



# WOAH Collaborative Centre Reports Activities 2024

This report has been submitted: 31 janvier 2025 14:48

## CENTRE INFORMATION

<b>*Title of WOAHCollaborating Centre</b>	Emerging Aquatic Animal Diseases
<b>*Address of WOAHCollaborating Centre</b>	Centre for Environment, Fisheries and Aquaculture Sciences
<b>*Tel:</b>	+44 1305 206600
<b>*E-mail address:</b>	kelly.bateman@cefas.gov.uk
<b>Website:</b>	<a href="https://www.cefas.co.uk/icoe/aquatic-animal-health/designations/woah-collaborating-centre-for-emerging-aquatic-animal-disease/">https://www.cefas.co.uk/icoe/aquatic-animal-health/designations/woah-collaborating-centre-for-emerging-aquatic-animal-disease/</a>
<b>*Name Director of Institute (Responsible Official):</b>	Dr Rachel Hartnell
<b>*Name (including Title and Position) of Head of the Collaborating Centre (WOAH Contact Point):</b>	Dr Kelly Bateman and Dr Richard Paley
<b>*Name of the writer:</b>	Dr Kelly Bateman and Dr Richard Paley

## TOR 1 AND 2: SERVICES PROVIDED

1. Activities as a centre of research, expertise, standardisation and dissemination of techniques within the remit of the mandate given by WOAHC

Category	Title of activity	Scope
	Provision of dedicated Fish Health	

--

Disease control (true)	Inspectorate (FHI) to fulfil statutory responsibilities regarding aquatic animal health	The FHI is responsible for the delivery and enforcement of aquatic animal health legislation in England and Wales.
Epidemiology, surveillance, risk assessment, (true)	Provision of aquatic animal health epidemiological surveillance service	Provision of advice for aquatic animal health policy, risk assessment and modelling: design and assessment of surveillance plans; horizon scanning published and grey literature for emerging diseases.
Training, capacity building (true)	Sharing of positive control reference materials Production of guidance documents and videos Provision of training in DNA/RNA extraction and PCR analysis Provision of training in sampling crustacean and bivalve mollusc tissues Research network on emerging intracellular bacterial pathogens in bivalves Provided assistance and support for setting up a histopathology laboratory Provision of advice for farm management and biosecurity	Positive control reference materials made available and can be provided upon request for some of the listed and non-listed aquatic animal diseases. Protocols and videos produced to cover the dissection and storage of aquatic animal materials for analysis. Training in DNA and RNA extraction for analysis via PCR for WOAHA listed diseases. Training in sampling of crustacean and bivalve mollusc tissues for histological and PCR analysis for WOAHA listed and emerging diseases. Building collaborations with Institutes in Chile, Japan and Scotland for knowledge transfer and advice on intracellular bacterial infections. Supported establishment of a new histopathology laboratory in Belize to build capacity in screening for aquatic animal diseases. Advice on biosecurity, farm management and husbandry methods provided.
Wildlife (true)	Monitoring of health and disease of wild fish, crustacean and bivalve molluscs	Samples of fish, crustacean and bivalve mollusc tissues were assessed for disease and samples collected for reference materials
Aquatic animal diseases (true)	WOAHA experts available for Koi Herpesvirus (KHV) and Spring Viraemia of Carp (SVC) Research into Francisella haliotidica infection in mussels Bacterial culture collection International Database on Aquatic Animal Diseases (IDAAD)	Provision of expert advice on these disease conditions, their diagnostics, host range, pathogenicity and characterisation, including pathogen testing when required. Media optimisation for the isolation and in vitro culture of this worldwide emerging bacterium pathogen and phylogenetic studies. Review of data and samples within culture collection, accessions

--

		added. Complete review of the disease data, accessions added and updated as required
--	--	--------------------------------------------------------------------------------------

## TOR 3: HARMONISATION OF STANDARDS

2. Proposal or development of any procedure that will facilitate harmonisation of international regulations applicable to the main focus area for which you were designated

Proposal title	Scope/Content	Applicable Area
Tilapia Lake Virus Chapter for WOA Diagnostic Manual	Draft preparation following WOA template is ongoing.	Laboratory Expertise Training and Education Health Management
WOAH ad hoc group on susceptibility of crustacean species to infection with WOA listed diseases	Finalised reports for evidence for susceptibility of crustacean species with Decapod Iridovirus 1 (DIV1) and White Spot Syndrome Virus (WSSV), required re-assessment for some species following feedback and review from members. Invited to chair the next meeting which will concentrate on crayfish plague and be held in April 2025.	Laboratory Expertise Training and Education Health Management
Provided comments to revise sections of the WOA Aquatic Code	Comments detailing suggested changes provided following request from WOA secretariat.	Laboratory Expertise
Development of Positive control material	Synthetic positive control plasmids designed for EUS, ISKNV and TiLV. Each encompassing several WOA and non-WOA PCR assay targets and including reporter tag regions for discrimination of lab contamination for new and developing diagnostic laboratories.	Laboratory Expertise

3. In exercising your activities, have you identified any regulatory research needs\* relevant for WOA?

No

4. Did your Collaborating Centre maintain a network with other WOA Collaborating Centres (CC), Reference Laboratories (RL), or organisations designated for the same specialty, to coordinate scientific and technical studies?

Yes

Name of WOA CC/RL/other organisation(s)	Location	Region of networking Centre	Purpose

European Union Reference Laboratory for Fish and Crustacean Diseases	DTU, Denmark	Europa	Sharing of information on fish and crustacean health, participation in interlaboratory proficiency tests
European Union Reference Laboratory for Bivalve Mollusc Diseases	IFREMER, France	Europa	Sharing of information on bivalve mollusc health, participation in interlaboratory proficiency tests, sharing positive control materials
FAO Antimicrobial Resistance (AMR) Reference Centre	Cefas, UK	Europa	Collaboration to provide services in identifying AMR risks to aquatic animals and to help develop and assess the effectiveness of alternative solutions to control disease in farmed aquatic animals (particularly finfish and shrimp)
International Council for the Exploration of the Seas (ICES). Expert working group on Pathology and diseases of marine organisms (WGPDMO)	ICES, Denmark	Europa	Chair of the WGPDMO, reporting of disease emergence and trends in marine fish and shellfish stocks (wild stocks and aquaculture)
International Council for the Exploration of the Seas (ICES). Expert working group on crab	ICES, Denmark	Europa	Reporting of disease emergence and trends in wild crustacean stocks
European Virus Archive – Global (EvaG)	Various	Europa	International group of 47 laboratories that represent an extensive range of virological disciplines, generating and distributing diagnostic materials and protocols globally
WOAH Reference Laboratory for AHPND, IHHNV, NHP, TSV, WSSV	University of Arizona, USA	América	Participation in histological proficiency test for crustacean diseases

Belize Agricultural Health Authority (BAHA)	Belize	América	Supported establishment of a histopathology laboratory and provided protocols and training in dissection, sampling and analysis of tissues. Provided advice for biosecurity, farm management and husbandry methods
Department of Fisheries	Bangkok, Thailand	Asia y el Pacífico	Collaboration on shrimp health
Network of Aquaculture Centres in Asia-Pacific (NACA)	Bangkok, Thailand	Asia y el Pacífico	Collaboration on shrimp health
Food and Agricultural Organisation (FAO) regional office for Asia and the Pacific	Bangkok, Thailand	Asia y el Pacífico	Collaboration on shrimp health
National Centre for Genetic Engineering and Biotechnology (BIOTEC)	Bangkok, Thailand	Asia y el Pacífico	Collaboration on shrimp health
National Centre for Genetic Engineering and Biotechnology (NSTDA)	Bangkok, Thailand	Asia y el Pacífico	Collaboration on shrimp health
Department for Animal Production and Health (DAP&H)	Kandy, Sri Lanka	Asia y el Pacífico	Collaboration on project investigating slow growth syndrome in shrimp
National Aquatic Resource Research and Development Agency (NARA)	Colombo, Sri Lanka	Asia y el Pacífico	Collaboration on project investigating slow growth syndrome in shrimp and declines in the mud crab fishery

National Aquaculture Development Authority (NAQDA)	Colombo, Sri Lanka	Asia y el Pacífico	Collaboration on project investigating slow growth syndrome in shrimp
Bangladesh Agricultural University, Bangladesh Fisheries Research Institute, Khulna University, and Bangabandhu Sheikh Mujibur Rahman Science and Technology University	Bangladesh	Asia y el Pacífico	Technical training to staff and students at Bangladesh Agricultural University, Bangladesh Fisheries Research Institute, Khulna University, and Bangabandhu Sheikh Mujibur Rahman Science and Technology University in histopathology, in situ hybridisation, and molecular biology techniques for detection and diagnoses of pathogens of shrimp and finfish farmed in Bangladesh.
Behrampur University (Odisha State), Cochin University of Science and Technology (CUSAT; Kerala State), and Nitte University (Mangaluru State)	India	Asia y el Pacífico	Developing understanding of syndromic/multi-factorial diseases and their elucidation, sequencing of Streptococcus isolates associated with fish disease, eDNA for fish stock and pathogen diversity in Chilika Lake.
WorldFish	Malaysia	Asia y el Pacífico	Break out meetings with WorldFish staff during the 2024 IIFET conference in Penang, Malaysia. Demonstration given of a CEFAS breakeven analysis tool developed to assess the economic viability of biosecurity and disease intervention methods in SME aquaculture systems.
National Agricultural Research Organisation (NARO)	Uganda	África	Histopathological analyses of tilapia samples indicating myxozoa, species id pending and ongoing.

--

Ministry of Fisheries and Aquaculture Development, Fisheries Commission, Fish Health Unit	Ghana	África	Ongoing support of capacity development and supervision of PhD students. Whole genome sequencing of bacterial isolates
----------------------------------------------------------------------------------------------------	-------	--------	------------------------------------------------------------------------------------------------------------------------------------

## TOR 4 AND 5: NETWORKING AND COLLABORATION

5. Did your Collaborating Centre maintain a network with other WOAHO Collaborating Centres, Reference laboratories, or organisations in other disciplines, to coordinate scientific and technical studies?

Yes

Name of WOAHO CC/RL/other organisation(s)	Location	Region of networking Centre	Purpose
WOAHO Collaborating Centre Network in Wildlife Health	Online	Africa Americas Asia and Pacific Europe	Network of Collaborating Centres on Wildlife Health to support the wildlife health framework towards improving wildlife health around the globe by effectively targeting the needs of its member countries
WOAHO Aquatic Collaborating Centre Network	Online	Americas Asia and Pacific Europe	Network of Collaborating Centres on Aquatic Animal Health to enhance communication, identify and share opportunities for collaboration on projects (research and technology transfer) and identify and facilitate opportunities for aquatic animal health collaborative training within the WOAHO community

## TOR 6: EXPERT CONSULTANTS

6. Did your Collaborating Centre place expert consultants at the disposal of WOAHO?

Yes

Name of expert	Kind of consultancy	Subject
		Co-Head of the WOAHO Collaborating Centre for

Dr Kelly Bateman	Advice	Emerging Aquatic Animal Diseases and crustacean disease sector lead. Member of the WOAH ad hoc group on susceptibility of crustacean species to infection with WOAH listed diseases, recently been invited to become chair of the group. Expert in crustacean diseases, histopathology and electron microscopy. Chair invited member of the International Council for the Exploration of the Seas (ICES) Working Group on Crab (WGCRAB).
Dr Richard Paley	Advice	Co-Head of the WOAH Collaborating Centre for Emerging Aquatic Animal Diseases and fish disease sector lead. Head of the WOAH Reference Centre for Spring Viraemia of Carp Virus (SVCV) from April 2024. Principal virologist. Chair of the International Council for the Exploration of the Seas (ICES) Working Group on Pathology and Diseases of Marine Organisms (WGPDMO).
Dr Frederico Batista	Advice	Mollusc disease sector lead and Molecular diagnostics lead from April 2024. Expert in bivalve mollusc diseases and emerging molecular diagnostic tools.
Dr Edmund Peeler	Advice	Recipient of the WOAH Meritorious Award for his leadership and involvement in shaping aquatic animal health standards globally in 2024. Expert in Epidemiology and Risk.
Dr Jessica Witt	Advice	WOAH Focal point for Aquatic Animal Health for the UK, expert in epidemiology and risk.
Dr Mickael Teixeira Alves	Advice	Principal risk modeller, expert in epidemiology, risk modelling and statistics
Prof David Bass	Advice	Animal and Human Health Theme Lead at Cefas. Molecular biologist, microbiologist, and molecular parasitologist with expertise in multi-disciplinary approaches to investigating aquatic animal health & disease, and pathogen characterisation, including application of high-throughput sequencing, 'omics, and bioinformatic techniques.
Dr Craig Baker-Austin	Advice	Director of FAO AMR Reference Centre, expert aquatic animal bacteriologist.



--

Dr Irene Cano Cejas	Advice	Head of the WOA Reference Centre for Koi Herpes Virus (KHV) from April 2024 and Principal virologist, expert in immunology.
Dr Ronny van Aerle	Advice	Principal bioinformatician, expert in genomics and bioinformatics, focussing on Aquatic Animal Health. Co-Director of the Centre for Sustainable Aquaculture Futures (SAF), a joint initiative between Cefas and the University of Exeter.
Mr Christopher Evans	Advice	Head of the Fish Health Inspectorate from April 2023 - responsible for the regulatory functions for the national control of aquatic animal diseases in England and Wales.

## TOR 7: SCIENTIFIC AND TECHNICAL TRAINING

7. Did your Collaborating Centre provide advice/services to requests from Members in your main focus area?

Yes

*Ongoing assistance provided to a European country investigating an unexplained mortality event in European lobster (*Homarus gammarus*) and shore crab (*Carcinus maenas*, *Liocarcinus sp.*) stocks. Samples were submitted to the Collaborating Centre for analysis via histology, electron microscopy, PCR and sequencing.*

*Assistance provided to European country investigating a potential White Spot Syndrome (WSSV outbreak in crayfish. Samples submitted to CCEAAD for assistance with metagenomic analysis.*

*Assistance provided to European country investigating unusual intracellular bacterial infection of bivalve molluscs.*

*Assistance provided to researchers in Vietnam for the histological assessment of mud crab tissues.*

*Support investigating small scale sardine mortality event in Europe (UK).*

*Support provided to researchers in Chile for developing nanopore sequencing capability for pathogen sequencing infecting molluscs*

8. Did your Collaborating Centre provide scientific and technical training, within the remit of the mandate given by WOA, to personnel from WOA Members?

Yes

a) Technical visit : 0

b) Seminars : 2

c) Hands-on training courses: 7

d) Internships (>1 month) : 12

Type of technical training	Country of origin of the expert(s)	No. participants from the
----------------------------	------------------------------------	---------------------------

provided (a, b, c or d)	Content	provided with training	corresponding country
B	Co-organised and presented at Shrimp Health workshop, held in Bangkok, Thailand	Thailand	37
B	Invited speaker on systems approaches to animal health and aquaculture: AquaSustain Conference	Thailand, delegates from India, Bangladesh and Vietnam	20
C	Oversight training and advice for Fish Health Unit vets (who had previously received hands on training) as they delivered similar training for local fisheries officers	Ghana	30
C	Hands on training in shrimp and mud crab dissections	Sri Lanka	30
C	Hands on training in DNA and RNA extraction and PCR for known aquatic diseases	Sri Lanka	15
C	Hands on training in dissection of bivalve molluscs and analysis of tissues	Ghana	6
C	WOAH 4th cycle training of Aquatic Animal Health Focal Points in Africa (08-10/07), invited expert, facilitator	French-speaking African countries	16
C	WOAH workshop on AMR in Aquaculture for French-speaking Africa (11-12/07), invited expert, facilitator	French-speaking African countries	18
C	Hands on training in fish and shrimp tissues, biosecurity measures and assisted with establishing histology facility	Belize	6

--

D	PhD and MPhil and 12 month placement students, various subjects in the field of aquatic animal disease	Various	12
---	--------------------------------------------------------------------------------------------------------	---------	----

## TOR 8: SCIENTIFIC MEETINGS

9. Did your Collaborating Centre organise or participate in the organisation of scientific meetings related to your main focus area on behalf of WOA?H?

Yes

National/International	Title of event	Co-organiser	Date	Location	No. Participants
Nationally	"Mitigating diseases in animal and shrimp farming" – a Shrimp Health Workshop	Department of Fisheries, Thailand	2024-02-12	Bangkok, Thailand	37
Internationally	Aquatic Animal Health in the Pacific	Meeting organised by WOA?H regional office	2024-01-31	Online	8
Internationally	Development meeting for a WOA?H Global cost of disease review project	Meeting organised by WOA?H regional office	2024-01-22	Online	6

## TOR 9: DATA AND INFORMATION DISSEMINATION

10. Publication and dissemination of any information within the remit of the mandate given by WOA?H that may be useful to Members of WOA?H

a) Articles published in peer-reviewed journals:

12

- Alathari, S., Joseph, A., Bolaños, L.M., Studholme, D, J., Jeffries, A. R., Appenteng, P., Duodu, K.A., Sawyerr, E. B., Paley, R., Tyler, C.R., and Temperton, B. (2024) In field use of water samples for genomic surveillance of infectious spleen and kidney necrosis virus (ISKNV) infecting tilapia fish in Lake Volta, Ghana. *PeerJ*. Jul 12;12:e17605. doi: 10.7717/peerj.17605. PMID: 39011377; PMCID: PMC11248997.
- Ayiku, A N. A., Adelani, A., A. Appenteng, P., Nkansa, M., Ngoi, J., Morang'a, Collins M., Dzabeng, F., Paley, R., Cudjoe, K. S., Verner-Jeffreys, D., Duodu, S. (2024). Molecular epidemiology and current management of Infectious Spleen and Kidney Necrosis Virus (ISKNV) infection in Ghanaian cultured tilapia. *Aquaculture* 581: 740330.
- Bateman. K.S., Paley, R.K., Batista, F.M., Bass, D., Peeler, E.J. (2024) Advances in aquatic animal health within the WOA?H framework. *Scientific and Technical Review, Retrospective: Special Edition for WOA?H's centenary*, 159-167, doi.org/10.20506/rst.SE.3571
- Bateman, K.S, van Aerle, R. (2024) Chapter 32 – Nudiviruses of crustaceans. In: Kibenge, F.S.B., Godoy, M.G. (Eds.), *Aquaculture Virology (Second Edition)*. Academic Press, 2024, pp.557-585.
- Cano, I., Wood, G., Stone, D., Noyer, M.; Canier, L.; Arzul, I. (2024) Loop-Mediated Isothermal Amplification for the Fast Detection of *Bonamia ostreae* and *Bonamia exitiosa* in Flat Oysters. *Pathogens*, 2024, 13, 132. doi: 10.3390/pathogens13020132.
- Cano, I., Blaker, E., Hartnell, D., Farbos, A., Moore, K.A., Cobb, A., Santos, E.M., van Aerle, R. (2024) Transcriptomic Responses to Koi Herpesvirus in Isolated Blood Leukocytes from Infected Common Carp. *Viruses*, 28;16(3):380. doi: 10.3390/v16030380.

- Chokmangmeepisarn, P., Azmai, M.N.A., Domingos, J.A., van Aerle, R., Bass, D., Prukbenjakul, P., Senapin, S., Rodkhum, C. (2024) Genome Characterization and Phylogenetic Analysis of Scale Drop Disease Virus Isolated from Asian Seabass (*Lates calcarifer*). *Animals (Basel)*. 2024 Jul 18;14(14):2097. doi: 10.3390/ani14142097. PMID: 39061559; PMCID: PMC11274154.
- Hill, R., Stentiford, G.D., Walker, D.I., Baker-Austin, C., Ward, G., Maskrey, B.H., van Aerle, R., Verner-Jeffreys, D., Peeler, E., Bass, D. (2024) Realising a global One Health disease surveillance approach: insights from wastewater and beyond. *Nat Commun*. 2024 Jun 22;15(1):5324. doi: 10.1038/s41467-024-49417-4. Erratum in: *Nat Commun*. 2024 Jul 30;15(1):6412. doi: 10.1038/s41467-024-50682-6. PMID: 38909028; PMCID: PMC11193741.
- Hiltunen Thorén, M., Onuț-Brännström, I., Alfjorden, A., Pecková, H., Swords, F., Hooper, C., Holzer, A.S., Bass, D., Burki, F. (2024) Comparative genomics of Ascetosporea gives new insight into the evolutionary basis for animal parasitism in Rhizaria. *BMC Biol*. 2024 May 3;22(1):103. doi: 10.1186/s12915-024-01898-x
- Lorgen-Ritchie M, Uren Webster T, McMurtrie J, Bass D, Tyler CR, Rowley A, Martin SAM (2024) Microbiomes in the context of developing sustainable intensified aquaculture. *Front Microbiol*. 2023 Jun 23;14:1200997. doi: 10.3389/fmicb.2023.1200997
- Molto-Martin I, Neil DM, Coates CJ, MacKenzie SA, Bass D, Stentiford GD, Albalat A (2024) Infection of Norway lobster (*Nephrops norvegicus*) by the parasite *Hematodinium* sp.: insights from 30 years of field observations. *R Soc Open Sci*. 2024 Jan 17;11(1):231147. doi: 10.1098/rsos.231147
- Potts, R.W.A., Regan, T., Ross, S. Bateman, K.S., Hooper, C., Paley, R., Houston, R.D., Bean, T.P. (2024) Laboratory replication of Ostreid Herpes Virus (OsHV-1) using Pacific oyster tissue explants. *Viruses*, 16, 8, 1343, doi.org/10.3390/v16081343

b) International conferences:

9

- "Mitigating diseases in animal and shrimp farming" – a Shrimp Health Workshop, Bangkok, Thailand 15-16 Feb 2024. Kelly Bateman provided an overview of CC and update on shrimp health genomics and sequencing projects and capabilities.
- "Fish-Vet+ Dialogue II: One Health and Biosecurity" 18-19th June 2024 and "Aquatic organism health: To vaccinate or not to vaccinate" 20th June 2024, FAO Headquarters, Rome, Italy. Jessica Witt (UK Focal point) attended in person
- Kelly Bateman was an invited speaker presenting an overview on shrimp health in the pan-divisional symposium on "Diseases in Invertebrates for Feed and Food: Global Perspectives", Ronny van Aerle chaired a session and presented "Exploring the Pathobiome of White Faeces Syndrome in *Penaeus vannamei*" at the Society for Invertebrate Pathology, held in Vienna, Austria 28th July – 1st August 2024.
- Kelly Bateman attended the ICES Working Group for Crab annual workshop held in Weymouth 5th – 7th November 2024.
- Richard Paley chaired the ICES Working Group for Pathology and Diseases of Marine Organisms (WGPDMO) annual workshop 16th – 19th December 2024.
- David Bass was invited as Keynote Speaker at the Aquaculture Sustainability conference (AquaSustain 2024) on One Health Approach, AMR and its impact in global pond-based aquaculture which was held 24th – 26th July 2024 in Bangkok, Thailand.
- Adam Kennerly attended the International Institute of Fisheries Economics and Trade (IIFET) conference, Aquatic Food Systems in the Blue Economy which was held 15th – 19th July 2024 in Penang, Malaysia.
- Mickael Teixeira Alves was an invited expert and facilitator at the WOAHA 4th cycle training of Aquatic Animal Health Focal Points in Africa, held in Tunis, Tunisia 8th – 10th July and presented on "Certification: trade facilitation" and "International regulatory information systems in the United Kingdom".
- Mickael Teixeira Alves was an invited expert and facilitator at the WOAHA workshop on AMR in Aquaculture for French-speaking Africa, held in Tunis, Tunisia 11th – 12th July and presented on "Development and strengthening of professional capacities in the fight against antimicrobial resistance through Cefas' collaborations with Ghana, Nigeria, Senegal and Sierra Leone".

c) National conferences:

4

- UK WOAHA Centenary Event - Celebrating the UK's international collaborations on animal health and welfare, 29th April 2024, APHA Weybridge. Kelly Bateman, Richard Paley, Irene Cano Cejas and Jessica Witt attended the event in person.
- "Farmed Invertebrate welfare workshop" - London School of Economics, 16th May 2024. Kelly Bateman attended remotely to meet with



scientists, industry professionals, and NGO representatives to discuss the welfare of farmed mealworms, black soldier flies, and tropical prawns.

- Workshop on "The Genomics of Fish Pathogens" for Early Career Researchers, held at the Roslin Institute, Edinburgh, 19th of November 2024. Ronny Van Aerle and Nicola Coyle.
- 5th European Association of Fish Pathologists (EAFP) UK & Ireland branch meeting, held at Moredun Research Institute, Edinburgh, 20th - 21st November 2024. Athina Papadopoulou presented: Genomic diversity of bacterial hitchhikers of ornamental fish into the UK, Nicola Coyle presented; Genomic and morphological characterisation of a novel iridovirus associated with cockle mortalities, Chantelle Hooper presented; Exploring the pathobiome of White Faeces Syndrome in *Penaeus vannamei*, and Ronny van Aerle presented; Exploring the pathobiome of White Faeces Syndrome in *Penaeus vannamei*.

d) Other (Provide website address or link to appropriate information):

11. What have you done in the past year to advance your area of focus, e.g. updated technology?

*Ongoing research to develop pathogen enrichment / host depletion methods to improve metagenomic and meta transcriptomic high throughput sequencing investigations of tissue samples from suspect disease cases with unknown aetiologies.*

*Protocols for single-cell barcoding and sequencing are currently being evaluated for their effectiveness in sequencing uncultured eukaryotic pathogens.*

12. Additional comments regarding your report: