further contributions	
Discussion of priorities Develop dot points of issues for discussion with industry.	
11:00 Summary of Discussions	
13:30 Industry session: Report of the pathologists workshop's key findings and actions –open forum	

Appendix 4: List of Acronyms:

ACWA	Aquaculture Council of Australia
AMWING	Pearl Disease Association
AQIS	Australian Quarantine Inspection Services
DEST	Department of Education, Science and Training
DoF	Department of Fisheries
FR	French Polynesia
FRDC	Fisheries Research and Development Corporation
NAAHTWIG	National Aquatic Animal Health Technical Working Group
WA	Western Australia
IFREMER	French-Australian Science and Technology Programme
NT	Northern Territory
OOD	Oyster Oedema Disease

Appendix 5: Workshop Evaluation

Appendix 6: Summary of the issues discussed the current status and the outcomes

Issues	current status and specific issues	Action plan agreed
Disease surveillance	**French Polynesia:** Zoosanitary monitoring network was carried out over a 3 yr period on 30 Islands and 4 atoll. They were zoned and 6 zones, 2 sites/zone, 30 oysters/site plus other species of mollusc were selected and tested. In France (not in FP) if there is more than 15% mortality between a time period of 2 ebb tides (approximately 15 days), they have to report to IFREMER. As an incentive if reported within 15 days it will be covered by insurance. For non *P maxima* sp, must report if suspect disease. For *P. maxima,* it is not required as they are considered pests.	Identify when to report, what to do if having a problem. Spreadsheet of ongoing mortality to benchmark what are the signals of what's happening in your farm to help decision making triggers. He emphasised the need for baseline parameters for the occurrence, prevalence and distribution of pathogens and parasite with and without disease association. The proposed zoning protocol has been agreed in principle by AMWING & DoF. This includes disease testing of adults and hatchery

	Western Australia: For *P maxima* histological testing of 150-300 samples prior to movement is required. New policy approved for *P margaritifera* (proposed system similar to above). **Queensland**: Passive surveillance through health testing. Must report suspected or unusual mortalities. **Northern Territory**: No prospective disease surveillance. Must advice fisheries of any mortality or significant mortality. Encourage industry to notify each other. **New South Wales**: It is a requirement to submit sample if the mortality rate is more than 5% but time period is not specified. Farms are provided with kits for sampling, provide free of charge. Disease investigation is part paid for.	stock. Overall in all states there is a lack of current baseline information. The last survey was 10 years ago. There is a need for industry legislative support for application to FRDC (letter of support). If unsuccessful we have to look at other funding sources.
Biosecurity issues and movement	**French Polynesia**: There is no import or export of live animals. Technicians must sterilize equipments on arrival (especially to prevent Akoya Disease). Restriction on transfers between	Lessons to be learnt from OOD where movement of boats and divers between leases caused the spread. High health hatcheries needed for

control	islands is placed, especially if disease event occurs. Northern territory: There is unrestricted movement within zones of equivalent health status. Movement between zones subjected to quarantine, disease testing and health certification. No translocation where unacceptable risk of disease incursion exists. Third party movement: Vessels – decontamination following WA protocol. Illegal boats bring in pests as green Asian mussel, Legal boats brought back fish from Taiwan for feeding to our fish thus very high risk and AQIS refuse to interfere.	*P margaritifera*. With increase in pearl oyster movement there was a need for zoosanitory monitoring and network to improve knowledge, evaluate and provide statistic basis in developing the diagnostic procedure. Saturated copper sulphate is recommended as it will kill off this pests.
Hatchery protocol	In WA in *P maxima* - practice of filtering air and incoming water, so its bacteria and algae free. *Haplosporidium* - found in spat and ciliates, thus a potential problem in hatchery. Broodstock associated risk in hatchery and the risk of emerging diseases once aquaculture of a new species starts was noted. Expensive and sometimes better survival post-hatchery in low health hatchery.	Look at disinfection of spawning products and broodstock - may be impossible. The problem of subclinical carriers and method to detect carriers should be further investigated. Reference recommended is Wayne O'Connor's report in Journal of Shellfish Research and FRDC report on evaluation of hatchery production of scallops *Pecten fumatus* .
Disinfectants and anaesthetics used:	In French Polynesia no anaesthetic is used, and antibiotic coating on beads is practised. Disinfection of seeding equipment. In WA- mostly untreated seed. In NT- there is an improvement in seeding success with disinfection of seeding equipment. Most follow protocol at seeding as it is all parts of Farm management procedure. Anaesthetic: For comparison Cichlid / guppies use $MgCl_2$ at 0.3 mg/L but for *P margaritifera* (filter large amounts of water) $MgCl_2$ at 30g/L is used; 1 hr see gaping; Epsom salt (MgSo4) also can be used.	To find most suitable disinfectant/ anaesthetic for different purposes. John Norton had done some work in anaesthetic and disinfectant used in Pearl oysters. Reference: An evaluation of some relaxants for use with pearl oysters; in Aquaculture 144(1966) 39-52
Stocking densities and biomass issues	In French Polynesia the farms are close together and there was less than 12000 seeded oysters/ha however there can also be unseeded oyster growing alongside. Now there is no overstocking except on the purpose to regress gonad. However natural biomass is always more than the recommended state!!!! In NSW 2.1 ton /ha. All relative to the amount of phytoplankton available. NT- Quota system was set up. For small site it is < 50,000 pearl oyster at 1-16 ha; and 50-200,000 pearl oyster in 100 Ha site. Usually if 1000 grafted, 43% will be good quality pearls.	This is all base on volume of water, growth rate, area and phytoplankton. It's a tedious process taken over a long time (years) and over different tides; usually results are inconclusive and variable. In the tropics the biomass will be less than the temperate.

	Generally 12000 seeded/ ha, but it was twice before.	
Laboratory issues	Lack of succession planning in diagnostic capacity. Lack of funding for succession planning. Diagnostic procedures : There is quality assurance programme for histopathology in Australia .In French Polynesia it is as according to other European laboratories (IFREMER) Sampling issues: Setbacks include no background level for blooms such as Trichodemium blue green algae and phytoplankton bloom. The time between collecting and preserving is critical as changes occur quickly, and thus need immediate preservation. For Electron Microscopy this not always helpful as some virus do not have particle formation for too long. Charges and fees : Funding for free diagnosis is under threat in WA. Approved by the current government.	Attention has been brought up to relevant organisations. Ring testing network (NAAHTWG), Australia, Vet Lab system. Farmers to be advised on serial sampling and keep it aside (kit contain Iodine which will preserve it). These can be sent together with samples collected during an outbreak. Water quality collections kits for planktons, chemicals should be available. Daily temperature record is critical and careful observations of what is around the farm. This information can be downloaded and compared when required. ACWA lobbies for this.

Appendix 7: French-Australian Science and Technology Programme Final report