



# **Aquatic Animal Health and Biosecurity Subprogram: Strategic planning, project management and adoption**

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**2016/404**

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In submitting this report, the researcher has agreed to FRDC publishing this material in its edited form.

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# Acknowledgments

The Subprogram leader and coordinator thank all members, past and present, of the AAHB Subprogram Steering and Scientific Advisory Committees for their valuable contributions; the Subprogram would not have succeeded without them.

# Abbreviations

AHPND	Acute Hepatopancreatic Necrosis Disease
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
DAWE	Australian Government Department of Agriculture, Water and Environment
DPIRD	Department of Primary Industries and Regional Development, Western Australia
EOI	Expression of Interest
FBI	Federal Budget Initiative
FRAB	Fisheries Research Advisory Board
IPA	Industry Partnership Agreement
IHHNV	Infectious Hypodermal and Haematopoietic Necrosis Virus
KBBE	Knowledge-Based Bio-Economy
NNV	Nervous Necrosis Virus
OIE	The World Organisation for Animal Health
PPA	Pearl Producers Association
RAC	Research Advisory Committee
R&D	Research and Development
SCAAH	Sub-committee on Aquatic Animal Health
SAC	Scientific Advisory Committee
STC	Steering Committee
TBA	To be announced
YHV	Yellow Head Virus
WSD	White Spot Disease
WSSV	White Spot Syndrome Virus

# Executive Summary

## What the report is about

This report is about the activities of the FRDC's Aquatic Animal Health and Biosecurity Subprogram (AAHBS) for the period 2016-2020. AAHBS is responsible for coordinating FRDC-funded R&D aimed at addressing aquatic animal health and biosecurity priorities. Specifically, AAHBS is concerned with infectious diseases of aquatic animals; issues concerning invasive pests, food safety or toxicology are excluded.

AAHBS' structure comprises of a Subprogram Leader who, together with the Subprogram Coordinator, take advice from a Steering Committee that is supported by a Scientific Advisory Committee. AAHBS provides the important function of ensuring FRDC's contribution towards aquatic animal health and biosecurity R&D in Australia is directed towards high priority research projects.

The Subprogram has many functions aside from assessing research proposals. The Subprogram also provides expert scientific and technical input during the initial stages of research proposal development and furthermore oversees delivery thus ensuring enhanced output and outcomes from the research. The Subprogram is also linked to SCAAH, the national sub-committee that advises governments and industry on aquatic animal health issues, thus ensuring communication between the main interest groups in aquatic animal health and biosecurity. The scientific conferences and workshops, organised through the Subprogram, enhances this communication.

## Background

The Subprogram was founded in 2001 and, based on the continued need and strong stakeholder support, has been operating without interruption since then. Australia's aquatic animal sector is free from many diseases that occur overseas, providing us with a competitive advantage in both production and trade. However, as the Australian fisheries and aquaculture industry expands new diseases caused by emerging infectious agents threaten the sustainability of significant enterprises. Thus, the need for health and biosecurity services, including R&D, to support this expanding industry is growing.

AAHBS provides the necessary function of evaluating submitted health and biosecurity research proposals with respect to their relative priority to industry and government and to their scientific soundness and feasibility. Since its establishment, the subprogram has managed in excess of 130 projects relevant to the aquatic animal health and biosecurity key research areas identified in the Subprogram's R&D Plan: (i) Nature of disease and their epidemiology, (ii) Biosecurity, (iii) Diagnostics (iv) Strategic surveillance, (v) Disease mitigation, (vi) Training and capacity building and (vii) New technologies and applications.

## Aims/objectives

1. Manage a portfolio of R&D projects that are directly concerned with aquatic animal health & biosecurity and are not managed by other FRDC subprograms, FRABs or IPAs

2. In consultation with key stakeholders (industry, government and aquatic animal health providers) develop strategic directions for R&D
3. Facilitate the dissemination of outputs (information and results) from R&D projects to key stakeholders

## **Methodology**

Objective 1: The Subprogram Steering and Scientific Advisory Committees met up to four times per year to conduct Subprogram business. Expressions of interest were canvassed and evaluated, full applications were invited and evaluated, and recommendations were submitted to the FRDC Board. All projects were managed to ensure that project milestones were achieved, scheduled payments were paid on approval of milestone reports and Final Reports were completed.

Objective 2: AAHBS is guided by its R&D Plan which has been reviewed and updated on a regular basis since 2001. Review includes consultation on aquatic animal health and biosecurity R&D priorities and strategies with the Animal Health Committee's Sub-committee on Aquatic Animal Health (SCAAH) and industry peak bodies such as the National Aquaculture Council.

Objective 3: Dissemination of information and results was achieved through implementing the AAHBS' communication plan which involved production and dissemination of the biannual newsletter, *Health Highlights*; convening scientific workshops on specific issues, as needed; convening scientific conferences, specifically the biennial FRDC Australasian Scientific Conference on Aquatic Animal Health & Biosecurity; with FRDC, maintaining a specific area on the FRDC Website; maintaining formal and informal communication with other Subprograms, FRABs, IPAs, SCAAH, as needed; and use of developed databases (e.g. Final Reports on FRDC Website).

## **Results/key findings**

Objective 1: In the period 2016-20, AAHBS has managed 27 projects concerned with aquatic animal health and biosecurity. AAHBS also provided advice on other aquatic animal health- and biosecurity-related projects that were part of other FRDC programs. In addition, AAHBS has a specific role in managing the DAWE/FRDC Aquatic Animal Health Training Scheme. AAHBS also provided comment, as requested, on health-related projects submitted to industry peak bodies.

Objective 2: AAHBS reviewed, in-house, the Subprogram R&D Plan on an annual basis which included consultation with major stakeholders (industry and governments). The revisions accounted for the changing aquatic animal health and biosecurity R&D needs at the enterprise, industry sector, and state and national levels.

Objective 3: During the period 2016-2020, there were seven issues of the Subprogram newsletter, *Health Highlights*, which has a broad distribution list (>300 subscribers) that includes industry associations, research providers and regulators both domestically and internationally. In addition, AAHBS provided support for the 2017 White Spot Disease R&D Needs Workshop and 2017 *Pinctada maxima* Pearl Oyster Health Workshop. Two FRDC Australasian Scientific Conferences on Aquatic Animal Health and Biosecurity were convened in Cairns (in 2017 and 2019). The Cairns conference provides a unique opportunity for regulators, researchers and industry to meet and discuss the latest research results and current issues relating to aquatic animal health and

biosecurity. Workshop and conference proceedings were distributed electronically to participants.

### **Implications for relevant stakeholders**

During 2016-20, Australia's capability to manage aquatic animal disease in the commercial, recreational and customary fisheries sectors was enhanced through (1) improved diagnostic capability and/or disease management for a number of aquatic animal pathogens including *Perkinsus olseni*, various novel yellow head virus genotypes, white spot syndrome virus and various ornamental fish pathogens; (2) development of enhanced awareness of emergency aquatic animal disease response arrangements and other training to enhance the disease emergency management capability of industry and government personnel.

### **Recommendations**

Until recently, the Australian fisheries and aquaculture sector has been relatively disease-free and suffered few major national emergencies. However, the frequency of disease outbreaks appears to be on the rise. Thus, as the current Aquatic Animal Health and Biosecurity Subprogram comes to an end, it is recommended that its major stakeholders (governments, industry and the broader aquatic animal sector) support renewal of AAHBS to ensure that R&D and training needs continue to be addressed in a coordinated and timely manner.

### **Keywords**

Aquatic animal health; biosecurity; research and development; training



# Introduction

The Aquatic Animal Health Subprogram (AAHS) was founded in 2001, funded by the federal budget initiative (FBI) - *Building a National Approach to Animal and Plant Health*. Under a DAFF/FRDC joint agreement, AAHS was established and, in consultation with the fisheries and aquaculture industry, a portfolio of research projects was developed. AAHS provided support to, and management of, these projects as well as other aquatic animal health-related projects within FRDC. Based on the continued need and strong stakeholder support, the Subprogram has been renewed on a continuing basis. An external review of AAHS was undertaken in 2015 and it found that the consensus among the major stakeholders was that AAHS provides an essential service for the major stakeholders. Thus, AAHS was renewed in 2016 based on national need, previous performance and strong stakeholder support. The subprogram was initially known as the Aquatic the Animal Health Subprogram but in 2016 it was re-named the Aquatic Animal Health & Biosecurity Subprogram (AAHBS) to reflect an increased focus on biosecurity by the Australian Government, the FRDC and industry.

Since its establishment, the subprogram has managed in excess of 130 projects relevant to the aquatic animal health and biosecurity key research areas identified in the Subprogram's R&D Plan: (i) Nature of disease and their epidemiology, (ii) Biosecurity, (iii) Diagnostics (iv) Strategic surveillance, (v) Disease mitigation, (vi) Training and capacity building and (vii) New technologies and applications. Currently, there are 13 active projects and a further 3 projects in development.

AAHBS has access to industry and scientific expertise via a Steering Committee, a Scientific Advisory Committee and a core of technical experts (SCAAH) that have provided expert advice to the Subprogram Leader, supported by a Subprogram Coordinator. Thus, all research proposals have been evaluated with respect to their relative priority to industry and government and to their scientific soundness and feasibility. Where appropriate, collaboration between research providers has been encouraged and has resulted in improved project outputs. Through collaborations within the research community, an extensive network of expertise has developed, which has improved Australia's research capacity in the area of aquatic animal health and biosecurity, not only for the aquaculture sector but also for the other aquatic animal sectors - wild-capture, recreational, customary and ornamental.

Australia's aquatic animal sector is free from many diseases that occur overseas, providing us with a competitive advantage in both production and trade. While the number of aquatic animal species and the absolute number of aquatic animals being farmed in Australia is increasing annually, new diseases caused by emerging infectious agents (e.g. new yellow head virus genotypes (YHV7; Mohr *et al.* 2015), oyster oedema disease (Goncalves *et al.* 2017), ostreid herpesvirus (Liu *et al.* 2020), *Bonamia exitiosa* (Corbeil *et al.* 2006, Bradley *et al.* 2019), *Penaeus monodon* hepatopancreatitis (Chong *et al.* 2020), pilchard orthomyxovirus (Godwin *et al.* 2020, Mohr *et al.* 2020)) continue to threaten the sustainability of significant enterprises, and the call on health and biosecurity services, including R&D, to support the aquaculture sector is growing.

In addition to aquaculture, aquatic animal health and biosecurity R&D is required for the other aquatic animal sectors, including wild-capture (cf. *Edwardsiella ictaluri* in catfish (Lymbery *et al.* 2015), recreational (cf. *Perkinsus* in abalone (Gudkovs *et al.* 2016) and ornamental (cf. gourami iridovirus (Whittington & Chong 2007, Mohr *et al.* 2015a)), that share the aquatic environment. Thus, health and biosecurity services need to be coordinated across all aquatic sectors to ensure synergy while avoiding duplication. FRDC, through AAHBS, plays a major role in addressing research

and training needs in aquatic animal health and biosecurity. With its incumbent expertise and experience, AAHBS is able to direct these activities to the priority areas.

## Objectives

No.	Details
1	Manage a portfolio of R&D projects that are directly concerned with aquatic animal health & biosecurity and are not managed by other FRDC subprograms, FRABs or IPAs
2	In consultation with key stakeholders (industry, government and aquatic animal health providers) develop strategic directions for R&D
3	Facilitate the dissemination of outputs (information and results) from R&D projects to key stakeholders

# Methods

## Subprogram Structure

AAHBS is led by a Subprogram Leader (currently Dr. Mark Crane, CSIRO AAHL Fish Diseases Laboratory) who is assisted by a Subprogram Coordinator (currently Joanne Slater, CSIRO AAHL Fish Diseases Laboratory), and guided by a Steering Committee which is advised by a Scientific Advisory Committee. During the 2016-20 period the membership of these committees has changed, as detailed below.

### ***Steering Committee members (2016-20)***

Jo-Anne Ruscoe (FRDC; until 2018)

Wayne Hutchinson (FRDC; 2018-present)

Pheroze Jungalwalla (National Aquaculture Council; until 2019)

Dr David Mills (Paspaley Pearling Company; until 2018)

Aaron Irving (National Aquaculture Council; 2019-present)

Dr. Steve Percival (Huon Aquaculture; 2019-present)

Dr. Brett Herbert (Federal Government Department of Agriculture & Water Resources; until 2017)

Dr. Ingo Ernst (Federal Government Department of Agriculture, Water & Environment; 2017-present)

Dr. Tracey Bradley (Agriculture Victoria, representing the SCAAH)

### ***Scientific Advisory Committee members (2016-20)***

Prof. Richard Whittington (University of Sydney Veterinary Medical School; until 2017)

Dr. Kate Hutson (James Cook University; until 2018)

Dr. Stephen Pyecroft (University of Adelaide Veterinary Medical School; until 2019)

Dr Jeremy Carson (Department of Primary Industries, Parks, Water & Environment, Tasmania, 2017-2018; Carson BioConsulting; 2018-present)

Dr. Nick Moody (CSIRO AAHL Fish Diseases Laboratory)

Dr. Ian Anderson (Biosecurity Queensland; 2019-present)

Dr. Ellen Ariel (James Cook University; 2019-present)

Dr. Cecile Dang (Department of Primary Industries and Regional Development WA; 2019-present)

In consultation with stakeholders, the Subprogram has developed seven key research areas. These have evolved over time and are detailed in the current R&D Plan (see Appendix 2):

- Nature of diseases and their epidemiology
- Biosecurity
- Diagnostics
- Strategic surveillance
- Disease mitigation
- Training and capacity building
- New technologies and applications

During the period of the current subprogram these strategic directions underwent a review process on a regular basis, in consultation with key stakeholders, and R&D activities were aligned with these key research areas.

## Methods addressing each objective

***Objective 1.*** To manage a portfolio of R&D projects that are directly concerned with aquatic animal

*health and are not covered by other FRDC subprograms.*

The Subprogram Steering and Scientific Advisory Committees met, either face-to-face or by teleconference, up to four times per year to conduct Subprogram business. The schedule of meetings was aligned with the normal FRDC funding cycle to ensure that expressions of interest were canvassed and evaluated, full applications were invited and evaluated, and recommendations were submitted to the FRDC Board, in a timely manner. All projects within the R&D portfolio were managed to ensure that project milestones were achieved, scheduled payments were paid on approval of milestone reports and Final Reports were completed according to FRDC contracts.

**Objective 2.** *In consultation with key stakeholders (industry and aquatic animal health specialists) develop strategic directions for R&D.*

Following the establishment of AAHS in 2001, one of the first activities was to develop the Subprogram's R&D Plan (see Appendix 2 for the latest version). The R&D Plan is a living document which has been reviewed and updated on a regular basis, usually annually prior to the annual call for research applications. In preparation for each R&D Plan review, the Subprogram consulted on aquatic animal health and biosecurity R&D priorities and strategies with the Animal Health Committee's Sub-committee on Aquatic Animal Health (SCAAH). In addition, there was regular communication with industry peak bodies, e.g. National Aquaculture Council, Australian Abalone Growers' Association, Australian Prawn Farmers' Association, Oysters Australia.

**Objective 3.** *Facilitate the dissemination of information and results*

Dissemination of information and results was achieved through implementing the AAHBS' communication plan. The current communication plan for AAHBS includes:

- Production and dissemination of the biannual newsletter, *Health Highlights*
- Convening scientific workshops on specific issues, as needed
- Convening scientific conferences, specifically the biennial FRDC Australasian Scientific Conference on Aquatic Animal Health & Biosecurity
- With FRDC, maintaining a specific area on the FRDC Website
- Maintaining formal and informal communication with other Subprograms, FRABs, RACS, IPAs, SCAAH
- Use of developed databases (e.g. Final Reports on FRDC Website)

# Results and Discussion

**Objective 1.** To manage a portfolio of R&D projects that are directly concerned with aquatic animal health and biosecurity and are not covered by other FRDC subprograms.

To manage the AAHBS RD&E and training portfolio of projects, the AAHBS committees met either face-to-face or by teleconference, as organised by the AAHBS Coordinator. Table 1 provides the schedule of meetings convened to progress AAHBS business for 2016-20. It was most cost-effective to have most face-to-face meetings convened in Melbourne which is central for all committee members and allowed for direct air flights. In addition, four committee members are resident in Victoria which made Melbourne meetings cost-effective. In the years when scheduled July meetings coincided with the Cairns Conference, it was cost-effective for the AAHBS meetings to be held in Cairns on the day prior to the conference, which was attended by all AAHBS committee members.

**Table 1. FRDC Aquatic Animal Health & Biosecurity Subprogram**

**Schedule of meetings 2016-20**

Meeting	Date	Venue	Main purpose
1	01/09/16	Teleconference	Discuss AAHBS <i>modus operandi</i> and planning for the 2017 Scientific Conference
2	13/10/16	Melbourne	Discuss AAHBS <i>modus operandi</i> , Aquatic Animal Health Training Scheme (AAHTS) and planning for the 2017 Scientific Conference
3	15/3/17	Melbourne	Evaluate 5 full applications; discuss AAHTS and 2017 Scientific conference
4	10/7/17	Cairns	Evaluate 3 full applications, 2 expressions of interest (Eols), 4 AAHTS applications and discuss applications for committee membership; participate in the 2017 Scientific Conference
5	17/10/17	Brisbane	Evaluate 5 Eols; review R&D Plan; participate in WSD Planning Workshop
6	18/3/18	Melbourne	Evaluate 5 full applications, 5 Eols, 8 applications for committee membership
7	20/7/18	Melbourne	Evaluate 3 full applications, 3 Eols; review R&D Plan
8	29/10/18	Melbourne	Evaluate 6 full applications; commence planning for 2019 Scientific Conference
9	28/2/19	Melbourne	Evaluate 1 full application, 3 Eols, 5 AAHTS applications and discuss applications for committee membership
10	8/7/19	Cairns	Evaluate 6 full applications; participate in 2019 Scientific Conference
11	31/10/19	Melbourne	Evaluate 10 full applications, 3 Eols, 4 AAHTS applications

Meeting	Date	Venue	Main purpose
12	11-12/3/20	Melbourne	Evaluate 7 full applications, 3 EoIs; discuss application for renewal of AAHBS (2020-25)

To assist researchers making applications for funding *A Guideline To Preparing Funding Applications* was developed; the intention is for the guideline to be available through the Subprogram's web page.

In the period 2016-20, AAHBS has managed 27 projects concerned with aquatic animal health and biosecurity (Table 2). A few of these were continuation of active projects from the previous subprogram (2012-16). Others are relatively new and will continue past the completion date of the current AAHBS. In addition, AAHBS provided advice on other aquatic animal health- and biosecurity-related projects that were part of other FRDC programs. For example, AAHBS had a specific role in managing the DAWE/FRDC Aquatic Animal Health Training Scheme. AAHBS also provided comment, on request, on health and biosecurity related applications/milestone reports submitted to industry peak bodies, e.g. Oysters Australia, Australian Prawn Farmers Association and Australian Barramundi Farmers Association.

**Table 2. FRDC Aquatic Animal Health & Biosecurity Subprogram – R&D Projects 2016-20**

Project	Project Title	Date of Final Report
2013/002	Identifying the cause of Oyster Oedema Disease (OOD) in pearl oysters ( <i>Pinctada maxima</i> ), and developing diagnostic tests for OOD	Feb 2017
2014/001	Strategic approaches to identifying pathogens of quarantine concern associated with the importation of ornamental fish	Mar 2017
2014/002	Development of stable positive control material and development of internal controls for molecular tests for detection of important endemic and exotic pathogens.	Due Jun 2020
2015/001	Bonamiasis in farmed Native Oysters	Jan 2020
2015/003	Development of standard methods for the production of marine molluscan cell cultures	Jan 2020
2015/005	Determining the susceptibility of Australian <i>Penaeus monodon</i> and <i>P. merguensis</i> to newly identified enzootic (YHV7) and exotic (YHV8 and YHV10) Yellow head virus (YHV) genotypes	Due Jun 2020
2016/009	<i>Perkinsus olseni</i> in abalone: Development of fit-for-purpose tools to support its understanding and management	Due Jun 2020
2016/011	Disinfection measures to support biosecurity for ISKNV at aquaculture facilities	Jan 2019
2016/013	Comparative pathogenicity of exotic AHPND and the presumptive bacterial hepatopancreatitis detected in farmed <i>Penaeus monodon</i> in Queensland	Due Jun 2020
2016/064	Field observations and assessment of the response to an outbreak of White Spot Disease (WSD) in Black Tiger Prawns ( <i>Penaeus monodon</i> ) farmed on the Logan River in November 2016	Feb 2017
2016/404	Aquatic Animal Health and Biosecurity Subprogram: Strategic planning, project management and adoption	Due Jun 2020
2017/117	Identification of differentially expressed innate immune genes in the New Zealand pāua ( <i>Haliotis iris</i> ) and the Australian hybrid	Feb 2020

Project	Project Title	Date of Final Report
	abalone ( <i>H. laevisgata</i> X <i>H. rubra</i> ) upon immersion challenge with the abalone herpesvirus-1 (HaHV-1)	
2017/190	Assessment of gamma irradiation as a feasible method for treating prawns to inactivate White Spot Syndrome Virus	Due Jun 2020
2017/206	Assessment of the Inflamark method as a sensitive and cost-effective measure of oxidative stress in cultured fish	TBA
2018/100	Optimisation of treatment of <i>Cryptocaryon irritans</i> in Barramundi aquaculture	TBA
2018/144	Aquatic Animal Health Technical Forum and Training workshops	TBA
2018/147	Diagnostic detection of aquatic pathogens using real-time next generation sequencing	TBA
2018/180	Benchmarking for health and productivity in aquaculture	TBA
2019/005	Risk analysis to identify and minimise biosecurity risks arising from recycling bivalve mollusc shell waste during shellfish reef restoration projects in Australia	TBA
2019/019	Evaluation of cell reprogramming technology for generating prawn cell lines	TBA
2019/089	Evaluation of point of care (POC) tests for White Spot Syndrome Virus (WSSV)	TBA
2019/097	A longitudinal investigation of enteritis in juvenile barramundi <i>Lates calcarifer</i> , L. in North Queensland	TBA
2019/106	Minor use permit for oxytetracycline in non-salmonid finfish	TBA
2019/126	Assessing compliance and efficacy of import conditions for uncooked whole and eviscerated barramundi and grouper in relation to exotic viruses	TBA
2019/148	Aquatic Animal Health Training Scheme 2019-2022	TBA
2019/150	Feasibility study - Assessment of the pearl oyster farming industry capacity to retrospectively investigate stock health concerns	TBA

In addition to managing the RD&E portfolio of projects, AAHBS also managed a portfolio of projects within the Aquatic Animal Health Training Scheme (AAHTS) on behalf of DAWE and FRDC. Of the 29 AAHTS applications received by AAHBS during 2016-20, 15 projects were supported with 14 gaining approval (Table 3).

**Table 3. Aquatic Animal Health Training Scheme applications**

Application Title	Applicant	Organisation	Supported
Training for Global Aquaculture Alliance audit consultant	Helen Jenkins	Animal Health Australia	No
Masaryk University study visit	Chloe English	CSIRO	Yes
Laboratory visit: Isolation, characterization and screening of host-derived probiotic bacteria	Paula Lima	CSIRO	Yes
Study visit to EU Reference Laboratory	Peter Mohr	CSIRO	Yes
Conference attendance	Francisca Samsing Pedrals	CSIRO	No
CEFAS study visit	Paula Lima	CSIRO	No

<b>Application Title</b>	<b>Applicant</b>	<b>Organisation</b>	<b>Supported</b>
Shrimp pathology workshop	Tansyn Noble	CSIRO	No
Dr Bloecher expert visit	James Wynne	CSIRO Tasmania	Yes
Shrimp Pathology Short Course	David Cummins	CSIRO-AAHL	Yes
Aquatic Animal Health Technical Workshop	Lynette Williams	CSIRO-AAHL	Yes
Conference attendance	James Fensham	Future Fisheries Vet Services	No
Planning Workshop for an Emergency Disease Response Training Exercise	Erica Starling	Indian Ocean Fresh Australia	Yes
Growing disease testing capability in northern Australia	Dean Jerry	James Cook University	Yes
Disease diagnosis, biosecurity and disease management training for prawn farmers in Australia	Kelly Condon	James Cook University	Yes
AQUAVET II course	Erin Kelly	Murdoch University	Yes
Intensive pathology training workshop for laboratory veterinarians	Zoe Spiers	NSW DPI	Yes
Aquatic Animal Pathology and Histopathology: Specialist Skill Enhancement	Paul Hardy-Smith	Panaquatic Health Solutions	No
Professional development in Aquatic Animal Reproduction and Genetics	Torin Philpot	Petuna Aquaculture	Yes
Training in ultrasound scanning of broodstock	Phillipa Sims	Petuna Aquaculture	No
Biosecurity Audit Training	Evan Rees	PIRSA	No
Conference attendance	Shane Roberts	PIRSA	No
YTK Health Training Workshop	Steven Clarke	SARDI	Yes
Investigating jaw and gill deformities in marine larval fish aquaculture	Joy Becker	Sydney University	No
Biosecurity and Disease Prevention in the Home Aquarium Industry	Robert Jones /Josiah Pit	The Aquarium Vet	Yes
University of Tasmania Histopathology Course	Maximiliano Canepa	The Company One	Yes
Shrimp Pathology Short Course	Giana Gomes	The Fish Vet	No
Conference attendance	Johanna Mahadevan	University of Adelaide	No
Conference attendance	Thibault Legrand	University of Adelaide	No
Pre-training Package for Industry Ready Aquatic Animal Veterinarians	Liz Tudor/Paul Hardy-Smith	University of Melbourne	No

While the application received from Indian Ocean Fresh Australia (Erica Starling), “Planning Workshop for an Emergency Disease Response Training Exercise”, received support from AAHBS, the project did not go ahead due to logistical issues and significant restructuring within the WA Dept



Primary Industries & Regional Development (to include WA Fisheries), resulting in the main parties involved being unable to agree on content or attendance within a reasonable time-frame.

**Objective 2.** *In consultation with key stakeholders (industry and aquatic animal health specialists) develop strategic directions for R&D.*

To address this objective, AAHBS reviewed, in-house, the Subprogram R&D Plan on an annual basis which included consultation with major stakeholders (industry and governments). The revisions accounted for the changing aquatic animal health and biosecurity R&D and training needs at the enterprise, industry sector, and state and national levels.

Consultation with State/Territory Government aquatic animal health and biosecurity specialists included formal face-to-face meetings. "FRDC AAHBS research priorities" is a standing agenda item at the face-to-face meetings of SCAAH, convened annually (in March or April). It was during these meetings that R&D priorities were discussed by government, university and industry representatives and taken to AAHBS March meeting for discussion by the STC and SAC. The AAHBS R&D Plan was then up-dated, as needed, in time for the annual call for expressions of interest for that specific year. The most recent version of the R&D Plan is attached (Appendix 2).

**Objective 3.** *Facilitate the dissemination of information and results*

A communication strategy was developed in the first three years of the Subprogram's existence. This communication plan has continued and includes:

- Production and dissemination of the Subprogram Newsletter - *Health Highlights*
- Planning and convening scientific workshops
- Planning and convening scientific conferences
- Undertake formal and informal communication with other Subprograms, FRABs, as needed
- With FRDC, maintain AAHBS webpage, <http://www.frdc.com.au/en/frdc-stakeholders/national-priorities-and-subprograms/aquatic-health-and-biosecurity>
- Use of developed databases <http://www.frdc.com.au/research/final-reports>

### **Health Highlights**

During the period 2016-2020, there were seven issues of the Subprogram newsletter, *Health Highlights*, which has a broad distribution list (>300 subscribers) that includes industry associations, research providers and regulators both domestically and internationally. *Health Highlights* includes information about scientific conferences and workshops, progress reports on active and completed AAHBS research projects and various notices submitted by subscribers. Past issues of *Health Highlights* are available on the AAHBS page of the FRDC website (<http://www.frdc.com.au/en/frdc-stakeholders/national-priorities-and-subprograms/aquatic-health-and-biosecurity>).

### **Scientific Workshops**

In the past, AAHS coordinated workshops on priority issues in response to emerging needs, e.g. 2002 National Workshop on *Pfiesteria*, 2007 National Workshop on *Nodavirus* and 2011 International Workshop on Ostreid Herpesvirus. In addition, in 2013, FRDC provided funds in support of an international KBBE Workshop on Mollusc Disease Diagnosis. During 2016-2020, AAHBS provided support for the 2017 White Spot Disease R&D Needs Workshop and 2017 *Pinctada maxima* Pearl Oyster Health Workshop.

### White Spot Disease R&D Needs Workshop

Following the 2016 white spot disease outbreak in SE Queensland, this workshop was convened (in October 2017) for stakeholders (industry sectors and governments) to identify future research and prioritise research needs for the prawn sector (wild-catch, aquaculture and post-harvest), post disease outbreak. The workshop outputs were detailed in the workshop report (Crane *et al.* 2017). Several research projects, identified during the workshop, were funded by FRDC and are currently being progressed.

### 2017 Pinctada maxima Pearl Oyster Health Workshop

This workshop was convened in Cairns, following the 2017 FRDC Australasian Scientific Conference on Aquatic Animal Health and Biosecurity and was coordinated by Aaron Irving (PPA) and Cecile Dang (DPIRD). The workshop brought together an expert group consisting of representatives from the pearling industry and a range of government and university experts in the field of aquatic animal health and biosecurity (particularly for mollusc diseases) and other disciplines of relevance. It was planned that the outputs from the workshop would form the basis of a new R&D plan for the pearling industry.

### **Scientific Conferences**

During 2016-20 two FRDC Australasian Scientific Conferences on Aquatic Animal Health and Biosecurity were convened in Cairns (in 2017 and 2019). These FRDC-sponsored 2017 and 2019 conferences attracted, respectively, 83 (mainly from Australia and New Zealand) and 97 (90 registrations from Australia and New Zealand and 7 from Hong Kong, Singapore, Bangladesh, PR China, Taiwan and Thailand) participants. The Cairns conference has become an important event in the diaries of aquatic animal health and biosecurity specialists throughout Australia and New Zealand and provides a unique opportunity for regulators, researchers and industry to meet and discuss the latest research results and current issues relating to aquatic animal health and biosecurity. Conference proceedings were produced and distributed electronically to all conference participants.

### **FRDC Website and databases**

There is a dedicated page to the Aquatic Animal Health and Biosecurity Subprogram on the FRDC website that provides information on the Subprogram and links to other related websites and information (see <http://www.frdc.com.au/en/frdc-stakeholders/national-priorities-and-subprograms/aquatic-health-and-biosecurity>). In addition, as with all FRDC projects, final reports for aquatic animal health and biosecurity projects are available from the FRDC database (see <http://www.frdc.com.au/research/final-reports>).

# Conclusion

The Aquatic Animal Health Subprogram (AAHS) was established by the FRDC in mid-2001 to provide a cohesive and national approach to aquatic animal health R&D in Australia and has been an integral part of FRDC's business ever since. The continued support from the Federal Government, FRDC and other stakeholders is evidence of AAHS relevance to the Australian aquatic animal health community. In 2016, the subprogram was re-named the Aquatic Animal Health & Biosecurity Subprogram (AAHBS) to reflect an increased focus on biosecurity by the Australian Government, the FRDC and industry. The Subprogram's R&D Plan was revised accordingly. Thus, within FRDC's operations, AAHBS has remained a national subprogram with a dedicated budget which provides continuity of research funds for national aquatic animal health and biosecurity priorities.

It is well-established that wherever there are aquaculture activities, new diseases of the aquatic animals under culture will emerge on a regular basis. This is evidenced by the ever-changing and increasing number of OIE-listed diseases of aquatic animals (OIE, 2019). For Australia, during the period 2016-20, a number of aquatic animal health and biosecurity issues arose which required prompt attention. Foremost among these was the 2016 WSD outbreak in SE Queensland. Following the immediate response to this exotic disease outbreak, several projects were supported by FRDC including the 2017 White Spot Disease R&D Needs Workshop which identified several priority R&D needs. Since that workshop several projects to address these needs were established (Projects 2016/064, 2017/190, 2018/147 and 2019/089). In addition to WSD, other health issues within prawn aquaculture arose including the emergence of new YHV genotypes and a hepatopancreatitis reminiscent of AHPND. Research projects were initiated on these emerging pathogens as soon as possible (Projects 2015/005 and 2016/013, respectively). One of the strengths of AAHBS is the capability to provide extra funding for research on diseases when they arise. Thus, the AAHBS R&D Plan is updated on a regular basis (at least annually during the 2016-20 period) to incorporate R&D priorities on any significant emerging diseases.

Other priorities addressed during 2016-20 included oyster oedema disease in pearl oysters (Project 2013/002), abalone viral ganglioneuritis (Project 2017/117) and various issues concerned with exotic disease risks (Projects 2014/001, 2014/002, 2015/005, 2016/011, 2016/013 and 2019/126). The R&D portfolio is balanced with, in addition to those projects on pathogen/host interaction and biosecurity, projects addressing more strategic issues (Projects 2015/003 and 2019/019), training and professional development (Projects 2018/144 and 2019/148), the application of new technologies (Projects 2018/147 and 2019/089) and cross-jurisdictional initiatives (Projects 2015/001 and 2018/180).

In addition to managing the portfolio of R&D projects, the subprogram has seen several administrative changes such as changes to the committee membership during 2016-20. The retirement/resignation of a few of the committee members during this period provided the subprogram with an opportunity to refresh the committees and broaden the expertise base while maintaining continuity.

Dissemination of information and research results is undertaken by AAHBS through various means. The subprogram newsletter, *Health Highlights*, is produced biannually and publicises current research and other activities of interest to the subscribers. It also provides a vehicle for subscribers (which number over 300) to make announcements concerning up-coming events/workshops/conferences, job vacancies and the like. Other information on aquatic animal health and biosecurity is available on the FRDC website (<http://www.frdc.com.au/en/frdc-stakeholders/national-priorities-and-subprograms/aquatic-health-and-biosecurity>).

The FRDC Australasian Scientific Conferences on Aquatic Animal Health and Biosecurity offer a unique experience in Australia in that they provide a forum dedicated exclusively to aquatic animal health and biosecurity RD&E. The biennial conference is an event held over 4 days where aquatic animal health and biosecurity specialists can meet and discuss current R&D and newly emerging health and biosecurity issues for the fisheries and aquaculture sector. The conferences are open to all aquatic animal health and biosecurity specialists and research providers, including representatives from industry, Governments, universities and other academic institutions and private laboratories not only from Australia but also New Zealand and further afield.

It is an expectation that results from FRDC-funded AAHBS R&D projects are presented at the conference and these presentations represent a significant portion of the program. However, the conferences are open to all aquatic animal health and biosecurity specialists who are also invited to present their results from other, non-FRDC-funded, projects. In this way, linkages to other research providers have been enhanced. The conferences also provide an opportunity for the younger aquatic animal health specialists, the students and newcomers in the field, to develop their networks and to practice their presentation skills in front of a relatively friendly audience. The establishment of the Student Awards for the best student presentations at the Cairns conference has been a very successful innovation. It is interesting to note that feedback has been overwhelming in support of a single conference session (i.e. no parallel sessions) and that posters or excursions should not be included.

International experts are invited as keynote presenters at the conference and the benefits of this are at least two-fold. Firstly, the keynote presentations provide an educational experience for local aquatic animal health and biosecurity specialists. Secondly, the keynote presenters get the opportunity to visit Australia and to learn about Australian/New Zealand R&D which is show-cased at the conference. It is noteworthy that some of the world's foremost experts on aquatic animal health and biosecurity have participated in the Cairns conference over the years.

In recent times, the subprogram has been active in encouraging industry representatives to attend and participate in the conference and there has been a noticeable increase in industry attendance at the past two conferences. This is an important development, increasing the opportunities for researchers, regulators and industry to discuss aquatic animal health and biosecurity issues from each of their perspectives, and can only be highly beneficial. It is worthwhile noting that feedback from industry participants has been very positive and which presumably resulted in the noted increased participation rate.

In summary, major stakeholders continue to acknowledge the key role that the Aquatic Animal Health and Biosecurity Subprogram plays in (1) ensuring that the strategic direction for R&D investment in aquatic animal health and biosecurity, at the national, state and enterprise levels, is maintained and (2) further developing aquatic animal health and biosecurity capability in Australia.

# Implications

The overall planned outcome of the FRDC Aquatic Animal Health and Biosecurity Subprogram was an increased ability to manage aquatic animal disease in the commercial, recreational and customary fisheries sectors and thus assist Australia's aquaculture and fisheries industries become more competitive, profitable and sustainable. In addition, there is a broader responsibility towards the Australian community to ensure the sustainability of Australian aquatic natural resources by protecting them from biosecurity threats.

This overall outcome was achieved through (1) improved diagnostic capability and/or disease management for a number of aquatic animal pathogens including *Perkinsus olseni*, various novel yellow head virus genotypes, white spot syndrome virus and various ornamental fish pathogens; (2) development of enhanced awareness of emergency aquatic animal disease response arrangements and other training to enhance the disease emergency management capability of industry and government personnel. Achievement of outcomes addressing aquatic animal health and biosecurity priorities identified by industries and governments was ensured through the structure of a Subprogram Steering Committee which had a balance of industry and government representatives and was supported by a Scientific Advisory Committee.

Efficiency and effectiveness in R&D prioritisation, as well as delivery and extension of R&D results, have been achieved through the Aquatic Animal Health and Biosecurity Subprogram's STC and SAC structure and their linkages to other organisations involved in aquatic animal health and biosecurity, such as National Aquaculture Council, state and federal governments and SCAAH.

Extension of R&D results was further achieved through a proactive communication strategy, with the Subprogram newsletter *Health Highlights* and the FRDC Scientific Conferences on Aquatic Animal Health and Biosecurity being the two most effective mechanisms for information dissemination. Preventing duplication of aquatic animal health and biosecurity research is an important reason for the existence of the FRDC Aquatic Animal Health and Biosecurity Subprogram. By ensuring that all health-related proposals are reviewed by the Subprogram STC and SAC FRDC-funded research, at least, was not duplicated. The development of a nationally agreed FRDC AAHBS R&D plan with regular review by the major stakeholders and its placement on the FRDC website also assists in this respect. The updated R&D Plan, with the FRDC research projects relevant to aquatic animal health and biosecurity issues included, is also attached to calls for expressions of interest. In addition, all final reports are available from the FRDC website (<http://www.frdc.com.au/research/final-reports>).

# Recommendations

In recent years, there has been a noticeable underspend of the annual AAHBS budget. While there could be several factors involved, the precise reason for this is unknown. With biosecurity very much in the fore these days, there is an opportunity to raise the profile of AAHBS amongst the major stakeholders. It is recommended that AAHBS committee members should participate in industry meetings within their jurisdictions to raise awareness of AAHBS within these groups.

Furthermore, AQUAPLAN is Australia's national strategic plan for aquatic animal health which was developed in consultation with governments and industry. As such it is important for the FRDC Aquatic Animal Health and Biosecurity Subprogram to align with AQUAPLAN and support research to expedite implementation of the plan. Currently, there are some research projects within the subprogram's portfolio (e.g. FRDC Projects 2014/001, 2014/002 and 2015/005) but it is likely that there could be further projects developed that would assist in addressing AQUAPLAN objectives. It is noted that the new AQUAPLAN 2020-25 is currently under development.

FRDC has a strong record in supporting workshops on aquatic animal health and biosecurity issues (e.g. 2017 White Spot Disease R&D Needs Workshop) in order to discuss and plan research needs for current and urgent priorities. These workshops provide relatively rare opportunities for experts and stakeholders to meet and focus on very specific topics, and with the aim to develop research plans for future consideration. It is recommended that workshop support be continued, perhaps through the Aquatic Animal Health Training Scheme (Project 2019/148).

## Further development

Until recently, the Australian fisheries and aquaculture sector has been relatively disease-free and suffered few major national emergencies. However, the frequency of disease outbreaks appears to be on the rise. Examples include piscine nodavirus in farmed giant grouper, pilchard orthomyxovirus in farmed Atlantic salmon, white spot disease and hepatopancreatitis in farmed prawns. In the period since 2012 the following incidences have occurred:

2012: *Megalocytivirus* in farmed ornamental fish (Queensland)

2012: Pilchard Orthomyxovirus in farmed Atlantic salmon (SE Tasmania)

2013: New yellow head virus genotypes in farmed prawns (Queensland)

2014: *Edwardsiella ictaluri* in catfish (Queensland)

2015: AHPND-like *Penaeus monodon* hepatopancreatitis (Cardwell, Queensland)

2015: *Bonamia exitiosa* in native oysters (Victoria)

2015: *Bonamia exitiosa* in native oysters (South Australia)

2015: Bellingen River turtle mortalities (NSW)

2016: AHPND-like *Penaeus monodon* hepatopancreatitis (Bundaberg, Queensland)

2016: Ostreid herpesvirus-1  $\mu$ Var in Pacific oysters (Tasmania)

2016: WSSV in farmed and wild prawns (SE Queensland)

2017: NNV in giant grouper (Queensland)

2018: IHNV (WA)

2018: Ostreid herpesvirus-1  $\mu$ Var in Pacific oysters (South Australia)

2019: *Perkinsus olseni* and *Perkinsus beihaiensis* in rock oysters (WA)

2020: *Perkinsus olseni* in abalone (WA)

2020: Reoccurrence of WSD in Queensland

The presence of these diseases/agents has had significant negative impacts on profitability and sustainability of industry sectors through direct effects such as mass mortality and reduced growth of animals, as well as more indirect effects such as increased expenditure on control and management measures. Moreover, an understanding of the epidemiology is required before appropriate management and control measures can be implemented. Thus, when new agents emerge it is critical not to underestimate their significance even if there appears to be no overt disease or negative impact. It is important to implement at least some basic research in an effort to provide an understanding of their biology and develop some basic diagnostic tools.

With the occurrence of climate change, it is likely that increased stress on farmed species will increase their susceptibility to infectious agents; agents that are normally non-pathogenic may become pathogenic for some host species at the higher temperatures and under conditions of intensive culture (see Crane and Carlile, 2008 for example). In addition, geographical ranges of disease agents may expand as warmer water temperatures allow host ranges to expand southward.

# Extension and Adoption

The major output from this project includes all the knowledge, processes and technologies that has been developed from research and training projects within the AAHBS R&D portfolio. Thus, AAHBS encourages that the outputs from each research project are published, widely disseminated and promoted.

With respect to AAHBS communication, extension and adoption of results has been facilitated through various means, including:

- The Subprogram Newsletter, *Health Highlights*
- Scientific workshops/conferences
- FRDC Website
- Databases
- Provision of advice to other FRDC Subprograms and FRABs regarding aquatic animal health and biosecurity research

Milestone Progress Reports for this project have been submitted, at intervals of approximately 6 months, to the STC/SAC for approval prior to submission to FRDC.



# Project materials developed

The latest version of the FRDC Aquatic Animal Health and Biosecurity Subprogram R&D Plan is attached (Appendix 2).

Conference and workshop proceedings have been produced and distributed. Copies of these proceedings remain available, on request:

2017 Fourth FRDC Australasian Scientific Conference on Aquatic Animal Health & Biosecurity

2017 White Spot Disease R&D Needs Workshop: Workshop Report

2019 Fifth FRDC Australasian Scientific Conference on Aquatic Animal Health & Biosecurity

A Guideline to Preparing Funding Applications – FRDC Aquatic Animal Health & Biosecurity Subprogram

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# Appendices

## Appendix 1: Project Staff

Mark Crane, Aquatic Animal Health and Biosecurity Subprogram Leader

Joanne Slater, Aquatic Animal Health and Biosecurity Subprogram Coordinator

### ***Steering Committee members (2016-20)***

Jo-Anne Ruscoe (FRDC; until 2018)

Wayne Hutchinson (FRDC; 2018-present)

Pheroze Jungalwalla (Chair, National Aquaculture Council; until 2019)

Dr David Mills (Paspaley Pearling Company; until 2018)

Aaron Irving (Chair, National Aquaculture Council; 2019-present)

Dr. Steve Percival (Huon Aquaculture; 2019-present)

Dr. Brett Herbert (Federal Government Department of Agriculture & Water Resources; until 2017)

Dr. Ingo Ernst (Federal Government Department of Agriculture, Water & Environment; 2017-present)

Dr. Tracey Bradley (Agriculture Victoria, representing the SCAAH)

### ***Scientific Advisory Committee members (2016-20)***

Prof. Richard Whittington (University of Sydney Veterinary Medical School; until 2017)

Dr. Kate Hutson (James Cook University; until 2018)

Dr Jeremy Carson (Department of Primary Industries, Parks, Water & Environment, Tasmania; 2017-2018; Carson BioConsulting; 2018-present)

Dr. Stephen Pyecroft (University of Adelaide Veterinary Medical School; until 2019)

Dr. Nick Moody (CSIRO AAHL Fish Diseases Laboratory)

Dr. Ian Anderson (Biosecurity Queensland; 2019-present)

Dr. Ellen Ariel (James Cook University; 2019-present)

Dr. Cecile Dang (Department of Primary Industries and Regional Development WA; 2019-present)

## Appendix 2: Aquatic Animal Health & Biosecurity Subprogram R&D Plan



# Aquatic Animal Health & Biosecurity Subprogram Research Development & Extension Plan 2016-2020 (updated Feb 2020)



### Prepared by:

FRDC Aquatic Animal Health and Biosecurity Subprogram

### Edited by:

Dr Mark Crane, Aquatic Animal Health and Biosecurity Subprogram Leader

Joanne Slater, Aquatic Animal Health and Biosecurity Subprogram Coordinator

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## 1. Introduction

This strategic RD&E plan ('the Plan') of the Fisheries Research and Development Corporation's Aquatic Animal Health and Biosecurity Subprogram ('the Subprogram') will guide the Subprogram to fulfill its objectives to provide leadership, direction and focus for aquatic animal health and biosecurity research, development and extension (RD&E) and other related non-RD&E activities and taking into consideration non-AAHBS research projects. The Plan will assist the Subprogram in assessing aquatic animal health and biosecurity project applications. A compilation of current RD&E issues is included.

***This strategic RD&E plan is applicable to the four-year period 2016-2020 after which a full review will be conducted.***

***However, the Plan will also be reviewed annually, as needed.***

The Plan:

- Describes the Subprogram including its role, objectives and structure;
- Describes criteria used in defining a project under the Subprogram;
- Outlines the key research areas;
- Will be used by the Subprogram to assist in assessing aquatic animal health and biosecurity project applications;
- Lists current RD&E priorities; and
- Will be reviewed annually with wide stakeholder consultation.

## 2. Background

Australia's fisheries/aquaculture continues to be a major sector of our primary industries in terms of both job creation and value of production. Commercial fishery and aquaculture production was valued at \$3.06 billion in 2016-17 (Abares, 2018). Globally, Australia produces less than 0.16% of the world's fishery and aquaculture supply but does export a range of high value products, e.g. SBT to Japan, lobster and abalone products to other Asian countries (Whittle et al., 2015). Salmonids, rock lobster, prawns, tuna and abalone dominate, being valued at over \$2 billion. Aquaculture production was valued at \$1.35 billion and is dominated by salmonids (52,779 tonnes valued at \$756 million (Abares, 2018). The National Aquaculture Strategy (2017-27) vision is to grow the value of aquaculture to \$2 billion by 2027 by improving market access, investing in RD&E, strengthening biosecurity, improving environmental performance, reducing regulatory burden and investing in education and training.

Australia is fortunate to have an aquatic animal sector free from many diseases that cause significant economic impact elsewhere in the world. It is vital for Australia to maintain this relative disease-free status, not only to enhance our competitiveness but also to protect Australia's natural resources. However, Australia also has a unique and poorly understood range of endemic pathogens including local strain variations of pathogens of international concern, which is becoming increasingly important and of significance to our export trade. Examples include local genotypes of YHV (YHV2, YHV7) in prawns, *Bonamia* sp. in edible oysters, oedema oyster disease in pearl oysters, *Penaeus monodon* hepatopancreatitis and pilchard orthomyxovirus. Furthermore, as aquaculture expands, the range of native aquatic animals being farmed is increasing which, in turn, increases the need for further research on aquatic animal health issues. In Australia there are approximately 70 aquatic species under aquaculture development of which 40 are farmed commercially. Research on all types of aquatic animals (finfish, crustaceans and molluscs) from all environments, i.e. tropical or temperate, marine, brackish or freshwater environments, is

required. It is noteworthy that, clearly, investment in aquatic animal health and biosecurity RD&E provides a better return on investment over post-outbreak response and recovery (cf. 2016 SE Queensland WSD outbreak)

Industry and government have recognised the importance of an integrated and planned approach to aquatic animal health. This recognition led to an industry/government cooperative effort in developing *AQUAPLAN 1998-2003*, Australia's first five-year National Strategic Plan for Aquatic Animal Health, and its successors *AQUAPLAN 2005-2010* and *AQUAPLAN 2014-2019*. A common theme within these strategic plans is the recognition of the need for research, and the adaptability of the plan to include emerging aquaculture industries. Research has a critical role in expanding this knowledge and enhancing management practices to prevent disease or limit its impact on the expanding fisheries/aquaculture sector, including recreational fisheries and natural resources.

### 3. Aquatic Animal Health and Biosecurity Subprogram

The Aquatic Animal Health & Biosecurity Subprogram (AAHBS) was established by the Fisheries Research and Development Corporation (FRDC) in mid-2001 to provide a cohesive and national approach to aquatic animal health research and development in Australia, and in particular to address *AQUAPLAN 1998-2003* Program 6: Research and Development. The Subprogram has a national focus, linking government and industry research priorities, consistent with international obligations. The subprogram was initially known as Aquatic Animal Health Subprogram but in 2016 it was re-named the Aquatic Animal Health & Biosecurity Subprogram (AAHBS) to reflect an increased focus on biosecurity by the Australian Government, the FRDC and industry.

From the Subprogram perspective, ***aquatic animal health*** concerns the health of the animal *per se* and the resources and procedures to maintain aquatic animal health (for the subprogram this relates to infectious disease). ***Aquatic animal biosecurity*** refers to all the resources and procedures in place to prevent pathogens affecting aquatic animal health from entering our country, regions, or farms; and to prevent their subsequent spread or establishment. Research and training activities that support this aim would be relevant for the Subprogram.

#### 3.1. Mission

***“To provide oversight and guidance to aquatic animal health and biosecurity RD&E and its adoption in Australia”.***

#### 3.2. Objectives

The Subprogram's key objectives are to:

1. Provide expert advice, coordination, management and planning for aquatic animal health and biosecurity RD&E;
2. In consultation with stakeholders, set and review FRDC Subprogram RD&E priorities, and on request provide advice on external projects addressing aquatic animal health and biosecurity;
3. Ensure that FRDC-funded projects are implemented and progressed according to stated project objectives; and
4. Facilitate the communication and extension of results of FRDC aquatic animal health and biosecurity research projects undertaken under the auspices of the AAHBS.

#### 3.3. Role

The role of the Subprogram is to:

- Implement the Subprogram strategic RD&E Plan;
- Set Subprogram RD&E priorities in aquatic animal health and biosecurity to maximise investment for the greatest potential return;
- Invite RD&E applications to address those priorities;
- Provide FRDC with expert technical advice on proposals submitted to the Subprogram and, where appropriate, RACs, IPAs and other funding agencies - particularly on methodology, capability and value for money, to identify technical risks/challenges, to identify potential linkages with other activities, to identify whether the Subprogram wishes to co-invest.
- Promote collaboration among researchers, and between researchers and the beneficiaries (of the research);
- Encourage co-investment from other RD&E funding sources;
- Communicate regularly with potential beneficiaries; and
- Influence the adoption of RD&E results.

### **3.4. Outcomes**

The Subprogram's activities will contribute to improved productivity and profitability of the fishing and aquaculture sectors through:

1. Reduced risks of exotic and new diseases in Australia's fisheries and aquaculture sectors.
2. Mitigation of the impacts of endemic disease on Australia's fisheries and aquaculture sectors.
3. Improved biosecurity
4. Improved market access
5. High quality and cost-effective research
6. Increased awareness of aquatic animal health and biosecurity issues

### **3.5. Scope and links within FRDC**

The scope of the Subprogram is 'health and biosecurity' with a focus on infectious diseases and their causative agents. The Subprogram is responsible for coordinating research projects that are funded under the following two separate components:

#### ***a) R&D projects in sectors with no dedicated subprograms***

The Subprogram adopts a special responsibility for health and biosecurity related project applications relevant to industry sectors for which there is no other specific subprogram or IPA. In particular, the Subprogram manages health and biosecurity related projects on new or emerging species ('orphan species') for aquaculture.

In situations where a species-specific aquaculture subprogram or IPA exists (see FRDC website for details), these subprograms and IPAs are responsible for the prioritisation and management of any health and biosecurity related projects involving those specific species. The Subprogram provides advice on these health and biosecurity related projects where requested. The Subprogram may also co-invest with these subprograms and IPAs in projects with a national focus.

#### ***b) R&D projects that may provide benefit across all aquatic industry sectors***

These projects contribute to maintaining and increasing Australia's capacity and capability to manage aquatic animal health and biosecurity. They may support national objectives in the area of aquatic animal health and biosecurity; for example, as reflected in AQUAPLAN and the FRDC's Research, Development and Extension Plan 2015-20. The Australian Government through FRDC supports the FRDC's mission to increase economic and social benefits for the fishing and aquaculture industry and the people of Australia through planned investment in research and

development in an ecologically sustainable framework. Such projects are managed by AAHBS on behalf of the FRDC.

### 3.6. Scope and links with other bodies

The Subprogram consults on health and biosecurity R&D priorities and strategies with the Animal Health Committee (AHC) which has primary responsibility for public policy decision-making on aquatic animal health and biosecurity. Consultation is primarily through AHC’s Subcommittee on Aquatic Animal Health (SCAAH). SCAAH consists of the Sub-committee Chair (a member of AHC), core members (aquatic animal health and biosecurity specialists nominated by the Federal and each State/Territory Government and New Zealand Government, CSIRO-AAHL and a university representative), co-opted members (as deemed necessary to undertake SCAAH business), and observers including the Chair of the National Aquaculture Council.

### 3.7. Operation of the Subprogram

The operation of the Subprogram is supported by a Steering Committee (STC), and a Scientific Advisory Committee (SAC), both appointed by the FRDC.

#### 3.7.1 Steering Committee (STC)

The *Terms of Reference* of the STC are:

- To provide a Strategic RD&E Plan with key performance measures and timeframes.
- To ensure that research objectives are commercially-focused, and outcome-driven.
- To coordinate industry and research provider involvement to maximise usage of available resources.
- To provide advice on aquatic animal and biosecurity projects to facilitate industry extension and technology transfer.
- To communicate between AAHBS and its major stakeholders.

The AAHBS STC provides for linkages to the National Aquaculture Council (NAC), Subcommittee on Aquatic Animal Health (SCAAH), Australian Government Department of Agriculture, Water and the Environment (DAWE), CSIRO Australian Animal Health Laboratory (CSIRO-AAHL), state and territory diagnostic laboratories, and the FRDC.

#### STC members

Membership of the STC is representative and includes industry and government (state and the Australian Government) representatives, and representatives of the FRDC and CSIRO-AAHL (See Table 1). Changes to membership are to be recommended by the STC to the FRDC for approval.

**Table 1. Current membership of the FRDC AAHBS STC**

Name	Affiliation
Mark Crane (Subprogram leader, Chair)	Commonwealth laboratory (AAHL Fish Diseases Laboratory, CSIRO-AAHL)
Joanne Slater (Subprogram coordinator)	Commonwealth laboratory (AAHL Fish Diseases Laboratory, CSIRO-AAHL)
Tracey Bradley	SCAAH/State Government (Principal Veterinary Officer - Aquatic Animal Health, DEDJTR, Victoria)
Ingo Ernst	Australian Government (Director - Aquatic Pest and Health Policy, Department of Agriculture, Water and the Environment)



Name	Affiliation
Wayne Hutchinson	FRDC (Research Portfolio Manager)
Aaron Irving	Industry (Chair - National Aquaculture Council and Executive Officer - Pearl Producers Association)
Steve Percival	Huon Aquaculture Company Pty Ltd

### 3.7.2 Scientific Advisory Committee (SAC)

The purpose of the formal Scientific Advisory Committee (SAC) is to provide the STC with timely scientific and technical advice in all matters relating to aquatic animal health & biosecurity and to facilitate communication between AAHBS and other scientific experts.

The *Terms of Reference* of the SAC are:

- To assess new research proposals, *inter alia* to ensure that the research proposed is scientifically feasible.
- To advise on scientific problems with project progress as well as identify remedial action, to ensure scientific objectives and milestones are met.
- To foster and develop collaboration amongst researchers.
- To provide advice on projects to facilitate research extension and technology transfer.
- To assess Milestone Progress Reports and draft Final Reports.

#### SAC members

Membership of the SAC is expertise-based (see Table 2). Members will be chosen to ensure complimentary knowledge and skills are brought to the SAC so that it is best placed to provide the STC with scientific advice. Changes to membership are to be recommended by the STC-SAC to the FRDC for approval.

**Table 2. Current membership of the FRDC AAHBS SAC**

Name	Affiliation
Ian Anderson	Queensland DAF, Brisbane, Qld
Ellen Ariel	James Cook University, Townsville, Qld
Jeremy Carson	Carson BioConsulting, Launceston, Tas
Cecile Dang	DPIRD WA
Nick Moody	CSIRO AAHL Fish Diseases Laboratory, Geelong, Vic

## 4. Stakeholders

The key stakeholders in the Subprogram, i.e. those that have the greatest stake in the success of the Subprogram and with whom the Subprogram consults to identify aquatic animal health and biosecurity RD&E needs, are:

- Australian Government Department of Agriculture, Water and the Environment
- Animal Health Committee (AHC) and its Subcommittee on Aquatic Animal Health (SCAAH)
- Capture fisheries
- Customary fisheries
- Recreational fisheries
- FRDC

- Aquaculture industries
- National Aquaculture Council
- Research providers
- State/Territory Departments of Fisheries/Natural Resources/Agriculture

It is acknowledged that the list of beneficiaries is much larger, including e.g. the post-harvest industry, the ornamental fish industry, conservation interests, indigenous groups, pharmaceutical companies, research investors, extension services, consumers of seafood, and the public at large.

## 5. Method of operation

The Subprogram fulfils its role by:

- Being accountable for actions outlined in this strategic plan;
- Adopting a proactive and holistic approach to aquatic animal health and biosecurity;
- Adopting sound governance processes;
- Encouraging a collaborative/cooperative RD&E environment;
- Advocating the importance of aquatic animal health and biosecurity; and
- Communicating with Fisheries Research Advisory Councils (RACs) and other FRDC subprograms/IPAs on:
  - ✓ Research EoIs and full project applications received by the Subprogram – informing and seeking comment by RACs/subprograms/IPAs;
  - ✓ Subprogram assessment of research EoIs and full applications; and
  - ✓ Advice sought on health and biosecurity related EoIs and full applications submitted to RACs or other subprograms/IPAs.

The STC and SAC assist the Subprogram in fulfilling its role and managing its projects. The Subprogram follows the FRDC's standard operating procedures for project approval and management, especially regarding communication with other subprograms/IPAs and RACs.

The Subprogram achieves its four key objectives through the following methods:

### ***Objective 1: Provide expert advice, coordination, management and planning for aquatic animal health and biosecurity RD&E***

#### ***A) Planning***

- Establishment and annual review of the strategic RD&E plan (update; identify gaps)

#### ***B) Development of applications***

Project applications submitted to the Subprogram:

- Commissioned, unsolicited or forwarded (by FRDC, RACs or other subprograms/IPAs, or by AHC and SCAAH) applications are reviewed.
- Projects falling within the remit of the FRDC AAHBS are evaluated against the criteria below (C to F). Other projects referred to the FRDC AAHBS (e.g. by FRDC, RACs, other subprograms or IPAs) will be evaluated as per usual unless there are specific criteria requested with the referred project.

#### ***C) Assessment of applications***

- Determine whether application fits criteria<sup>1</sup> (if not, provide advice/expertise/leadership)
- Evaluate need

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<sup>1</sup> See 6.1 below

- Evaluate feasibility
- Determine overall priority (against other applications)

#### **D) Application funding**

- Identify appropriate funding body/ies

#### **E) Governance**

- Reporting/accountability (FRDC)
- Structure (STC; SAC – expertise based)

#### **F) Linkages**

- Establish strategic alliances

#### **Objective 2: In consultation with stakeholders, set and review FRDC Subprogram RD&E priorities, and on request provide advice on external projects addressing aquatic animal health and biosecurity.**

- Establish current RD&E issues in consultation with stakeholders, e.g. through the annual meetings of SCAAH, and FRDC-representative organisations
- Annual update of the strategic RD&E plan
- Full review of the strategic RD&E plan every 5 years
- Where requested, provide scientific advice and communication to other subprograms/IPAs and RACs regarding aquatic animal health and biosecurity research pre-proposals, applications, projects and results

#### **Objective 3: Ensure that FRDC-funded projects are implemented and progressed according to stated project objectives**

- Assess project milestone progress reports with reference to the project objectives
- Assess the project communication/extension plan
- Encourage/facilitate adoption of results

#### **Objective 4: Facilitate the communication and extension of results of FRDC aquatic animal health and biosecurity research projects undertaken under the auspices of the AAHBS**

Provide a communication strategy that may include:

- *Health Highlights* (AAHB Subprogram newsletter)
- Scientific workshops (convened to prioritise and facilitate a national approach to specific RD&E problems, for example, the national workshops on “Development of a national aquatic animal health curriculum for delivery by tertiary institutions”, Adelaide 13-14 February 2014 and “White spot disease R&D needs”, Brisbane 18 October 2017)
- FRDC National Aquatic Animal Health Conferences (previously held in 2003, 2005, 2007, 2009)
- FRDC Australasian Scientific Conference on Aquatic Animal Health & Biosecurity (previously held in 2011, 2013, 2015, 2017, 2019)
- Webpage on the FRDC Website
- Databases on the FRDC Website

## **6. Research Development & Extension**

This section outlines the criteria used to determine whether a project falls within the Subprogram. Key research areas for the Subprogram are listed as a guide for applicants in developing projects for funding under the Subprogram.

## 6.1 Scope

The following factors are used to prioritise projects for funding by the Subprogram:

- Exotic or endemic aquatic animal disease of putative infectious aetiology, with potential or existing significant impact on Australian fisheries and aquaculture (includes also capture fisheries, recreational fisheries, indigenous fisheries and/or aquatic ecosystems)
- Emergency disease of national significance (e.g. based on Australia's *National List of Reportable Diseases of Aquatic Animals*)
- Addresses gaps in existing aquatic animal health research and biosecurity and contributes to the future understanding of infectious aquatic animal diseases and their control (including diseases of new or potential species for aquaculture)
- Leads to increased productivity and/or profitability the Australian fisheries and aquaculture by improving the health status of target aquatic animals
- Facilitates collaborative research to avoid duplication or gaps
- Facilitates capability and capacity development within Australia
- Identified as a stakeholder priority (including industry, government and research providers)
- Addresses RD&E needs identified in *AQUAPLAN 2014-2019*.

## 6.2 Key research areas in aquatic animal health and biosecurity

When developing project applications for funding through the Subprogram, the outcomes of the project should address at least one of these key research areas. Current priorities for AAHBS in the next funding cycle are listed under pertinent areas.

### 6.2.1 Nature of diseases and their epidemiology

#### SCOPE

- Improved knowledge of the biology of enzootic diseases (including epidemiology, taxonomy of pathogens, pathophysiology, histology, etc)
- Improved knowledge on the host response to disease agents (aquatic animal immunology and immunomodulators)
- Knowledge about new and emerging infectious diseases

#### CURRENT PRIORITIES

- Development of robust methodologies for investigation of disease outbreaks
- Develop generic response/key strategies to manage an outbreak of a new (previously unknown) disease, including epidemiology and a guideline for undertaking initial investigation
- Research on newly emerging diseases
- Integrated health management practices for commercial enterprises

### 6.2.2 Biosecurity

#### SCOPE

- RD&E to inform risk analyses (including disease risk minimisation procedures for exported and imported aquatic animals and products)
- RD&E to facilitate translocation of aquatic animals and their products
- Development of protocols and methods to manage routine biosecurity and emergency disease outbreaks
- Treatments to prevent spread of disease (e.g. disinfection and decontamination)

## CURRENT PRIORITIES

- Research on risks from infectious disease agents carried by imported species/products
- Simplified, risk-based approach to translocation of live animals, harmonised across State/Territory boundaries. Improving regional and enterprise level biosecurity to underpin health accreditation for trade (including translocations and export) and best practice disease management
- Research to support the evaluation of quarantine risks to Australia, including susceptibility of Australian species to emerging and exotic diseases
- Pathways involved in incursion, transmission and establishment of emerging and exotic disease
- Pathogen persistence

### **6.2.3 Diagnostics**

#### SCOPE

- Development of tissue sampling and processing methodology to detect sub-clinical infections at low levels of prevalence
- Development of case definitions and diagnostic criteria
- Development and validation<sup>2</sup> of screening and diagnostic tests
- Facilitate transfer of knowledge and technology in diagnostics
- RD&E

## CURRENT PRIORITIES

- Development, improvement and harmonisation of procedures (tissue sampling, tissue processing, nucleic acid extraction, result interpretation) for molecular tests
- Development/establishment of cell culture systems for the isolation of viruses from finfish, crustaceans and molluscs
- Develop and validate fit-for-purpose diagnostic tests for significant diseases including detection of sub-clinical infections.

### **6.2.4 Strategic surveillance**

#### SCOPE

- Support projects to enhance existing and proposed surveillance programs
- Research into surveillance methodology
- Strategic RD&E to inform disease control programs, translocation, zoning, surveillance, and risk analyses in relation to disease organisms

## CURRENT PRIORITIES

- Identify possible improvements in the sensitivity of Australia's surveillance systems (including early detection of disease, disease management, confirmation of Australia's disease status etc.) for aquatic animal diseases.

### **6.2.5 Disease mitigation**

#### SCOPE

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<sup>2</sup>Validation, as defined in Chapter 1.1.2. Principles and methods of validation of diagnostic assays for infectious diseases of the OIE Manual of Diagnostic Tests for Aquatic Animals (the *Aquatic Manual*), is “the process that determines the fitness of an assay, which has been properly developed, optimised and standardised, for a specific, defined diagnostic purpose.” Projects aimed at diagnostic test development and validation should be guided by the validation pathway described in this OIE Chapter. The stage to which an assay will be validated needs to be described.

- RD&E that supports the application of veterinary medicines for the treatment of infectious diseases of aquatic animals
- RD&E (microbiology/immunology) that underpins development of autogenous vaccines for aquatic animals
- RD&E that supports selective breeding programs for disease resistance

#### CURRENT PRIORITIES

- Research on resistance to viral, bacterial and parasitic diseases of Australian aquaculture species that supports development and assessment of alternative therapeutics/vaccines.
- Research that supports the application (MUP/label registration) of veterinary medicines for the treatment of infectious diseases of aquatic animals
- Research that supports understanding the mechanisms of disease resistance

#### **6.2.6 Training and capacity building**

##### SCOPE

- Human capital development
- Facilitate the development of, and access to, training and extension tools
- Sustain and further develop technical skill-base in aquatic animal health and biosecurity
- Facilitate RD&E knowledge transfer in aquatic animal health and biosecurity

#### CURRENT PRIORITIES

- Improve the breadth of data included in the Neptune information facility, particularly the histopathology slide collections.
- Develop generic short-course training material for industry on management of aquatic animal disease incidents (including reporting procedures, collecting samples for laboratory diagnostics, record keeping).

#### **6.2.7 New technologies and applications**

##### SCOPE

- Next Generation Sequencing

Next-generation sequencing (NGS) is non-Sanger-based DNA sequencing (also referred to as massively parallel sequencing) technologies. Millions of DNA strands are generated from single or multiplexed samples that are sequenced in parallel. Commonly used platforms include MiSeq, PacBio, MinION and Ion Torrent.

- Bioinformatics

Bioinformatics is the computational analysis and interpretation of NGS data using either GUI- or Command Line-based computer programs.

- Transcriptomics

Transcriptomics is the study of the transcriptome - the complete set of RNA transcripts that are produced by the genome under specific experimental conditions.

- eDNA

Analysis of genetic material obtained from environmental samples (i.e. water or sediment). eDNA can be used for detection of specific targets (e.g. detection of OsHV-1 in plankton samples) or analysis of biodiversity in environmental samples.

#### CURRENT PRIORITIES

- Improved knowledge about microbiomes and their role in disease outbreaks

- Evaluation, optimisation and validation of analysis pipelines for the detection of WSSV and OshV-1 in plankton samples.

### **6.3 The application and evaluation process**

A general guide to developing research proposals for submission to FRDC is provided on the FRDC Website (<http://www.frdc.com.au/Research/Apply-for-funding>) and should be followed. In addition, PIs may contact any of the AAHBS committee members to obtain advice of the relevance of any project idea to the AAHBS.

In the sections that require text, it may be useful to draft these using your normal word-processor (e.g. MS Word) so that you can use tools such as spell-check and word-count and then copy and paste the final text into the on-line application. Thus poor presentation will not distract reviewers from the proposal content.

Selection of a successful application is a competitive process, taking into account the following criteria:

- Whether or not the project is of national significance
- Whether or not appropriate collaborations are included and corroborated
- The objectives are clearly defined and address identified AAHBS RD&E priorities
- Evidence of strong stakeholder support such as cash contributions
- Does the project provide value for money, is the budget justified and is the application of the project (to industry or environment) clearly identified?
- Are the methods appropriate to address the objectives to provide a high likelihood of their achievement?
- What is the track record of the PI and research team?
- Has a literature review been undertaken and does the project reflect current knowledge?

## 7. Current and completed projects within AAHB Subprogram

Projects are listed according to the most relevant key research areas and as such some projects may be listed more than once because they are relevant to more than one key research area. For completed projects the date of the Final Report is included. Final Reports can be found on the FRDC website: <http://www.frdc.com.au/Research/Final-reports>

### 7.1 Nature of diseases and their epidemiology

2002/043: The production of nodavirus-free fish fry and the nodaviruses natural distribution (Ian Anderson, QDPI&F) September 2008.

2002/044: Pilchard herpesvirus infection in wild pilchards (Brian Jones, Fisheries WA) October 2006.

2004/084: Investigating and managing the *Perkinsus*-related mortality of blacklip abalone in NSW Phase 1 (Geoff Liggins, NSW DPI) June 2010.

2006/062: Identification of host interactions in the life-cycle of QX disease (Rob Adlard, Qld Museum) May 2008.

2007/225: Metazoan parasite survey of selected macro-inshore fish of southeastern Australia, including species of commercial interest (Kate Hutson, U. Adelaide) February 2011.

2008/031: Investigation of Chlamydiales-like organisms in pearl oysters, *Pinctada maxima* (Brian Jones, Fisheries WA) June 2012.

2008/041: Tools for investigation of the nodavirus carrier state in marine, euryhaline and freshwater fish and control of NNV through integrated management (Richard Whittington, U. Sydney) November 2012.

2009/032: Characterisation of abalone herpes-like virus infections in abalone (Mark Crane, CSIRO) August 2014.

2009/075: Determining the susceptibility of remnant populations of abalone previously exposed to AVG (Mark Crane, CSIRO) January 2012.

2010/034: Investigation of an emerging bacterial disease in wild Queensland groppers, marine fish and stingrays with production of diagnostic and epidemiological tools to reduce the spread of disease to other states of Australia (Rachel Bowater, DEEDI, Qld) February 2015.

2011/003: Investigations into the genetic basis of resistance to infection of abalone by the abalone herpes-like virus (Serge Corbeil, CSIRO) September 2013.

2011/043: Understanding and planning for the potential impacts of OHsV1 on the Australian Pacific oyster industry (Tom Lewis, RDS Partners Pty Ltd) September 2012.

2011/048: Determining the susceptibility of Australian species of prawns to infectious myonecrosis (Mark Crane, CSIRO) April 2015.

2011/053: Pacific oyster mortality syndrome (POMS) - Understanding biotic and abiotic environmental and husbandry effects to reduce economic losses (Richard Whittington, U. Sydney) January 2013.



- 2011/255: Tactical Research Fund: Optimisation of treatment of *Ichthyophthirius multifiliis* in farmed trout (Marty Deveney, SARDI) May 2014.
- 2012/032: Pacific oyster mortality syndrome (POMS) - risk mitigation, epidemiology and OsHV-1 biology (Richard Whittington, U. Sydney) December 2015.
- 2012/052: Development of a laboratory model for infectious challenge of Pacific oysters (*Crassostrea gigas*) with ostreid herpesvirus type-1 (Peter Kirkland, NSW DPI) April 2015.
- 2013/001: Determination of susceptibility of various abalone species and populations to the various AbHV genotypes (Serge Corbeil, CSIRO) May 2016.
- 2013/002: Identifying the cause of Oyster Oedema Disease (OOD) in pearl oysters (*Pinctada maxima*), and developing diagnostic tests for OOD (David Raftos, MacQuarie University) February 2017.
- 2015/001: Bonamiasis in farmed Native Oysters (*Ostrea angasi*) (Tracey Bradley, DEDJTR, Victoria) July 2019.
- 2015/005: Determining the susceptibility of Australian *Penaeus monodon* and *P. merguensis* to newly identified enzootic (YHV7) and exotic (YHV8 and YHV10) Yellow head virus (YHV) genotypes (Nick Moody, CSIRO) TBA.
- 2016/013: Comparative pathogenicity of exotic AHPND and the presumptive bacterial hepatopancreatitis detected in farmed *Penaeus monodon* in Queensland (Nick Moody, CSIRO) TBA.
- 2016/064: Field observations and assessment of the response to an outbreak of White Spot Disease (WSD) in Black Tiger Prawns (*Penaeus monodon*) farmed on the Logan River in November 2016 (Ben Diggles, DigsFish Services) February 2017.
- 2017/117: Identification of differentially expressed innate immune genes in the New Zealand paua (*Haliotis iris*) and the Australian hybrid abalone (*H. laevis* X *H. rubra*) upon immersion challenge with the abalone herpesvirus-1 (HaHV) (Serge Corbeil, CSIRO) February 2020.

## **7.2 Biosecurity**

- 2001/214: Development of a disease zoning policy for marsteiliosis to support sustainable production, health certification and trade in Sydney rock oyster (Rob Adlard, Qld Museum) November 2005.
- 2001/660: Enhancement of Emergency Disease Management Capability in the Queensland Department of Primary Industries and the Redclaw Crayfish (*Cherax quadricarinatus*) industry (Iain East, DAFF) March 2002.
- 2002/600: Facilitating the establishment of the Aquatic Animal Health Consultative Committee (AAHCC) as the primary industry/government interface for aquatic animal health (Eva-Maria Bernoth, DAFF) June 2004.
- 2002/640: Viral Haemorrhagic Septicaemia (VHS) – A Disease Strategy Manual (Paul Hardy-Smith, Panaquatic Health Solutions) June 2004.
- 2002/641: Crayfish plague - disease strategy manual (Fran Stephens, Aquatila Healthcare) March 2004.

- 2002/643: Viral encephalopathy and retinopathy – disease strategy manual (Barry Munday, IDEXX) December 2003.
- 2002/647: Development of the AQUAVETPLAN disease strategy manual for white spot disease of prawns (Chris Baldock, AusVet Services) March 2004.
- 2002/651: Whirling Disease – A Disease Strategy Manual (Paul Hardy-Smith, Panaquatic Health Solutions) June 2004.
- 2002/652: Victoria’s arrangements for the management of aquatic animal disease emergencies (Anthony Forster, DPI Vic) December 2003.
- 2002/653: AQUAVETPLAN aquatic disease disinfection manual (Kevin Ellard, Livestock & Aquaculture Veterinary Consulting Services) March 2006.
- 2002/661: Enhancing the emergency disease response capability of NSW and Qld Government agencies and industry bodies associated with oyster culture (Matt Landos, NSW Fisheries) March 2004.
- 2002/665: Enhancement of the emergency disease management capability in Victoria – adapting Victoria’s arrangements for the management of aquatic animal disease emergencies (Anthony Forster, Fisheries Victoria) June 2004.
- 2002/668: Enhancing the emergency disease response capability of the Western Australian Department of Fisheries and industry bodies associated with non-maxima oyster culture (Brian Jones, Fisheries WA) March 2004.
- 2003/216: Detection and management of yellowtail kingfish (*Seriola lalandi*) health issues (Mark Shepperd, Sakana Vet Services) October 2005.
- 2003/640: Subprogram conference “emergency disease response planning and management” (Mark Crane, CSIRO) May 2004.
- 2003/641: Development of the Control Centres Manual for managing aquatic animal disease emergencies in Queensland (Tiina Hawkesford, QDPI&F) January 2004.
- 2003/644: NSW aquatic animal diseases Control Centres Manual (Damian Ogburn, NSW Fisheries) June 2004.
- 2003/648: The revision of the Tasmanian fish health plan and incorporation into the Tasmanian control centre manual (Mary Lou Conway, DPIWE Tas) March 2004.
- 2003/649: Industry's emergency preparedness and response to mass mortality of yellowtail kingfish *Seriola lalandi*: development of plans and protocols (Mark Shepperd, Sakana Vet Services) August 2008.
- 2003/650: Update of the AQUAVETPLAN Enterprise Manual (semi-open systems) (Jo Sadler) December 2003.
- 2003/670: Emergency response microalgal identification for the finfish aquaculture industry (Judith-Anne Marshall, U. Tasmania) May 2004.

- 2003/671: Enhancing the emergency disease response capability of the Western Australian Department of Fisheries and industry bodies associated with freshwater crayfish (Fran Stephens, Fisheries WA) May 2004.
- 2004/080: Development of a national translocation policy using abalone and prawns as templates for other aquatic species (Brian Jones, Fisheries WA) October 2006.
- 2005/620: Development of national investigation and reporting protocols for fish kills in recreational and capture fisheries (Barbara Nowak, U. Tasmania) June 2005.
- 2005/640: Technical guidelines for the translocation of live aquatic animals (Brian Jones, Fisheries WA) December 2005.
- 2006/243: Development of management strategies for herpes-like virus infection of abalone (Mehdi Doroudi, DPI Victoria) May 2009.
- 2009/072: Risk analysis - aquatic animal diseases associated with bait translocation (Ben Diggles, DigsFish) July 2011.
- 2010/036: Improved fish health management for integrated inland aquaculture through Better Management Practices (BMPs) (Tracey Bradley, DPI Victoria) February 2014.
- 2012/001: Strategic planning, project management and adoption (Mark Crane, CSIRO) June 2016.
- 2013/036: Tactical Research Fund: Viral presence, prevalence and disease management in wild populations of the Australian Black Tiger prawn (*Penaeus monodon*) (Jeff Cowley, CSIRO) June 2015.
- 2015/001: Bonamiasis in farmed native oysters (*Ostrea angasi*) (Tracey Bradley, Department of Economic Development, Jobs, Transport and Resources, Victoria) July 2019.
- 2016/011: Disinfection measures to support biosecurity for ISKNV at aquaculture facilities (Joy Becker, U. Sydney) January 2019.
- 2016/066: Assessing compliance and efficacy of import conditions for uncooked prawn in relation to White Spot Syndrome Virus (WSSV) through testing retail commodities and comparison of stringency of import measures with other imported commodities into Australia (Matt Landos, Future Fisheries Veterinary Services Pty Ltd) April 2017.
- 2016/266: Prawn White Spot Disease Response Plan (Len Stephens) March 2017.
- 2016/245: Development of sector-specific biosecurity plan templates and guidance documents for the abalone and oyster aquaculture industries (Elise Matthews, PIRSA) November 2017.
- 2017/190: Assessment of gamma irradiation as a feasible method for treating prawns to inactivate White Spot Syndrome Virus (Stephen Wesche, Biosecurity Queensland) TBA
- 2018/180: Benchmarking for health and productivity in abalone aquaculture (Tracey Bradley, Agriculture Victoria) TBA
- 2019/005: Risk analysis to identify and minimise biosecurity risks arising from recycling bivalve mollusc shell waste during shellfish reef restoration projects in Australia (Ben Diggles, DigsFish Services) TBA

### 7.3 Diagnostics

- 1999/226: Generation of diagnostic reagents for pilchard herpes virus (Bryan Eaton, CSIRO) June 2002.
- 2001/620: Development of improved procedures for the identification of aquatic birnaviruses (Mark Crane, CSIRO) April 2004.
- 2001/621: Molecular diagnostic tests to detect epizootic ulcerative syndrome (*Aphanomyces invadans*) and crayfish plague (*Aphanomyces astaci*) (Nicky Buller, Agriculture WA) June 2004.
- 2001/624: Development of diagnostic procedures for the detection and identification of *Piscirickettsia salmonis* (Mark Crane, CSIRO) April 2004.
- 2001/625: Development of diagnostic capability for priority aquatic animal diseases of national significance: Spawner-isolated mortality virus (Leigh Owens, JCU) April 2004.
- 2001/626: Development of diagnostic tests for the detection of nodavirus (Nick Moody, QDPI&F) August 2004.
- 2001/628: Vibrios of aquatic animals: Development of a national standard diagnostic technology (Jeremy Carson, DPIWE Tas) December 2006.
- 2001/630: Validation of DNA-based (PCR) diagnostic tests suitable for use in surveillance programs for QX disease of Sydney rock oysters (*Saccostrea glomerata*) in Australia (Rob Adlard, Qld Museum) June 2003.
- 2003/620: Establishment of diagnostic expertise for detection and identification of red sea bream iridovirus (RSIV) (Mark Crane, CSIRO) June 2006.
- 2003/621: Development of diagnostic and reference reagents for epizootic haematopoietic necrosis virus of finfish (Richard Whittington, U. Sydney) June 2004.
- 2003/622: Development of molecular diagnostic expertise for the mollusc pathogen *Bonamia* sp. (Serge Corbeil, CSIRO) June 2004.
- 2004/091: Further research and laboratory trials for diagnostic tests for the detection of *A. invadans* (EUS) and *A. astaci* (crayfish plague) (Nicky Buller, Agriculture WA) June 2007.
- 2006/064: Development of diagnostic tests to assess the impact of *Haplosporidium* infections in pearl oysters (Philip Nicholls, Murdoch U.) November 2009.
- 2007/006: Development of molecular diagnostic procedures for the detection and identification of herpes-like virus of abalone (*Haliotis* spp.) (Mark Crane, CSIRO) November 2009.
- 2007/007: Validation of PCR tests for diagnosis of megalocytivirus (gourami iridovirus) (Richard Whittington, U. Sydney) May 2009.
- 2008/030: Development of a DNA microarray to identify markers of disease in pearl oysters (*Pinctada maxima*) and to assess overall oyster health (Brian Jones, Fisheries WA) June 2012.
- 2011/004: Development of improved molecular diagnostic tests for *Perkinsus olseni* in Australian molluscs (Nick Gudkovs, CSIRO) June 2016.

- 2013/002: Identifying the causes of Oyster Oedema Disease (OOD) in pearl oysters (*Pinctada maxima*) (David Raftos, Macquarie U.) February 2017.
- 2014/002: Development of stable positive control material and development of internal controls for molecular tests for detection of important endemic and exotic pathogens (Nick Moody, CSIRO) TBA.
- 2015/003: Development of standard methods for the production of marine molluscan cell cultures (Andrew Reid, EMAI) November 2019.
- 2016/009: *Perkinsus olseni* in abalone – development of fit-for-purpose tools to support its management (Cecile Dang, Fisheries WA) TBA.
- 2017/206: Assessment of the Inflamark method as a sensitive and cost-effective measure of oxidative stress in cultured fish (Gavin Partridge, DPIRD WA) TBA
- 2018/147: Diagnostic detection of aquatic pathogens using real-time next generation sequencing (David Cummins, CSIRO-AAHL) TBA

#### **7.4 Strategic surveillance**

- 2001/630: Validation of DNA-based (PCR) diagnostic tests suitable for use in surveillance programs for QX disease of Sydney rock oysters (*Saccostrea glomerata*) in Australia (Rob Adlard, Qld Museum) June 2003.
- 2003/622: Development of molecular diagnostic expertise for the mollusc pathogen *Bonamia* sp. (Serge Corbeil, CSIRO) June 2004.
- 2006/064: Development of diagnostic tests to assess the impact of *Haplosporidium* infections in pearl oysters (Philip Nicholls, Murdoch U.) November 2009.
- 2007/225: Metazoan parasite survey of selected macro-inshore fish of southeastern Australia, including species of commercial interest (Kate Hutson, U. Adelaide) February 2011.
- 2008/030: Development of a DNA microarray to identify markers of disease in pearl oysters (*Pinctada maxima*) and to assess overall oyster health (Brian Jones, Fisheries WA) June 2012.
- 2008/031: Investigation of Chlamydiales-like organisms in pearl oysters, *Pinctada maxima* (Brian Jones, Fisheries WA) June 2012.
- 2009/044: Surveys of ornamental fish for pathogens of quarantine significance (Joy Becker, U. Sydney) June 2013.
- 2014/001: Strategic approaches to identifying pathogens of quarantine concern associated with the importation of ornamental fish (Joy Becker, U. Sydney) May 2017.

#### **7.5 Disease Mitigation**

- 2007/226: Rapid strain identification of the bacterial fish pathogen *Streptococcus iniae* and development of an effective polyvalent vaccine for Australian barramundi (Andy Barnes, U. Queensland) February 2010.
- 2011/255: Tactical Research Fund: Optimisation of treatment of *Ichthyophthirius multifiliis* in farmed trout (Marty Deveney, SARDI) May 2014.

## 7.6 Training and capacity building

- 2001/093: Strategic planning, project management and adoption (Eva-Maria Bernoth, DAFF) June 2004.
- 2002/645: Aquatic animal health exotic diseases training manual (Shane Raidal, Murdoch U.) June 2004.
- 2002/654: Development of a training course on exotic diseases of aquatic animals (Ken McColl, CSIRO) June 2004.
- 2002/655: Design and organisation of a multi-state disease emergency simulation exercise (Iain East, DAFF) January 2004.
- 2002/660: Enhancement of emergency disease management through the education and training of the CCEAD participants on the CCEAD process (Lynda Walker, DAFF) February 2004.
- 2002/664: Aquatic animal health emergency management training and incident simulation (Melanie Ryan, Seafood Training SA) June 2004.
- 2002/666: Training course on exotic diseases of aquatic animals (Mark Crane, CSIRO) June 2004.
- 2003/642: Revision and expansion of the *Australian Aquatic Animal Disease Identification Field Guide* for publishing to CD-Rom (Alistair Herfort, DAFF) November 2004.
- 2003/645: The development of media tools to increase the awareness of aquatic animal diseases (Wayne Tindall, Big Time Solutions) August 2005.
- 2003/646: Database of diseases and pathogens of Australian aquatic animals (Gustad Boman, F1 Solutions) July 2004.
- 2003/647: Development of a database for Australian laboratory diagnostic expertise for diseases of aquatic organisms (Iain East, DAFF) March 2004.
- 2003/669: Conduct of a multi-jurisdictional simulation exercise focused on health management in Australian aquaculture (Iain East, DAFF) April 2004.
- 2004/079: Strategic planning, project management and adoption (Mark Crane, CSIRO) November 2008.
- 2005/621: Establishment of a national aquatic animal health diagnostic network (Richard Whittington, U. Sydney) December 2006.
- 2005/641: Current and future needs for aquatic animal health training and for systems for merit-based accreditation and competency assessments (Brian Jones, Fisheries WA) March 2007.
- 2008/039: Strategic planning, project management and adoption (Mark Crane, CSIRO) August 2012.
- 2009/315: People development program: scholarship program for enhancing the skills of aquatic animal health professionals in Australia (Jo-Anne Ruscoe, FRDC) March 2016.
- 2009/315.02: People development program: Aquatic animal health training scheme – Aquatic Animal Health Technical forum and Skills Training Workshop (Lynette Williams, CSIRO) February 2012.

2009/315.11: People development program: Aquatic animal health training scheme – Nick Moody (Nick Moody, CSIRO) February 2012.

2009/315.12: People development program: Aquatic animal health training scheme – Cassandra Ypelaan (Cassandra Ypelaan, Panaquatic Health Solutions) September 2012.

2009/315.13: People development program: Aquatic animal health training scheme – Richmond Loh (Richmond Loh, The Fish Vet) July 2012.

2009/315.16: People development program: Aquatic animal health training scheme – Boosting Biosecurity Capability in Western Australia (Susan Gibson-Kueh, ACWA) July 2013.

2009/315.21: People development program: Aquatic animal health training scheme – Jo Bannister (Jo Bannister, Western Australia) June 2013.

2009/315.22: People development program: Aquatic animal health training scheme – Teruo Miyazaki visit (Richard Whittington, U. Sydney) June 2013.

2009/315.23: People development program: Aquatic animal health training scheme – Jo Bannister (Jo Bannister, Western Australia) June 2013.

2009/315.24: People development program: Aquatic animal health training scheme - KBBE workshop on diagnostics for mollusc diseases (Mark Crane, CSIRO) May 2014.

2009/315.25: People development program: Aquatic animal health training scheme – Aquavet II Comparative Pathology Training Course, Cornell University, 2014 (Ben Diggles, DigsFish) June 2014.

2009/315.28: People development program: Aquatic animal health training scheme - Fish disease diagnosis, biosecurity and disease management training for fish farming industry of Australia (Rachel Bowater, QDAF) February 2016.

2009/315.29: FRDC People Development Program: Aquatic animal health training scheme – fish kill investigation (Shane Roberts, PIRSA) June 2014.

2009/315.31: People development program: Aquatic Animal Health Training Scheme: Introductory training workshop in surveillance for aquatic animal diseases (Evan Sargeant, AusVet Services) December 2014.

2012/001: Strategic planning, project management and adoption (Mark Crane, CSIRO) July 2016.

2012/002: Aquatic Animal Health Technical Forum (Lynette Williams, CSIRO) May 2016.

2013/004: The Neptune Project - a comprehensive database of Australian aquatic animal pathogens and diseases (Marissa McNamara, Qld Museum) September 2014.

2013/414: Review of vocational education courses on aquatic animal health available to fisheries and aquaculture sectors in Australia for the FRDC Aquatic Animal Health Subprogram (AAHS) (Mark Oliver, Aquaculture Support Services) March 2014.

2014/403: Development of a national aquatic animal health curriculum for delivery by tertiary institutions (Stephen Pyecroft, U. Adelaide) February 2014.

2016/404: Strategic planning, project management and adoption (Mark Crane, CSIRO) TBA.

2018/144: Aquatic Animal Health Technical Forum and Training workshops (Lynette Williams, CSIRO) TBA.

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## 8. Further information

- **Aquatic Animal Health & Biosecurity Subprogram website:**

Go to the FRDC website: <http://www.frdc.com.au/en/Partners/National-Priorities-and-Subprograms/Aquatic-Health-and-Biosecurity>

- **Department of Agriculture, Water and the Environment website:**

<https://www.agriculture.gov.au/animal/aquatic>

- **Contact Aquatic Animal Health & Biosecurity Subprogram:**

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- **Postal Address:** CSIRO Australian Animal Health Laboratory, Private Bag 24, Geelong, VIC 3220



### Appendix 3: Extension 1 July 2020 to 31 March 2021

The Aquatic Animal Health and Biosecurity Subprogram project (FRDC 2016/404) ended in June 2020. An FRDC project application for the AAHBS renewal had been prepared and submitted however, due to changes to priority setting and project assessment, management and delivery, being finalised by FRDC, remaining funds from FRDC 2016/404 were used to extend the project from 1 July 2020 to 31 March 2021. As well as managing current projects and ongoing business of the AAHBS, the project extension also enabled Subprogram members to discuss and contribute to the revised AAHBS renewal application.

The extended AAHBS was led by a Subprogram Leader (currently Dr. Nick Moody, CSIRO ACDP Fish Diseases Laboratory) who is assisted by a Subprogram Coordinator (currently Joanne Slater, CSIRO ACDP Fish Diseases Laboratory), and guided by a Steering Committee which is advised by a Scientific Advisory Committee. The only change to the membership of the AAHBS was the departure of Aaron Irving (National Aquaculture Council; 2019-2020).

The Objectives and Methodology for the AAHBS project extension did not change significantly from those described above and the following details the activities of the AAHBS project extension.

**Objective 1.** *To manage a portfolio of R&D projects that are directly concerned with aquatic animal health and biosecurity and are not covered by other FRDC subprograms.*

To manage the AAHBS RD&E and plan the AAHBS renewal, the AAHBS committees met by teleconference, as organised by the AAHBS Coordinator. Table A1 provides the schedule of meetings convened to progress AAHBS business. Due to COVID-19 travel restrictions all meetings were by teleconference.

**Table A1. FRDC Aquatic Animal Health & Biosecurity Subprogram  
Schedule of meetings 2020-21**

Meeting	Date	Venue	Main purpose
13	29/07/20	Teleconference	FRDC update on the future direction of the AAHBSp, evaluate 3 AAHTS applications.
14	10/12/20	Teleconference	FRDC update on the future direction of the AAHBSp, evaluate 2 full applications.
15	26/02/21	Teleconference	Discuss the future direction and processes of the AAHBSp.
16	13/04/21	Teleconference	Discuss the future direction and processes of the AAHBSp.

In the period 1 June 2020 to 31 March 2021, AAHBS continued to manage 20 projects concerned with aquatic animal health and biosecurity (Table A2).

**Table A2. FRDC Aquatic Animal Health & Biosecurity Subprogram – R&D Projects 2020-21**

<b>Project</b>	<b>Project Title</b>	<b>Date of Final Report</b>
2014/002	Development of stable positive control material and development of internal controls for molecular tests for detection of important endemic and exotic pathogens.	Mar 2021
2015/005	Determining the susceptibility of Australian <i>Penaeus monodon</i> and <i>P. merguensis</i> to newly identified enzootic (YHV7) and exotic (YHV8 and YHV10) Yellow head virus (YHV) genotypes	Draft Final Report submitted 11/05/21
2016/009	<i>Perkinsus olseni</i> in abalone: Development of fit-for-purpose tools to support its understanding and management	Oct 2020
2016/013	Comparative pathogenicity of exotic AHPND and the presumptive bacterial hepatopancreatitis detected in farmed <i>Penaeus monodon</i> in Queensland	Due Jun 2020
2016/404	Aquatic Animal Health and Biosecurity Subprogram: Strategic planning, project management and adoption	Due Apr 2021 (this addendum)
2017/190	Assessment of gamma irradiation as a feasible method for treating prawns to inactivate White Spot Syndrome Virus	Draft Final Report submitted 30/04/21
2017/206	Assessment of the Inflamark method as a sensitive and cost-effective measure of oxidative stress in cultured fish	Submitted Feb 2021
2018/100	Optimisation of treatment of <i>Cryptocaryon irritans</i> in Barramundi aquaculture	TBA
2018/144	Aquatic Animal Health Technical Forum and Training workshops	Due Nov 2022
2018/147	Diagnostic detection of aquatic pathogens using real-time next generation sequencing	Due Oct 2022
2018/180	Benchmarking for health and productivity in aquaculture.	Due Sept 2021
2019/005	Risk analysis to identify and minimise biosecurity risks arising from recycling bivalve mollusc shell waste during shellfish reef restoration projects in Australia	Submitted Nov 2020
2019/019	Evaluation of cell reprogramming technology for generating prawn cell lines	Project withdrawn
2019/089	Evaluation of point of care (POC) tests for White Spot Syndrome Virus (WSSV)	Due Apr 2022
2019/097	A longitudinal investigation of enteritis in juvenile barramundi <i>Lates calcarifer</i> , L. in North Queensland	TBA
2019/106	Minor use permit for oxytetracycline in non-salmonid finfish	TBA
2019/126	Assessing compliance and efficacy of import conditions for uncooked whole and eviscerated barramundi and grouper in relation to exotic viruses	Due July 2021
2019/148	Aquatic Animal Health Training Scheme 2019-2022	Due May 2022

<b>Project</b>	<b>Project Title</b>	<b>Date of Final Report</b>
2019/150	Feasibility study - Assessment of the pearl oyster farming industry capacity to retrospectively investigate stock health concerns	TBA
2019/196	Investigation of common microorganisms and pathways in pearl oysters affected by health issues.	Commenced 2021

In addition to managing the RD&E portfolio of projects, AAHBS supported one project (subject to lifting of COVID-19 travel restrictions) within the Aquatic Animal Health Training Scheme (AAHTS) on behalf of DAWE and FRDC (Table A3).

**Table A3. Aquatic Animal Health Training Scheme applications**

<b>Application Title</b>	<b>Applicant</b>	<b>Organisation</b>	<b>Supported</b>
AQUAVET II course	Phillipa Sims	Petuna Aquaculture	Yes

## **Conclusion**

During the AAHBS project extension, Subprogram business essentially continued as usual, albeit reduced efficiency due to the requirement for teleconferences due to COVID-19 travel restrictions. While the project extension has ended, Subprogram members are continuing to progress discussions and contribute to the new AAHBS project application which is expected to be completed and submitted shortly.