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Prawn White Spot Disease Response Plan

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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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EXECUTIVE SUMMARY

The aim of this report is to provide guidance to Australian prawn farmers and governments about how to respond and recover from the impact of the outbreak of White Spot Disease (WSD) in Queensland that began in November 2016. Outside the scope of this report is a complementary response plan for fifteen commercial fishers affected by WSD being prepared by Queensland Seafood Industry Association (QSIA).

The report has been prepared by interviewing affected farmers, industry leaders, government officials, farm advisers and scientists. The literature on control of WSD in other countries has also been reviewed.

The response to the outbreak was still underway when this report was written. As such it should be seen as an interim report that may need to be updated if the situation changes.

White Spot Disease of prawns is a highly infectious disease caused by White Spot Syndrome Disease Virus (WSSV). The disease is exotic disease to Australia and is listed by the World Organisation for Animal Health (OIE – Office Internationale des Epizooties http://www.oie.int/), meaning that it is mandatory for Australian authorities to report incidents and respond according to pre-agreed procedures. When the disease broke out in a cluster of prawn farms bordering the Logan River, the Queensland Department of Agriculture and Fisheries (QDAF), with the support of the industry, implemented a strategy of Eradication, with the intention of following the Australian Aquatic Veterinary Emergency Plan (AQUAVETPLAN) – Disease Strategy Manual for WSD of Prawns (http://www.agriculture.gov.au/animal/aquatic/aquavetplan/white-spot). Consequently, six family businesses that owned seven prawn production farms and one separate hatchery within a designated control zone were quarantined, and all stocked ponds must be chlorinated, then drained and dried out.

There are 22 operational prawn farm businesses in Australia. The farms affected by WSD have lost most of the current season's income of approximately $25million. In order to continue to farm in future years all affected and non-affected prawn farms will need to invest in significant capital improvements to strengthen their biosecurity. The size of this investment could exceed $50million. The cost to QDAF for controlling the outbreak is $4.4million to date and is certain to rise.

A key determinant of the path to recovery for affected farms is whether or not they will be able to restock their farms by September 2017. To achieve this the affected farms will need:

- Clearance from QDAF to restock based on satisfactory decontamination of their farms.
- Preparation of a Code of Practice (CoP), agreed between industry and QDAF, that stipulates the minimum biosecurity standards required for prawn farms to operate in the WSD control zone and provides guidance on the levels of water treatment, vector control and farm infrastructure improvements needed to achieve the standard.
- The CoP to be enforced through an appropriate regulatory mechanism.
- Agreement on a reduced biosecurity level in the CoP once Australia is declared WSD free.
- Certainty from QDAF that should WSD recur on farms that have restocked, those farms will be able to implement an agreed, on-farm WSD quarantine and containment strategy rather than complete destocking.
- Updating the hatchery biosecurity facilities within the control zone to provide WSSV free prawn post larvae (PLs) to stock the ponds.
- Strengthening of the application of controls on the importation of uncooked prawns and investigations to discover how WSD entered their farms.
- Urgent updating of the prawn broodstock translocation protocol to increase the level of testing for WSD. This must include fast turn-around of broodstock test results.

At the time of writing there is considerable doubt that the decontamination and disposal operations underway in the control zone will be completed in time for those farms to make the changes necessary to comply with the CoP prior to restocking in September 2017.

If farms in the control zone do not receive clearance to restock, their losses will be compounded by inability to produce a crop of prawns for another year. This will threaten the viability of the businesses. Consequently, an option is for the affected farms not to restock until next season. This would give a better biosecurity outcome but it would not be possible unless the affected farms received financial compensation.

Unaffected farms outside the control zone should also, if finances allow, implement enhancements to biosecurity to reduce the risk of WSD.

If WSD cannot be eradicated within the control zone, the strategy is likely to be changed to one of Control and Contain and individual farmers will need to determine whether they will continue to operate, based on the likelihood that biosecurity improvements can prevent WSD recurring on their farms. Key to this will be ongoing surveillance for WSD in wild prawn populations.

Reliance on the current reliance on wild caught brood stock to produce PLs for each years' production is now an unacceptable risk for the industry. Work must begin immediately to establish a communal facility for production of Specific Pathogen Free broodstock. For the future, further research is also needed into:

- Breeding prawns for WSD resistance
- Validation of commercial diagnostic tests for WSD and other diseases by farmers and their advisers
- Proof of freedom from WSSV of current wild and domesticated stocks.
- Continued research into vaccination of prawns against diseases.
- The use of interference RNA (iRNA) to clear viruses from broodstock
- The complete range of chemicals available for control of carrier crustaceans, particularly crabs.

As with all other aquaculture and wild caught seafood industries in Australia, an Emergency Aquatic Animal Disease Response Agreement (EADRA) and associated cost sharing arrangements, are not in place between the APFA, Australian and State governments. A working group composed of government and aquaculture representatives is in place to remedy this situation but will not complete its work until the end of 2017. The APFA has contributed positively to this working group and should use the impetus of this incident to ensure it has a swift, successful outcome.

A complementary report to this one, prepared by Ridge Partners financial consultants, has examined the financial impact of this incident on the farms affected by WSD. There is strong case for the farm businesses affected by WSD to be paid compensation. Financial assistance will be necessary for the industry to recover and adapt to its new circumstances. Australian governments are therefore encouraged to consider the following funding proposals as outlined in the Ridge Partners report:

A. Establishment of an EADRA – like agreement to provide for payment of $7,883,525 to the six affected farm businesses as compensation for their direct losses.

B. Establishment of an industry adjustment fund to provide $12,653,153 to enable the six affected farm businesses to install biosecurity infrastructure needed to meet the new CoP.

C. An *ex gratia* payment of $11,890,540 to the six affected farm businesses if they are required to defer production until next season

D. A grant of $3 million to be administered by Fisheries Research and Development Corporation (FRDC) on behalf of APFA to establish an SPF broodstock facility and provide for the significant increase in disease testing of broodstock it will require.

It must be recognised that any cost sharing agreement between industry and government to provide this funding will be limited by the small size of the prawn farming industry. With only 22 businesses to spread costs between, the amount per business to cover the above amounts will be prohibitive.

A solution to this, consistent with the EADRA principles would be to cap the maximum repayment to be made by industry to a proportion of GVP. A levy could then be implemented whereby all prawn farm businesses repay this amount over ten years.

An alternative arrangement that would distribute the cost over many more businesses would be for the wild harvest and aquaculture sectors of the prawn industry, and the major businesses in the supply chain, to contribute a very modest levy for a defined period to repay the above amounts.

INTRODUCTION

The purpose of this report is to describe how the prawn farming industry might respond to this incident and ultimately recover from it.

The report is primarily concerned with prawn farms, as the commercial wild caught prawn fishing industry is preparing its own report. Where possible the two reports cross link with each other.

White Spot Disease (WSD) is caused by White Spot Syndrome Virus (WSSV). It is a disease that causes massive mortality in prawn farms across the globe. It is a highly contagious viral disease of a wide range of decapod crustaceans including prawns, crabs, yabbies and lobsters. Similar to Foot and Mouth Disease in cattle, WSD is the disease of prawns that the seafood industry and biosecurity agencies fear most. Due to its severity, WSD is a "Listed" disease in the World Organisation for Animal Health (OIE - Office Internationale des Epizooties) Aquatic Animal Health Code of Practice (CoP) that requires nations to notify and control OIE listed disease outbreaks when they occur.

Until late 2016 Australia was one of the few prawn farming countries in the world that was free of WSD. However, this changed when WSD was officially diagnosed on prawn farms surrounding the Logan River in Queensland on 1 December 2016. This diagnosis set in motion a series of events that have had wide ramifications for Australian businesses and governments. These include:

- Destruction of prawns on all affected farms and decontamination of those farms
- Cessation of commercial fishing around the Logan River
- Suspension of uncooked prawn imports to Australia
- Restrictions on recreational fishing around the Logan River
- Cessation of trade in prawn bait between Queensland and other states
- Very significant financial losses incurred by prawn farmers, fishers, importers, and a wide range of companies that supply those industries
- The likelihood of further losses by these businesses if farms cannot return to production by September 2017.
- The possibility that some farms may be forced to sell up.
- Loss of the low risk biosecurity status for Australia's prawn farms, meaning all farms, not just those affected by this incident, will need to implement expensive capital improvements to enhance biosecurity.
- Extensive testing of imported prawn products, bait and the environment to determine the extent and source of the infection
- Massive redirection of effort of human resources in Queensland and Australian government departments.
- Loss of confidence by existing and potential investors in the industry.
- Significant impacts on the personal wellbeing of many of the people involved

Most of these outcomes are consequences of procedures implemented, with industry support, by Queensland Department of Agriculture and Fisheries (QDAF) in response to the diagnosis of WSD, to attempt to **Eradicate** the disease. There is good justification for this action being taken. If WSD was to take a hold in Australia as it has done in most other countries, the cost of prawn farming would rise substantially due to mortalities caused by the disease and the cost of implementing strong biosecurity measures. In addition, there is the risk that the infection might spread to other species that sustain commercial fisheries, such as crabs, rock lobster, Moreton Bay Bugs and to wildlife. There would also certainly be impacts on Australia's international trade in prawns.

The WSD incident is ongoing. Detection of WSSV in a small proportion of prawns collected from the Logan River leads to the possibility of persistence of the disease in the environment that would cause the Eradication strategy to be revised to one of Control and Containment. This would greatly increase the risk of prawn aquaculture continuing in the area.

The ideal outcome would be for affected prawn farms to restock their properties at the start of the new production season, which begins in September 2017. If restocking is to occur, modifications to the farms to improve biosecurity must begin in March. Hence, the recommendations of this report must be urgently implemented.

With the uncertainty of timing to finish the compulsory disposal and decontamination process, and the time needed to implement new infrastructure according to a mandated CoP, it is likely there is no alternative but for government and industry to agree that farms in the control zone cease production for a year to enable more extensive decontamination while WSSV surveillance continues, but this would be at great cost to the businesses. If this occurs, affected farmers will not receive any income for two successive production seasons due to the loss of this year's prawn crop and have lost all the expenses incurred to produce that crop and restarting production will require costly modifications infrastructure and practices to strengthen biosecurity on their farms.

In this context, it is notable that despite many years of discussions, none of Australia's aquaculture industries have established an Emergency Aquatic Animal Disease Response Agreement (EADRA) with the Commonwealth, State and Northern Territory Governments. Consequently, there is no cost sharing arrangement in place to automatically reimburse farm owners for their losses.

THE AUSTRALIAN PRAWN INDUSTRY

Overview

Data available from the Fisheries Statistics Report 2014-15 produced by ABARES is summarised below.

Total annual production of prawns in Australia is approximately 25,300 tonnes, valued at $352 million. Aquaculture production is 5,300 tonnes valued at $80 million. Wild harvest prawn production is around $20,000 tonnes, valued at $272 million.

Australia exports prawns (mostly wild harvest) valued at $95million per annum.

Significant volumes of prawns are imported to Australia, primarily from Asia. Imports of frozen prawns (mostly uncooked) in 2014-15 total 20,000tonnes, valued at $280 million. Imports of processed prawns in the same year were 12,000tonnes, valued at $150 million.

The Prawn Farming Industry

There are 22 operational prawn farms in Australia, most of which are dispersed along the Queensland coast at Logan River, Bundaberg, Mackay, Ayr, Townsville, Cardwell, Cairns and Mossman. There are two farms at Yamba in Northern NSW and a hatchery in Exmouth WA. Production is seasonal, with ponds being stocked in spring and harvested during summer. The farms are capital intensive and range in size from ten to 75 hectares. Recently, approval has been granted for the construction of significantly larger prawn farms in Queensland and approval is pending for a very large greenfield farm north east of Kununurra in the Northern Territory. The recreational prawn fisheries in NSW and Victoria also have an estuary re-stocking component that is supplied by prawn farm hatcheries.

The primary species of prawn farmed is the Black Tiger Prawn (*Penaeus monodon*). A small quantity of Banana Prawns (*Fenneropenaeus merguiensis*) is also produced. White Leg Shrimp *(Litopenaeus vannamei)* the most common species in Asian aquaculture, is not produced in Australia as it is not endemic.

Prawns are fed commercial food produced in Australia or overseas. The farms require access to significant volumes of sea water which passes through the farm with a turnover of up to 10 per cent per day during peak production. Stringent controls are placed on farms to ensure that water returned to the sea is free from excess chemical and organic matter. To date farms have had no need to decontaminate their intake water.

To begin the production year farm ponds are stocked with juvenile prawns, called post larvae (PLs). These are produced in hatcheries from adult, broodstock prawns. Some farms have their own hatcheries and others purchase PLs from commercial hatcheries or other farms. In 2014-15, 280 million PLs were produced. Surprisingly, all but one or two farms rely on wild caught broodstock to breed the PLs each year. The broodstock are harvested from the wild in the Northern Territory and Queensland. Transport of these prawns to hatcheries is controlled by the Queensland Department of Agriculture and Fisheries. A translocation protocol must be followed, which includes testing for a range of diseases, including WSD.

One group of farms worked with CSIRO to establish a broodstock domestication program to overcome the need for wild broodstock. This domestication program was very successful because the progeny of these broodstock are adapted to growth in ponds, resulting in significantly increased production. While some individual farms are undertaking their own breeding programs in association with universities, there is no national genetic selection program for farmed prawns in Australia.

Prawn Farms Affected by the WSD Incident

Seven prawn production farms owned by six families are affected. The farms are all adjacent to the Logan River and are in close proximity to each other. See Appendix 1. A Biosecurity Control Program for the area surrounding all the properties (Control Zone) was established by QDAF and a Movement Control Zone has been established around the farms. See Appendix 2.

All ponds on these farms have be treated with chlorine. All prawns have been destroyed by the chlorination process or emergency harvested, cooked and frozen. Progressive release of treated water and pond decontamination is continuing on these farms.

Three of the infected properties also operate hatcheries that produce PLs for stocking their own farms. A fourth hatchery also produces over 50 million PLs per year for sale inside and outside the control zone. That hatchery was not infected but was cleared of all stock. It needs to recommence production as soon as possible. While it is easier to decontaminate a hatchery than a farm, experience from overseas is that hatcheries can be sources of spread of WSD. Therefore, the hatchery will need to undergo a stringent inspection by QDAF before it will be able to resume supplying PLs to farms.

Importantly, there are still 13 prawn farms remaining in Queensland and two in NSW that have not experienced WSD. The farms in northern Queensland are a thousand kilometres or more from Logan River, which reduces their risk of infection. But they are still impacted by this disease incident. With the source of the infection currently unknown, all prawn farms will need to implement intense surveillance. They will also need to implement the expensive intake water treatment and biosecurity measures proposed below for farms in the control zone.

THE INCIDENT

Time Line

A detailed, day by day report on the incident has been prepared by Digfish Services (*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.* See references). This report provides a time line from day one showing how the event unfolded. The Summary from that report is provided below.

This report provides independent documentation and analysis of events related to a White Spot Disease (WSD) outbreak in Black Tiger Prawns (*Penaeus monodon*) cultured on the Logan River from late November 2016 until February 2017.

Disease was first observed on the index farm (1IP) on 22nd Nov 2016 and spread rapidly to affect multiple ponds adjacent to and downwind from the index pond, suggesting on-farm spread via aerobiological means (aerosols) and probably via mechanical vectors (insects, toads, birds). By Monday 5th Dec WSD had spread to a second farm (3IP), 1 km north of the index farm and the White Spot Syndrome Virus (WSSV) was found in wild prawns (*Metapenaeus* spp., *Acetes* spp., n = 6) sampled from the Logan River near 3IP. By Thursday 8th Dec WSD had spread to a third farm (4IP) around 2 km downriver, while a separate compartment of the first farm (2IP) recorded clinical disease on 12th Dec.

An isolated case of a single clinically normal mud crab (*Scylla serrata*) positive for WSSV was recorded in the outlet canal of a 7th (then non-infected) farm (7ARP, 7.3 km east of 1IP) on 23rd Dec. Subsequently, disease spread to a 5th farm around 5 km downriver (5IP) with clinical disease recorded on 28th Dec.

Spread between these 5 farms did not appear random. In all cases index ponds at each farm were located at the southern ends of intake canals, downwind from the mainly northerly winds at the time. Location of index ponds along intake canals was the only consistent risk factor once other risk factors (PL source, pond stocking date, food source, water quality) were assessed at each site. Index pond location and non-random distribution of crustaceans and vectors within the intake canals suggests that the affected farms bought in the disease agent through their intake canals via unidentified, possibly planktonic, carrier hosts.

The sixth farm infected (8IP) was drawing water from southern Moreton Bay and was positive for WSSV in samples taken on 24th Jan 2017 during the later stages of harvest. The final farm (7ARP) remained uninfected until 11th Feb 2017. This farm may have been infected from nearby 8IP where hundreds of birds were observed wading in WSSV positive ponds on 3rd Feb. The WSSV positive P. monodon sampled from the river near 3IP (25th Jan) and on mud flats near the outlet of 8IP on 8th Feb 2017 are considered likely to be farm escapees, but genetic testing is required to confirm this assumption.

Epidemiology

The disease is primarily spread through the movement of infected prawns, prawn products, and contaminated water. Birds, crabs and polychaete worms that feed on and move infected animals can spread the disease.

The Australian Government Department of Agriculture and Water Resources (DAWR)advises that it is still working to determine how this outbreak occurred. No definite link has been established but all possible pathways are being investigated, including the use of infected bait in the Logan River, potentially contaminated imported feed or probiotics, or contaminated equipment. A particularly important potential source of the infection is the large volume of uncooked prawns imported into Australia over the past six months or more, which are now known to be infected with WSSV.

During its investigation DAWR surveyed recreational fishers in the Logan River area during the summer holiday and found fishers using imported prawns meant for human consumption as bait. The department collected and tested samples of the bait. The results indicated that two of six prawn bait samples (33%) taken from people engaged in fishing near prawn farms were positive for WSD. Around the same time DAWR collected samples of imported raw prawns available for sale in the area. Testing of these prawns showed a significant number were positive for WSD.

This is not surprising. The *2002 National Survey of Bait and Berley Use by Recreational Fishers* commissioned by Biosecurity Australia across 8,000 Australian households found 6.8 percent of recreational used prawns sold for human consumption as bait. A 2007 *Follow-up Survey Focusing on Prawns/Shrimp* found there was a significant increase in the number of fishers using prawns sold for human consumption as bait/berley.

To assess if WSD has established in the wild 13,000 wild caught samples have been tested for WSSV since December 2016, with a very low number of animals testing positive.

One sample of approximately 100 Black Tiger prawns collected from the Logan River adjacent to an infected farm tested positive. These prawns are the same species reared on the affected farms and are not commonly found in the river. According to a DAWR media statement on 10 February, *it is a reasonable assumption that the prawns came from these farms and it may not indicate that the disease itself is present in the wild populations in the river*.

Escape of infected prawns from farms is a serious issue, as it is proof that a path exists for movement of WSD and other diseases from farms to the environment.

Genome sequencing of WSSV isolates from various locations may help identify the source of the virus and. This work is underway at QDAF and CSIRO.

The report by Digfish Services referred to above also contains detailed comments on the likely source of the WSD infection. The relevant summary is reproduced below:

> While it is possible that introduction of WSSV to farms 4IP, 5IP and 8IP downriver from the 1IP/2IP/3IP farm cluster may be explained by predictable downstream movement of water and/or carriers as per CSIRO modelling, the mode of introduction of the virus into index farm 1IP and the anomalous positive mud crab in the outlet of 7ARP requires thorough investigation.
>
> Sources of feed, equipment or hatchery supplies of PL do not appear to explain the emergence of the disease at 1IP. Instead, the epidemiology and chronology of disease spread together with evidence of significant recreational fishing effort in and adjacent to the intake canal at 1IP, strongly suggests, in my professional opinion, that the incursion pathway was most likely introduction of WSSV via the 1IP intake canal. Indeed, surveys by fisheries officers allegedly found several groups of recreational fishers using imported green prawns as bait within 500

meters of the intake of farm 3IP, and of these 33% of bait samples were positive for WSSV. This pathway is plausible given evidence that; 1. Increasing numbers of recreational fishers are using imported prawns as bait, and 2. Biosecurity breakdowns at the international border resulting in c. 50-54% of imported green prawns sold at the retail counter being WSSV positive in the - to Christmas/New Year 2016.

The risk profile for this pathway may have increased since the 2009 Import Risk Analysis for prawn products, meaning that the risk analysis needs to be thoroughly reviewed and updated to more accurately reflect the various risk pathways and new emerging diseases prevalent in the world today.

Disease Control Response from Queensland Government Department of Agriculture and Fisheries

The Queensland Department of Agriculture and Fisheries has initiated a wide range of activities using powers conferred in the Biosecurity Act 2014. These include:

1. Implementation of a Biosecurity Control Program for the affected area. The Program began on 21 January 2017 and will continue until 31 December 2017. The purposes of the Program are:
    a. To prevent the further spread of WSSV beyond the Program Area.
    b. To minimise the risk of establishment of white spot syndrome virus; and
    c. To eradicate WSSV from Queensland within the Program Area.

2. Preparation of an Emergency Animal Disease Response Plan which has been approved by the Aquatic Consultative Committee on Emergency Animal Diseases (AqCCEAD). This plan provides for:
    a. Destruction of decapod crustaceans (carriers of WSSV)
    b. Decontamination of places for things that contain, or could contain WSSV
    c. Disposal of destroyed carriers of WSSV.

3. The declaration of a movement control order prohibiting the removal of decapod crustaceans and polychaete worms from the program area

4. Establishment of a surveillance program that began on 21 January 2017 and will continue until 19 January 2019, in order to:
    a. delimit the geographic distribution of white spot syndrome virus in Queensland
    b. monitor the wild populations of decapod crustaceans across the State
    c. monitor farmed populations of decapod crustaceans across the State.

Following destruction or emergency harvesting and cooking of all prawns on affected farms, the process of treating and discharging water, drying ponds and removing biomass from these ponds is continuing. In addition, the population of crabs on the farms needs to be eliminated if possible, using baits or alternative approaches. It is estimated that the disposal and decontamination phase will take several months. This time period is critical if farms are to be restocked this season.

On 15 February QDAF reported that its expenditure to date on the incident was $4.4million, that 50,000 PCR tests for WSSV had been conducted and 3.7 million litres of chlorine had been used. These amounts are certain to increase significantly.

All of these activities are prescribed in the nationally agreed response arrangements, including AQUAVETPLAN Disease Strategy Manual for WSD which sets out agreed destruction, disposal and decontamination activities.

Response by the Australian Government Department of Agriculture and Water Resources

It has become obvious that many shipments of uncooked prawns that arrive in Australia are contaminated with WSSV. This is not surprising as WSD is endemic in countries from where these products are sourced.

A media statement issued by the Department of Agriculture and Water Resources (DAWR) on 10 February made the following points:

> *Based on findings of previous compliance activity (related to imported, uncooked prawns), the department commenced an investigation in mid-2016.*
>
> *In 2014 the reported rate of rejected consignments of imported uncooked prawns following positive results for WSSV was four per cent. By the end of 2016 this had increased to 18 per cent.*
>
> *The first phase of the investigation involved targeted sampling and testing of retail product imported by a number of importers suspected of non-compliance. Because of the nature of the targeted testing, it could reasonably be expected that the results would be significant - around 50 per cent of product was infected.*
>
> *The department's investigation has, to date, seen one importer lose their approved arrangement and import permit. The department is in discussion with the CDPP for consideration of possible charges. Action against a number of other importers is being considered and is likely.*

In January 2017, the Director of Biosecurity suspended the import of uncooked prawns to Australia for a period of six months. The DAWR is working with seafood importers and retailers to assess and manage product that was already in transit when the suspension came into effect. The department has withdrawn infected product from the marketplace and will continue to immediately remove any product confirmed as white spot positive.

As of 24 February, the WSSV results for tests undertaken by DAWR on uncooked prawns as part of the enhanced border measures are as follows:

Summary	Number of batches fully tested	Number of batches released	Number of batches refused
Total	60	24	36

The department is progressively reviewing specific products and lifts the suspension where available evidence confirms an acceptable risk.

To date, the Commonwealth Director of Biosecurity has exempted the following goods from the suspension:

- dried prawns and shelf-stable prawn-based food products

- irradiated bait for aquatic use, pet fish food and aquaculture feed
- uncooked prawns sourced from Australia's exclusive economic zone (EEZ). Australian caught prawns are not exempt if they have been exported to another country for processing.

The following product categories are still being considered as part of the initial review:

- Australian sourced prawns sent overseas for processing
- mixed seafood consignments containing uncooked prawns
- marinated prawns.

Announcements of Support for the Prawn Industry

The Deputy Prime Minister and Minister for Agriculture and Water Resources, Barnaby Joyce, announced an assistance package of $1.7 million on 26 January 2017. This included $221,000 for the Australian Prawn Farmers Association (APFA) to engage scientific experts to assist with response and recovery and to employ a biosecurity liaison officer to develop biosecurity plans for the industry. A similar amount was provided to the Queensland Seafood Industry Association. A total of $400,000 was also made available to prawn farmers to keep their stock alive until destruction and decontamination procedure could be completed.

The Minister also wrote to the APFA, noting that although there was not an Emergency Aquatic Animal Disease Response Agreement (EADRA) in place that would enable cost sharing between industry and government, he would be willing to consider an agreement within the spirit of an EADRA to assist industry to recover from costs associated with the outbreak. Senior staff from his department have been assisting in that process.

The Queensland Rural Finance Counselling Service has contacted affected farms and fishers. This is a free service to primary producers and small, related businesses who are suffering financial hardship and have no alternative sources of impartial support.

The Queensland Rural Adjustment Authority also offers low interest Sustainability Loans of up to $1.3 million to affected fishers and farmers through the Primary Industry Productivity Enhancement Scheme (PIPE).

EXPERIENCE WITH WSD OVERSEAS

The report entitled *Reducing Disease Risk in Aquaculture* published by the World Bank (report No. 88257-GLB) in 2014 provides an excellent review of WSD across the globe and a detailed examination of a WSD incident in Mozambique and Madagascar in 2011. The following notes are summarised from that report and other reports listed under References.

There is no doubt that WSD is a disease of which we should be afraid. After first appearing in Taiwan in 1992 the disease spread across the globe over the next five years. In many countries it has caused catastrophic decreases in production of farm prawns. Some areas have not returned to production.

Only three countries, USA, Spain and Australia have been able to eliminate the disease through early detection and, immediate implementation of strict quarantine and destruction of affected prawns.

The disease was eliminated from the mainland USA in 1997. The virus is found in wild crustaceans in coastal waters around the USA, however, there has only been one incursion of the disease into the USA in 2007. This occurred on three crawfish (a fresh water crayfish similar to yabbies and marron) farms in Louisiana and was quickly controlled. This is a positive sign for Australia in relation to the current incident.

The disease was believed to be introduced into the USA with uncooked prawns imported from Asia that were processed in coastal packing plants and used for bait by fishers.

Until recently the virus was thought to have very little genetic variation. However, gene sequencing of virus isolated from shrimp with WSD in Saudi Arabia showed some degree of variation compared to the original Asian viruses. Gene sequencing can now be used to identify WSSV strain variants for epidemiologic investigations.

A well-established feature of WSSV is its temperature sensitivity. Experimentally, prawns carrying the virus do not express clinical WSD in water at 32°C but when water temperature is reduced to 26°C clinical disease manifests. This phenomenon is the basis for cold stressing of brood stock prior to PCR testing in order to maximise detection of carriers of WSSV.

Control of WSD in countries where it is endemic involves a range of strategies. These are summarised below.

- Avoid stocking ponds during cold periods.
- Give PLs a head start by keeping them indoors in tanks or plastic covered nursery ponds containing water of the correct temperature.
- Modification of farm layout to include storage ponds where water is disinfected by chlorination and stored prior to use in production ponds.
- Reduce the level of water exchange on the farm, to reduce the risk of introducing virus from the wild. This may require increased pond aeration and alternative pond management approaches.
- Use probiotics in pond water
- Exclude crustacean carriers (zooplankton) by filtering intake water to 200 microns, using drum filters or bags.
- Modification of canal structures to allow complete drainage when not in use to prevent build-up of carrier crustaceans
- Install crab fencing to prevent crabs entering ponds.
- Install bird netting where feasible.
- Stock ponds with PLs produced from SPF broodstock.

Wild broodstock are recognised throughout the world as a major point of disease entry to prawn farms. Extensive testing of broodstock for WSD and other diseases is essential to prevent disease entering production farms and nurseries. The prawns must be quarantined in individual holding tanks and each prawn must be individually tested by PCR. A negative PCR test does not guarantee freedom from disease, because the viral load in prawns with latent infections may be below the detection limit of the test, especially if the test samples are pooled. Since the stress of spawning may weaken the host's immune response broodstock should be retested after spawning and a sample of their PLs should also be tested prior to release on farms. Use of the cold stress procedure prior to testing is also recommended prior to testing broodstock.

Use of wild broodstock has decreased overseas and should only be seen as an interim strategy. The long term strategy for ensuring disease free status of broodstock should be to develop Specific Pathogen Free (SPF) broodstock. Use of SPF broodstock has been credited with being the single most important factor in the recoveries of the Asian and Latin American shrimp industries from WSD.

Genetic selection of *L vannamei* prawns that are resistant to WSD has been achieved in Columbia, Thailand and India. Some success with selection for resistance to WSD has been achieved in India with *P monodon*. The task may be facilitated in future by the recently reported finding of gene markers that correlate with WSD resistance in *P monodon*. The process genetic selection would require a minimum of five years to establish broodstock families and initiate the selection process. It could then be another five years before commercially viable disease resistant broodstock are available, due to the low heritability of disease resistance. Because the market is relatively small, and the available price margin for genetically resistant stock is not great, it is most likely that a prawn breeding program in Australia, like other countries, would need to be supported with some public funds.

While the profitability of prawn farming in Australia depends on the better prices achieved for *P monodon* prawns on the domestic market, it should be noted that the global WSD pandemic contributed to many countries switching to production of *L vannamei* prawns. This species is generally hardier than others and disease resistant stocks are available. Their ease of domestication and ability to grow in large densities in ponds also make them well suited to grow out to a smaller size and still make a good return on investment. Importation of *L vannamei* to Australia would be difficult at a biosecurity and political level, but continued incursions of WSD, or other diseases, could lead to its consideration.

PRAWN FARMERS' IMMEDIATE NEEDS

The most immediate needs are shown below in priority order below. A brief decision analysis is provided in Table 1, that summarises the major issues that determine whether prawn farms will be able to resume production in the spring of 2017. The situation is likely to change as more information becomes available and the passage of time determines whether the infection spreads to more farms and /or the environment. Accordingly, this report may need to be modified and should be regarded as an initial response plan.

1. Ability to restock ponds in the Control Zone this year

It is essential for the farmers in the Logan River control zone to be advised whether or not they will be able to stock their farms by September 2017. Since the Biosecurity Control Program for the affected area is in force until 31 December 2017, this decision rests primarily with government authorities. There are many variables impacting on this decision, but the determining factor for farmers is whether QDAF will allow restocking, what licence conditions will be applied and what the official disease control response will be if the farms become reinfected.

Development by the industry and QDAF of a CoP for prawn farming in the control zone, will be an important mechanism by which some of these issues will be resolved and actioned.

Some of the key questions are:

- When will farms be able to restock?
- If farms cannot be restocked, will they receive compensation for the loss of a second season's production?
- When will the level of risk of infection from the river be known?
- What quarantine procedures will be implemented if a pond in the control zone becomes reinfected?
- Will total stock destruction or emergency harvest be required if a pond becomes reinfected?
- What level of regulation will be applied to restocking?
- What are the details of the proposed on-farm sentinel program?
- Where will PLs be obtained from?

2. Improved biosecurity infrastructure on farms

The proposed CoP will require farmers that decide to restock in the Logan River control zone to make a substantial investment to improve the biosecurity of their farms. The primary objectives are to prevent WSSV entering farms and to destroy any virus that does gain entry before it infects the prawns. Equally important will be the establishment of structures that prevent prawns and virus from leaving the farm. As mentioned above, this may require:

- Earthworks to modify ponds to allow large volumes of intake and waste water to be held for a period for disinfection.
- Installation of 200micron filters on water intakes and outlets to remove crustaceans and other disease carriers.
- Disinfection of intake and waste water with chlorine or other approved chemicals to kill viruses.
- Plastic lining of ponds
- Reduced water intake with consequential increase in the need for pond aeration
- Installations of barriers to prevent movement of crabs and birds onto the farms.

- Treatment of water with trichlorofon or fipronil under special permit to reduce the number of crustaceans that may act as vectors.
- Routine surveillance for WSD and other diseases.

3. A supply of Post Larvae (PLs)

Post Larvae are needed to restock farms in the control zone and non-affected farms. All hatcheries in the control zone must be decontaminated and inspected by QDAF before they can resume PL production. There are hatcheries in the control zone that previously supplied farms within and outside the control zone. These hatcheries must be re-established by July 2017 if they are to supply farms inside the control zone. However, they will now face difficulty retaining customers outside the control zone, even if capable of supplying them, due to the perceived risk of infection. An option for these hatcheries is to relocate to another site outside the control zone. There are a number of disused hatcheries available that might be suitable, but it will take significant investments to bring them into production.

The QDAF facility at Bribie Island is also able to carry out contract production of prawn nauplii that can be grown out to PLs by farms. But Bribie Island cannot produce enough nauplii in time to meet the demand of all the farms that require stocking. It is also understaffed and any farms that request assistance from the facility will need to provide staff and other resources. It is likely that the biosecurity arrangements for the facility will also need to be strengthened.

4. Strengthened Translocation Protocol for Broodstock

Since PLs must be produced from brood stock harvested from the wild, the broodstock translocation protocol must be revised to require all stock to be tested for WSD before they are used. Since the translocation protocol is a regulatory instrument, this task will need to be completed by QDAF, with input from the industry. It will place further pressure on testing laboratories.

5. A New Code of Practice for Production of Prawns

All parties agree that a CoP must be prepared by the prawn farmers in conjunction with QDAF. It must be complete by the end of March 2017 if ponds are to restocked this year. Initially, the CoP should be written specifically for prawn farms in the control zone undergoing Eradication. It should set the minimum standards that must be met to farm in an environment that might contain WSSV. Once approved by QDAF the CoP should then be referenced in appropriate regulations or licence conditions to ensure it is enforceable.

The CoP will also be useful to prawn farms outside the control zone. It is likely that the minimum standards for these farms will be less demanding. However, it is not clear whether compliance with the CoP will be voluntary or mandatory.

If the CoP as applied to farms outside the control zone is less rigorous, it will be important to clarify whether farms inside the control zone will be able to operate against the less demanding CoP after Australia has been declared free of WSD; hopefully in two years. This may influence the type of biosecurity infrastructure implemented by those farms.

The CoP should set mandatory minimum standards to be achieved and also provide suggestions on the range of technologies that can be used to achieve the standards. CoPs and information for farms and nurseries will be required. There are CoPs available for shrimp production in other countries that might form a basis for an Australian CoP. FRDC will also support a visit to Australia by technical experts to advise farmers on all aspects of WSD, including preparation of the CoP. This will take place during the week beginning 13 March 2017. Some prawn farm owners are also planning to visit

countries that grow prawns in areas with a high risk of WSD, in order to see biosecurity arrangements first hand. The Biosecurity Liaison Officer to be employed by APFA, using the emergency grant from DAWR, should have a major role in advising farms on the implementation of the CoP.

6. Increased Diagnostic Testing Capacity

There must be an increase in the capacity of diagnostic laboratories to test for WSD in Australia. Currently three laboratories accredited by DAWR are responsible for most of the testing and they are at risk of being overwhelmed. This can result in long delays for test results. Confinement of testing to three approved laboratories during the acute phase of the incident is understandable, but as the incident continues and more monitoring is required, more testing capacity is needed. This could be achieved by the accreditation of existing laboratories with the capability.

A key element of enhanced biosecurity on farms is surveillance and early detection of disease to allow emergency harvesting if disease is detected. This means farms will need test results in a matter of days. Similarly, testing of broodstock and resulting PLs will be a key element in restocking this year and future development of SPF brood stock. In these situations, test results must also be provided quickly to enable decisions to be made about whether to move stock out of nurseries into production ponds.

If the WSD strategy is changed from Eradication to Contain and Control, individual farmers that continue to produce prawns will also need to be able to submit their own samples to laboratories, or send them overseas, or buy in commercial testing kits. There are several commercial kits available, including *Shrimple* and *Shrimpcheck* immunological tests and Agrigen, *MyLab* and *Profound* PCR tests. Use of these kits outside approved laboratories is currently prohibited in Australia, and consideration needs to be given to enabling farms to use them as a management tool..

Environmental surveillance might be enhanced if zooplankton harvested from rivers and estuaries adjacent to prawn farms could be tested, as microscopic crustaceans are susceptible to WSD and therefore might be a more concentrated source of virus. To date, use of the PCR test on these samples has not been technically possible.

7. Reduced Risk of Further WSSV incursions

The risk of further incursions of WSD and other exotic diseases must be reduced before owners can consider investing the capital needed to continue prawn farming under strengthened biosecurity arrangements. A competitive advantage for Australia is its disease freedom and our prawn farms are deliberately designed for farming under low risk conditions. One of the key advantages of the Eradication policy that has been adopted for this incident is that the risk of WSD occurring in future will be significantly reduced. Consequently, the prawn industry will wish to ensure that the current importation protocols for uncooked prawns are reviewed against the best available, up to date science, superimposed with a low tolerance for any future risk.

8. An 18 Month Suspension of Production

This approach is only feasible if the affected farms are compensated financially.

The uncertainty around the timing of the above activities makes it impossible for farmers to decide whether than can return to production by September this year. Consequently, farmers have reluctantly decided as a group that the best option might be to delay restocking until next year, which means a stand down period of 18 months from March 2017 to September 2018, and loss of another season's income. However, there are some benefits to this approach, including:

- It gives a stronger chance of achieving Eradication, which farmers strongly support.

- It bolsters biosecurity because farms can dry out, virus levels will decline over time, and risk of any virus escape eliminated is eliminated.
- A small number of prawns can be put on each farm as sentinels, to monitor whether the virus is still active.
- Farmers have a longer period to modify their farms to achieve high level biosecurity.
- The essential SPF facility can be brought on line to supply disease free brood stock

For this stand down year to occur, it must be supported by QDAF and affected prawn farmers. The farmers will need to be financially compensated for the lost year's production. Otherwise they will be forced to farm this year with reduced prawn numbers and minimalist biosecurity improvements.

Table 1. 2017 DECISION MATRIX FOR IMMEDIATE INDUSTRY NEEDS

(Immediate relates to issues that determine whether farms will restock in spring 2017)

ITEM	RESPONSE	OPTIONS	NEEDS
No evidence of spread of WSD to farms outside the control zone. WSSV detections in the environment are limited.	Government continues **Eradication** strategy. Logan control zone continues. Surveillance continues for 2 years. *Import controls* strengthened.	1. Farms in control zone restock in Aug/Sept 2017.	*Financial support* *CoP of Practice* for production under biosecure conditions – likely a combination of voluntary and regulated aspects *Source of PLs* Certainty around *farm quarantine policy* if re-infection occurs Significant farm refitting, engineering and water treatment works on-farm
		2.Farms in control zone do not restock in 2017. An 18 Month Suspension of Production, or exit the industry?	*Financial support* and compensation for further lost production Alternative employment Advice on farming alternative fish species. Approach to *Sentinel stocking* of farms must be determined. Ongoing risk assessment re potential for restocking in 2018. Significant farm refitting, engineering and water treatment works on-farm if planning to restock in 2018.
		3. Farms outside control zone continue production	*Financial support* Strengthen biosecurity arrangements on farm. *CoP of Practice* - voluntary *Source of PLs*
WSD spreads to other farms and environment	Change to **Control and Contain** strategy. Control zone increased? Movement restrictions eased within control zone. Destruction and disposal of prawns on infected farms	4. Farms in control zone cease farming	*Financial support* Alternative employment. Advice on farming alternative fish species. Ongoing risk assessment re potential for restocking.

ITEM	RESPONSE	OPTIONS	NEEDS
	delayed to allow emergency harvest if worthwhile. Reduced surveillance within control zone?.		
		5. Farms in control zone continue farming with increased risk.	Unchanged from Option 1 above. Fast turn around WSD testing service for use by growers for surveillance and early detection
		6. Farms outside control zone continue production	Unchanged from Option 3 above. Fast turn around WSD testing service for use by growers for surveillance and early detection
Code of Practice for Prawn Farming Under Biosecure Conditions (CoP)	Industry prepares CoP with input from many sources. CoP recognized in legislation as a farm licence requirement.	Farm licence specifies conditions to be met. CoP describes how they are achieved.	Written by *APFA Biosecurity Officer*. Input from *International experts*, local farmers, QDAF, Animal Health Australia, Aquavetplan, and CoPs from other countries. Training materials to match. Includes specifications and techniques for water intake and discharge, crab and bird control, pond lining and cleaning, personnel and equipment movement restrictions, etc.
Source of Brood Stock and PLs	PLs cannot move from hatcheries in control zone. Identify new sites and / or operators for hatcheries. Increased disease testing of all broodstock used in Qld.	Can hatcheries in the control zone be certified clean?	Risk of some farms outside the control zone not being able to obtain sufficient PLs. Financial assistance to set up a new hatchery, or allow market forces to operate? Revision of broodstock translocation protocol to include testing of all stock, including cold shock testing.
Strengthening of Import Controls	Import controls to be revised and enforced.	Advice needed on the range of possible options within WTO rules and political environment.	Information needed on whether the problem is due to weak rules or inadequate enforcement? At what level will the review occur? Will it have an independent rep? How does industry have input?

PRAWN FARMERS LONGER TERM NEEDS

There are numerous lessons to be learned from this incident about industry preparedness for emergency disease incursions. The list below provides a guide to the policy, research, and training initiatives worth considering by the industry.

Establishment on Specific Pathogen Free (SPF) supply of prawn broodstock

Most reports from countries that have recovered from WSD to greater of lesser degrees have emphasised the importance of SPF broodstock. This is because even a single infected prawn in the brood tank can infect the whole population. The nursery environment is perfect for rapid build-up of the level of infection, resulting in transfer of the disease to the production ponds when they are stocked with infected PLs.

The fact that most of the Australian prawn farming industry relied on wild caught brood stock as the starting nucleus for their production each year, is testament to the low risk environment which Australia enjoyed and these businesses profited from. However, those days are gone. It is time to establish a dedicated facility that has a mandate to supply broodstock to all nurseries in the industry.

While it will be essential to strengthen the disease testing protocol for movement of wild broodstock to hatcheries, it is not enough, because even repeated testing is not infallible. In addition, WSD can be carried vertically between generations. Consequently, the only solution is to establish a facility well separated from other prawn farms and to go through a proven process of sequential quarantine periods and generations to produce SPF stock. The added advantage of this process is that it also produces domesticated prawns, capable of better survival and growth in aquaculture systems.

The SPF facility could be established as a user pays, not for profit entity required to provide broodstock to farms as needed at minimal cost. This could be achieved by leasing an unused aquaculture facility. Since many of the broodstock currently used in Queensland are harvested in the Northern Territory, it would be very convenient to hold those broodstock in the currently underutilized Darwin Aquaculture Centre until they are tested disease free. They could then be shipped to a secondary holding facility in Queensland.

A national prawn selective breeding program

Once the SPF facility is established and shown to be operating effectively, with adequate back-up systems, consideration can be given to starting a selective breeding program. This would be extremely important if WSD becomes endemic in Australia. Australia has a high level of scientific capability in establishment and operation of genetic improvement programs. The primary target for selection would be WSD resistance, with other traits such as growth rate being monitored to ensure they do not decline as the selection process continues. Selection for WSD resistance in prawns has been shown to be possible, but would take many years.

Selection for WSD resistance has limited appeal if the current eradication program is successful and Australia maintains WSD-free status. Alternatively, industry may support this approach if the risk of importation of WSSV continues. Selection for WSSV resistance requires the broodstock prawns or their progeny (i.e. PLs) to be challenged with the virus, so that the resistant survivors can be used for breeding. This would be difficult while Australia is disease free. While it might be possible to conduct the challenges in the Australian Animal Health Laboratory, the cost is likely to be prohibitive. An alternative might be to conduct the challenges in WSD infected areas in an Asian country under a collaborative agreement.

An outline for a breeding program prepared for this report by Dr Mathew Cook of CSIRO is provided in Appendix 3. International aquaculture breeding companies such as CP Thailand and Nofima in Norway may also be willing to consider investment in the program.

Implementation of the genetic component of this program would not be difficult, as there are numerous geneticists with the necessary skills in Australia. The key requirements would be to establish sufficient funding to continue the project for five or more years until any disease resistant prawns were produced. In addition, the ownership arrangements and governance would need to be described in a business plan.

Establishment of an Emergency Aquatic Animal Disease Response Agreement.

The financial aspects of an Emergency Aquatic Animal Disease Response Agreement (EADRA) are discussed below in the section on Future Funding. However, there are other benefits from implementing an EADRA in addition to the cost sharing and financial compensation arrangements. These include the assistance of expert biosecurity groups such as Animal Health Australia in preparation of biosecurity plans, training of industry staff in biosecurity, the delivery of emergency disease incursion simulation exercises and participation in the management of Australia's biosecurity system. It also allows the industry to come to agreement with the Australian and State governments so that an industry representative is present when all major decisions are made concerning an emergency disease response. The agreement can also include conditions around communication and notification requirements.

The APFA has participated in the working group that is attempting to establish an EADRA with all aquaculture industries, and has been supportive of the process from its inception. It is suggested that this process is accelerated and if necessary, APFA moves before other sectors are ready to establish an EADRA.

Additional Research and Development

This incident has shown that the capacity of Australian laboratories to test for aquatic animal diseases can be quickly overwhelmed. Research into the capacity of laboratories to test a range of diseases is needed to identify any gaps and find a way to remedy them.

The process of using iRNA to clear prawn broodstock of other viruses has been shown to work by CSIRO and could be expanded to be applied to WSD.

Vaccination against prawn diseases is not practicable at present, owing to the lack of an acquired immune response in crustaceans. However, some experiments have been able to enhance naturally immunity in prawns. Research into this area should be pursued at a basic level in the hope of finding methods to vaccinate prawns in future.

Further research on the limitation of chemical use in prawn farming is also required. For example, better understanding is needed about the use of fipronil and trichlorofon to remove unwanted crustaceans from intake water in ponds.

Aquatic animal health expertise is thinly spread across Australia. Generally, the industry and governments are able to obtain what is needed, but there is room for expansion of our expertise.

Therefore, it is suggested that the APFA, other industry sectors, research organisations and FRDC use the impetus of this disease incident to put together a bid for an aquatic animal health CRC bid. Such a CRC would provide a leap in the technical capacity of Australia to prevent and well as respond to major disease problems.

FUTURE FUNDING

A complementary report to this one, prepared by Ridge Partners financial consultants, has examined the financial impact of this incident on the farms affected by WSD. The figures prepared by Ridge Partners are based on actual data collected from the six family businesses that operate seven farms and four hatcheries affected by WSD in the Logan River area. The inescapable conclusion is that substantial financial assistance will be necessary for the industry to recover and adapt to its new circumstances.

1. Compensation of affected farms for their losses

The six businesses in the control zone have already received some compensation for the cost maintaining prawns alive in ponds between the day of diagnosis and the day of chlorination of the ponds.

The APFA and Queensland Seafood Industry Association have each received $220,000 from the DAWR for the appointment of Biosecurity Liaison Officers.

However, the amounts received by the farms do not come anywhere near the total of their financial losses of as described in the report by Ridge Partners.

There is strong case for these farm businesses to be paid compensation because:

- The farms have lost all their income for this financial year.
- This incident has occurred through no fault of their own
- It is alleged that the cause of the incident might be related to apparent failure of import controls on uncooked prawns
- The farms are profitable, tax paying businesses, that can quickly return to profit if supported.
- It is critical for the hatcheries in the control zone to become operational again as soon as possible to supply PLs for restocking farms.
- Extensive capital works will be required on each farm to boost biosecurity before production can resume.
- The specialised staff employed by the farms must be retained at all cost, or restarting the businesses will be impossible.
- Other businesses in the region that are creditors of the affected farms would benefit from this compensation because their loans, by way of credit to farms to produce this years' crop of prawns, would be paid.

The Ridge Partners report estimates the loss directly suffered by the six affected businesses due to the cost of production up to the point of chlorination of the ponds and decommissioning is $7,883,525.

2. Assistance to all farms for enhancement of biosecurity

No matter what the result of the WSD control program around the Logan River, prawn farming in Australia has now become a medium risk activity, where it was previously low risk. The extensive capital infrastructure on prawn farms, the value of the harvest and the inability to influence the level of WSSV in the sea water used for production all mean that biosecurity on prawn farms must be enhanced to protect their investment and to prevent any future diseases escaping into the environment.

Ridge Partners calculated the total cost to the six affected farm businesses of establishing new biosecurity infrastructure to be $12,653,153. This was based on $87,600 per production pond hectare. This figure is likely to be revised after further consultation with experts overseas.

The same costs apply to non-affected farms outside the control zone. While their case for compensation is not as strong, there is no doubt that their cost of business has increased dramatically as a result of this outbreak. The estimated cost to fit out these farms with the required biosecurity is $40million.

3. Compensation for an 18 Month Suspension of Production

As discussed above this option is only feasible if farms are compensated for the lost season's production.

Ridge Partners calculated the total cost of compensation for deferring production for 18 months on the six affected farm businesses to be $11,890,540, based on $80,000 per ha for ponds, plus $8,000/ha for hatcheries, plus $2,000/ha for broodstock.

4. Establishment of a SPF supply of broodstock

It is suggested that a provision of $3million is set aside to establish an SPF broodstock operation. This should be initiated by ACPF and FRDC calling for expressions of interest. Interested parties would need to submit a business plan for consideration by a panel of experts.

5. Cost Sharing Arrangements

Discussions with government officials and parliamentarians have made it clear to industry that some arrangement for cost sharing would have to be established to facilitate any funding provided by the government. "Cost sharing" in this situation generally means collections of levies from farmers that are matched to varying degrees by government.

In many other industries the accepted method of cost sharing for emergency diseases is an EADRA. This involves industries imposing a small levy on themselves to cover the administration of the agreement and to provide training in emergency disease response. The agreement provides for the automatic implementation of a Response Levy when an emergency disease incident occurs. This levy rate is set at the time of the incident, according to the estimate of the likely cost of the incident and the industry's capacity to pay over time. The funds are only used for disease response activities, with the costs for recovery and consequential losses specifically excluded from the arrangement. Costs of response are shared one third by industry, one third by the Australian Government and one third by State Governments. Items that can be claimed under the EADRA include the costs of decontamination and destruction, owner compensation for destroyed livestock and loss of feed and other inputs.

If the prawn farming industry had an EADRA in place with State and Australian Governments, the six affected farm businesses could be compensated for their losses through a payment made by government, which would then be partly recouped from the industry through a Recovery Levy.

However, despite nearly a decade of trying it has not been possible to establish an EADRA with any Australian aquaculture industry sector. The main difficulty with an EADRA for aquaculture is that the industries are small and the potential losses from disease are large. This is exactly the case with the WSD incident.

> For example, the total costs for compensation and restructuring for the six affected farms, shown under items (1) to (3) above, plus SPF facility amount to $35,427,218. If one third of this amount was to be repaid by 22 prawn farm businesses, the cost per farm would be $536,776. This would require an annual levy payment by each farm of $53,677 over ten years, without interest.

Recently a working group established to find a way to make the EADRA concept work in the aquaculture, has made good progress. But its work will not be completed until the end of 2017 and the resulting levy collection might require another year for implementation. Hence there is an argument that the six businesses affected by this incident should be compensated as if an EADRA was in place.

There are several alternatives to how this could be done:

A. It has been suggested that a special agreement, based on an EADRA, could be established now between APFA and the Australian Government. The government could then make an immediate payment of $35 million for items (1) to (4) above. This would be conditional on one third of the amount being repaid over the next ten years from a levy collected from the industry. However, the problem of spreading the cost over a small group of remaining prawn farms still applies. The annual levy would be a considerable imposition on the non-affected prawn farmers, as they also need to find funds to boost their own biosecurity.

B. Another solution would be for the six affected businesses alone to establish an agreement with the government. Assuming the government would make an immediate payment to the farms and they would repay one third over a specified time period. This is essentially a loan and it would be even simpler for the government to pay an immediate grant of two thirds of the agreed costs.

C. The fourth possibility is to broaden the group of businesses that would pay back the amount required under options (1) or (2). This could include the wild catch prawn sector and the seafood importers. In order for this arrangement to be accepted it is almost certain that remaining prawn farmers would want to use some of the money raised to pay for new biosecurity arrangements and the importers would want to invest some of it in new arrangements for importation of uncooked prawns. It would take a considerable amount of negotiation and goodwill by all parties to implement. Such a broadening of objectives would be outside the conventional scope of an EADRA and would be better described as an industry adjustment levy.

D. It might be legally possible for the Australian Government to implement the broad based levy discussed in (4) above as a temporary emergency measure, with the support of the industry leadership. However, the National Pest and Disease Outbreak website (http://www.outbreak.gov.au/current-responses-to-outbreaks) lists sixteen exotic disease and pest incursions that are currently being managed by governments around Australia. Against this background it difficult to see how the prawn industry could argue it is an exception.

In summary, the prawn farming industry would like Australian governments to consider the following funding requests:

A. Establishment of an EADRA – like agreement to provide for payment of $7,883,525 to the six affected farm businesses as compensation for their direct losses.

B. Establishment of an industry adjustment fund to provide funds of $12,653,153 to enable the six affected farm businesses to install biosecurity infrastructure needed to meet the new CoP of Practice.

C. An *ex gratia* payment of $11,890,540 to the six affected farm businesses if they are required to defer production until next season

D. A grant of $3 million to be administered by FRDC on behalf of APFA to establish an SPF broodstock facility and provide for the significant increase in disease testing of broodstock it will require.

It must be recognised that any cost sharing agreement between industry and government to provide this funding will be limited by the small size of the prawn farming industry. With only 22 businesses to spread costs between, the amount per business to cover the above amounts will be prohibitive.

A solution to this, consistent with the EADRA principles would be to cap the maximum repayment to be made by industry to a proportion of GVP. A levy could then be implemented whereby all prawn farm businesses repay this amount over ten years.

An alternative arrangement that would distribute the cost over many more businesses would be for the wild harvest and aquaculture sectors of the prawn industry, and the major businesses in the supply chain, to contribute a very modest levy for a short period to repay the above amounts.

CONCLUSION

Aquaculture production of prawns was established in Australia as a low biosecurity risk, high profit industry and has remained so until December 2016. The incursion of WSD onto prawn farms in Queensland has brought that era to a close.

Even if the Eradication strategy being applied to the current WSD outbreak is successful, the incident has jolted the industry and governments into a new level of awareness of biosecurity. While the fault for the WSD outbreak is likely to be a result of a breach in the biosecurity at the Australian border, and use of infected prawns as bait by fishers, there is also the possibility that prawn farms may not have become infected if their biosecurity arrangements were much stronger.

This outbreak has also brought into focus the clear risk that is posed by other major pandemic disease of prawns that have not yet had any impact on Australia. These include Yellow Head Disease (YHD), Infectious Hypodermal and Haematopoietic necrosis disease (IHHND), Taura Syndrome, Infectious Myonecrosis, Hepatopancreatic microsporidiosis (HPM), Hepatopancreatic haplosporidiosis (HPH), Covert Mortality Disease (CMD), and Early Mortality Syndrome (EMS) now called Acute Hepatopancreatic Necrosis Disease (AHPND), which appears to be in Australia but has not had a major impact.

Consequently, a major consequence of this incident is that prawn farms that continue to operate will progressively increase their biosecurity arrangements. The industry has a major role in planning and implementing this transition and must quickly prepare a CoP of Practice and Biosecurity Plan for individual farms and the whole industry. It will be important that the fundamental features of this CoP are enforced by legislation or licence conditions to ensure uniform implementation at an appropriate quality standard. The risk of even one farm failing to implement the CoP is too great to the other farms.

For this reason, there is considerable public value in governments providing financial assistance to prawn farms to undertake this significant transformation.

The cause of this outbreak, the source of infection and the route of transmission are all subject to intense conjecture. Investigations are underway by epidemiologist and government investigators, but the definitive answer may never be known.

No matter what the outcome of these investigations, the information that shocked everyone was the revelation that an unacceptably high proportion or uncooked prawns imported to Australia are infected with WSSV. This was apparently known by DAWR several months before the outbreak and although investigations were initiated, the prawn farming industry was not advised of the increased risk. The risk was real enough because the department's own surveys had twice demonstrated that recreational fishers use imported raw prawns for bait. On site investigations during the incident confirmed the use of these prawns by fishers on the Logan River.

There is clearly much more information to be tabled about these aspects of the incident, including the possibility of prosecutions of offenders. Enquiries are to be conducted by the Australian Senate and possibly the Inspector General of Biosecurity. More investigations might ensue as the various parties also consider their legal positions.

These investigations are likely to continue over the next one to two years; long after critical decisions have been made by farmers about whether to continue prawn production. They are mentioned here because they provide background to the belief that many people in the prawn industry have that they should be financially assisted by the government that is ultimately responsible for the agencies that implement border controls on imports.

A counter argument is that the industry should have established an EADRA with government long ago which would result in automatic compensation for losses.

To date, during the preparation of this report, there have been constructive conversations between government and industry aimed at achieving some level of financial support for affected prawn farmers. It is hoped these discussions have a successful outcome.

In a period of two months more than 50,000 PCR tests for WSSV have been conducted by government laboratories. It has become apparent during the incident that government agencies wish to retain a high level of control over testing laboratories and would not endorse testing by other laboratories. This has led to a level of distrust by growers. It would serve all parties well if the government could explain the reasons behind this. Since WSD is a worldwide disease there are numerous commercial tests available, both immunologic and PCR based. These tests are not available in Australia. If Australian prawn farmers must learn to live with this disease, and start to breed SPF broodstock, they will want access to these tests. The regulations relating to their importation and use in private hands therefore require clarification.

For FRDC there are a number of research questions that this incident has defined. These include:

- Development of a WSD bioassay under PC3 conditions to enable sensitivity of other species to be tested, methods of transmission, evaluation of new tests and treatments, etc.
- Investigation of the survival of WSSV in prawn pond sediment.
- Options for early detection surveillance and use of sentinel stocking on farms prior to restocking
- A study of chemicals available for control of carrier crustaceans, particularly crabs, on prawn farms.
- Validation of testing on PLs and zooplankton
- Options for genetic selection of prawns for disease resistance, using both conventional selection and gene markers. There are several large prawn breeding companies (CP Thailand, Nofima) who may be interested in collaboration to achieve this objective.
- Continued basic research into vaccination of prawns against diseases.
- The use of iRNA to clear viruses from broodstock
- Rapid farm based diagnostic tools and rapid throughput laboratory testing
- Assessment of different sterilisation and filtration systems for destroying WSD
- Assessment of novel methods to manage bird control

While it would be difficult and controversial, the introduction to Australia of *L vannamei* broodstock might also need to be considered; but only if some of the major diseases mentioned above become established in Australia. Virtually all countries involved in prawn aquaculture have switched from *P monodon* to *L vannamei*, because they are easier to farm and disease resistant broodstock are available. The commercial argument against this is that the retail price of *L vannamei* is lower than other species and the consumer experience is completely different to Australia's larger prawns. As a high cost industry, relative to Asia, Australian growers may be wise to maintain higher profit margins from *P monodon* production for as long as possible.

Continued investment is necessary to boost Australia's technical capacity in aquatic animal health. The impetus of this incident could form the basis of an application for a Cooperative Research Centre dedicated to this topic.

There is a human element to incidents such as this. Everyone involved is working at or beyond capacity for weeks on end, which takes its toll. While this report makes no comment on this subject in relation to government employees, the impact on people in the industry should be noted. Most seafood

organisations employ one Executive Officer and have a board that is voluntary. In the face of an outbreak these staff are suddenly faced with an overwhelming number of people involved in disease control to consult with, media to respond to, and members who are highly stressed. Seafood organisations generally do not have the systems and people to respond to this challenge effectively.

There is not a lot that can be done to improve this situation, because the industries do not have the funds, but it is worth being aware of. Fortunately, the FRDC has been able to assist in many ways and has provided funding for reports such as this. In this outbreak the relationship between industry and government have generally worked well, due to willingness on both sides. One of the advantages of the industry signing an EADRA with government will be access to the network of biosecurity expertise in Australia.

Finally, the role of government agencies in this incident must be acknowledged. In particular, the response by QDAF has been very visible, and has combined a regulatory approach with technical expertise and a genuine desire by staff to overcome the problems that arise each day.

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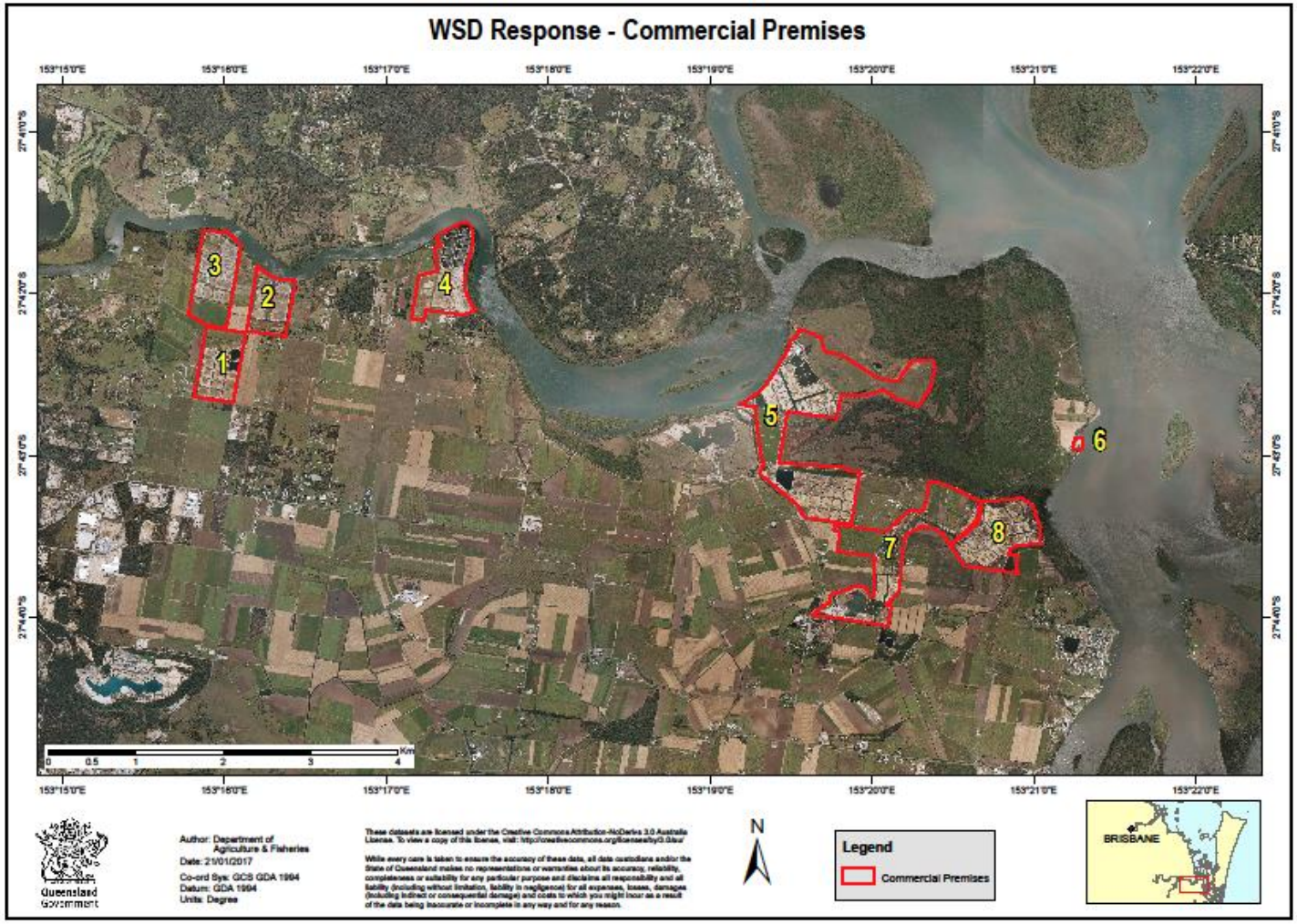
APPENDIX 1

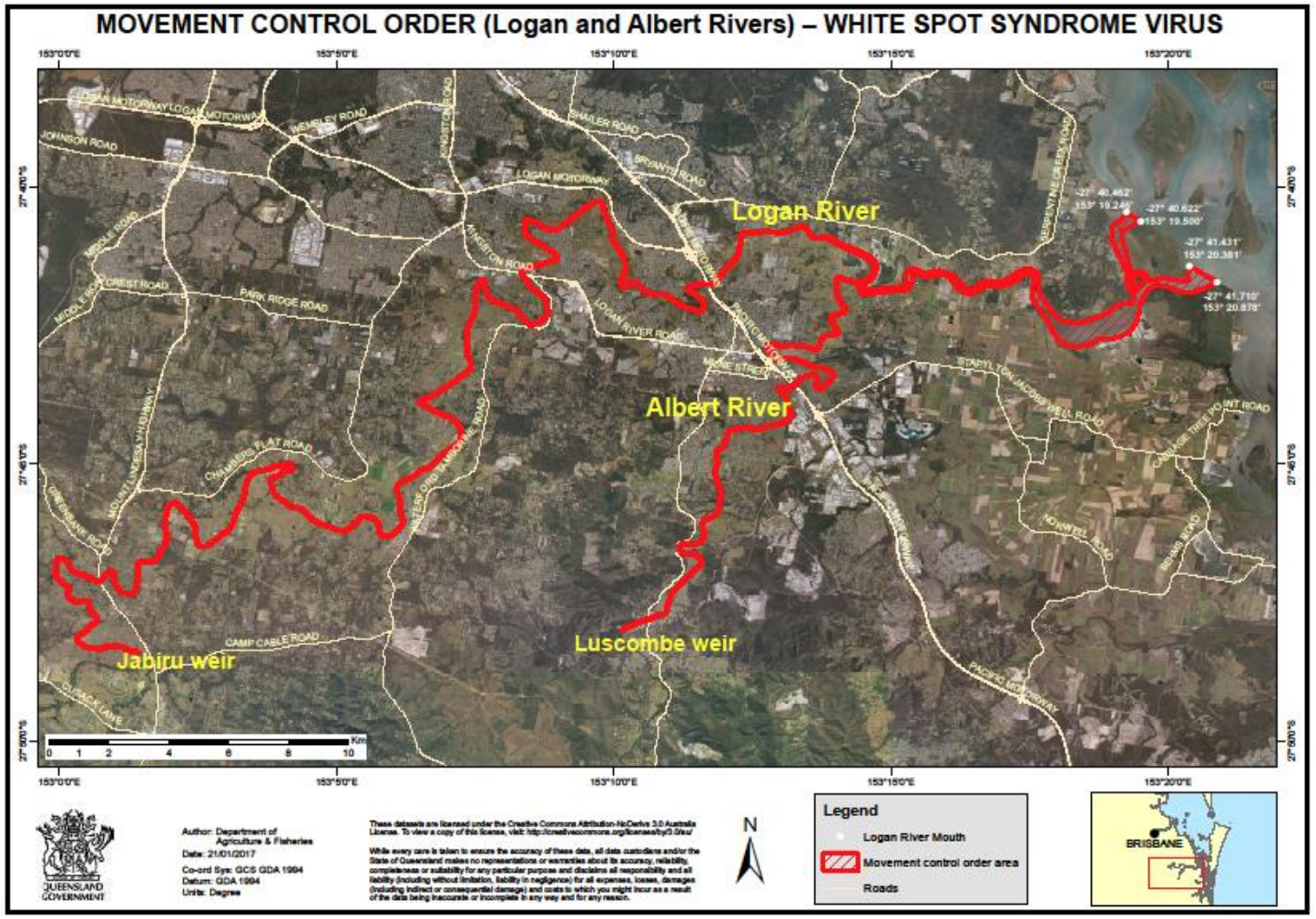
Location of affected farms.

(This map is for internal use only and must not be distributed.)



APPENDIX 2

Aerial photograph showing the location of the Movement Control Order.



APPENDIX 3

Response to White Spot Disease – Breeding for Resistance

Prepared by Dr Mathew Cook, CSIRO

Breeding for resistance to disease has been successful for a number of Aquaculture species and pathogens. At its core this involves subjecting offspring from many families to disease challenge and identifying families which demonstrate higher survival or tolerance to the disease. Providing that there is a genetic basis to the trait, which is established through assessment of heritability, genetic progress can be made through selection of families displaying high survival in presence of the disease agent. Siblings of the high tolerance families, which have been maintained without exposure to challenge, are selected and used to propagate subsequent generations to incrementally increase the overall population (sic. Breeding program) resistance to a said pathogen. Many examples of the success of such approach exist including resistance to pathogens in Atlantic salmon, prawns and molluscs. Within Australia, CSIRO has worked closely with both the Atlantic salmon breeding program and Pacific Oyster breeding programs, both of which have demonstrated success in breeding resistance to both Amoebic Gill Disease (AGD) and Pacific Oyster Mortality Syndrome (POMS). Central to the success of any efforts to breeding for resistance are the existence of a structured breeding program with adequate genetic diversity and a reliable, relevant disease challenge (either in the field or artificially created in the lab).

As of this time there is neither an industry wide or individual company lead family based breeding program for *P. monodon* in Australia. In order to breed for resistance to whitespot or any disease there needs to be a program that is well managed that uses pedigree based breeding. In order to make significant progress adequate assessments a program of sufficient numbers of half or full sib families needs to be in existence. Such a program should have the right infrastructure to enable adequate selection and identification of both individuals and families. It also needs to be run separately from commercial activities due to the different focus of activities, the scale of these activities and the non-complementarity of disease challenge trials. Two examples of such programs in Australia include the Atlantic salmon SBP run by Saltas and the Pacific oyster SBP run by ASI. Such a program could be instigated by either the APFA and/or individual companies in conjunction with an R&D partner with the required width and breadth of skills.

The accuracy of determining both heritabilities and subsequent estimated breeding values for use in selection is dependent on having a reliable phenotypic measure of the trait of interest. In the case of selection for disease resistance this may be survival, reduced pathology or decrease in treatments. Such phenotypes can be generated through natural challenge (e.g. in the case of AGD in salmon), artificial challenge or through a combination of the two (e.g. POMS in oysters). As Whitespot disease is exotic to Australia and the current focus is to eradicate it then breeding for resistance will not be able to be undertaken in the field. Similarly, the establishment of an artificial challenge would be limited to facilities that can handle exotic pathogens such as AAHL and/or EMAI. Central to this is the appropriate expertise in virology as well as challenge system development.

In summary, breeding for resistance offers a medium term solution for the Australian prawn industry and requires a systematic approach to overcome some serious challenges. It is not without risk but offers the best long term solution and is therefore should be a risk worth taking. Ideally, these activities should be entrusted to those R&D organisations with the appropriate range of skills and track record in delivering industry relevant breeding programs. Furthermore, if there was the motivation within the government at state or federal levels to help secure the appropriate resources and overcome red tape then such an approach can confidently be embarked upon. Such a program would not only target White Spot Disease

resistance but would also target other key traits of commercial relevance which would help underpin the sustainability and growth of the industry. Given our track record, range of skills and the well-developed systems and networks (within Australia and Internationally), the CSIRO Aquaculture Program is best placed to put together the appropriate project team to assist industry and government to deliver on such an undertaking.