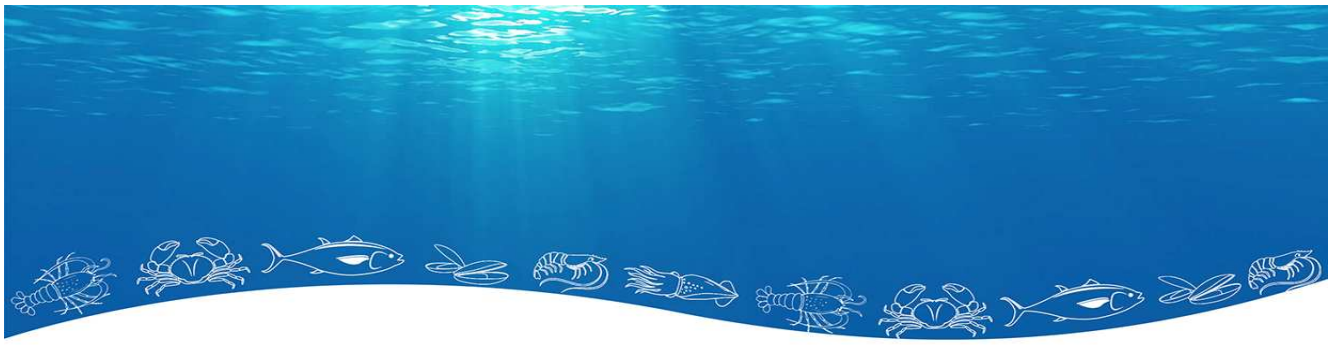

BIOSECURITY PLAN FOR THE SPANNER CRAB FISHERY

Version 1.0

March 2018

QUEENSLAND SEAFOOD INDUSTRY

BIOSECURITY PLAN

SPANNER CRAB FISHERY

Australian Government
Department of Agriculture and Water Resources

This project is supported by the Queensland Seafood Industry Association, through funding from the Australian Government through the Department of Agriculture and Water Resources.

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and

Biosecurity Queensland

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Overview

The detection of the exotic White Spot Disease in crustaceans in the Logan River and Moreton Bay in the summer of 2016/17 required an emergency biosecurity response from the Queensland State Government in order to attempt to eradicate, manage, control and prevent spread of the internationally significant White Spot Syndrome Virus (WSSV) into other regions of Queensland and Australia. This response included eradication attempts on prawn farms that were affected by the disease, and establishment of a movement control area encompassing the entire Moreton Bay region (Figure 1), from which movement of uncooked crustaceans and other WSSV hosts, carriers or unsanitised fishing equipment was prohibited. The biosecurity requirements of the White Spot Disease movement control zone highlighted how severely biosecurity related issues can impact seafood businesses in Queensland.

One of the broader outcomes of the White Spot Disease response was an undertaking funded by the Federal Government to develop a Biosecurity Plan for the Queensland Seafood Industry. The aim of this plan is to enhance the ability of Queensland's wild harvest seafood industry to prepare for, identify, mitigate the impact of and respond to future biosecurity incidents by:

- Alerting the industry about its role and responsibilities during biosecurity incidents;
- Reviewing and implementing best practice biosecurity measures within the wild harvest seafood industry; and
- Communicating with and educating stakeholders about the characteristics, prevention and management of important aquatic pests and diseases.

The educational resources developed as part of this Biosecurity Plan together form an information toolkit. In Queensland every person has a general biosecurity obligation under the Biosecurity Act and there are large penalties for non-compliance. The main aim of developing this toolkit is to improve industry biosecurity capacity to assist commercial fishers and processors to develop the necessary skills to become more aware of their general biosecurity obligations and responsibilities under the Queensland Biosecurity Act 2014, and to know what to do if they suspect the presence of a major aquatic pest or disease. The development of the toolkit includes the various resources in a total of 23 fishery-specific Biosecurity Plans, which are also published online as well as in hard copy.

The disease identification sheets in this Biosecurity Plan provide information relating to diseases that may affect the Spanner Crab Fishery, hence it only contains information on those diseases that may effect this fishery. For information on diseases that may affect other fisheries, see the relevant biosecurity plan for that fishery.

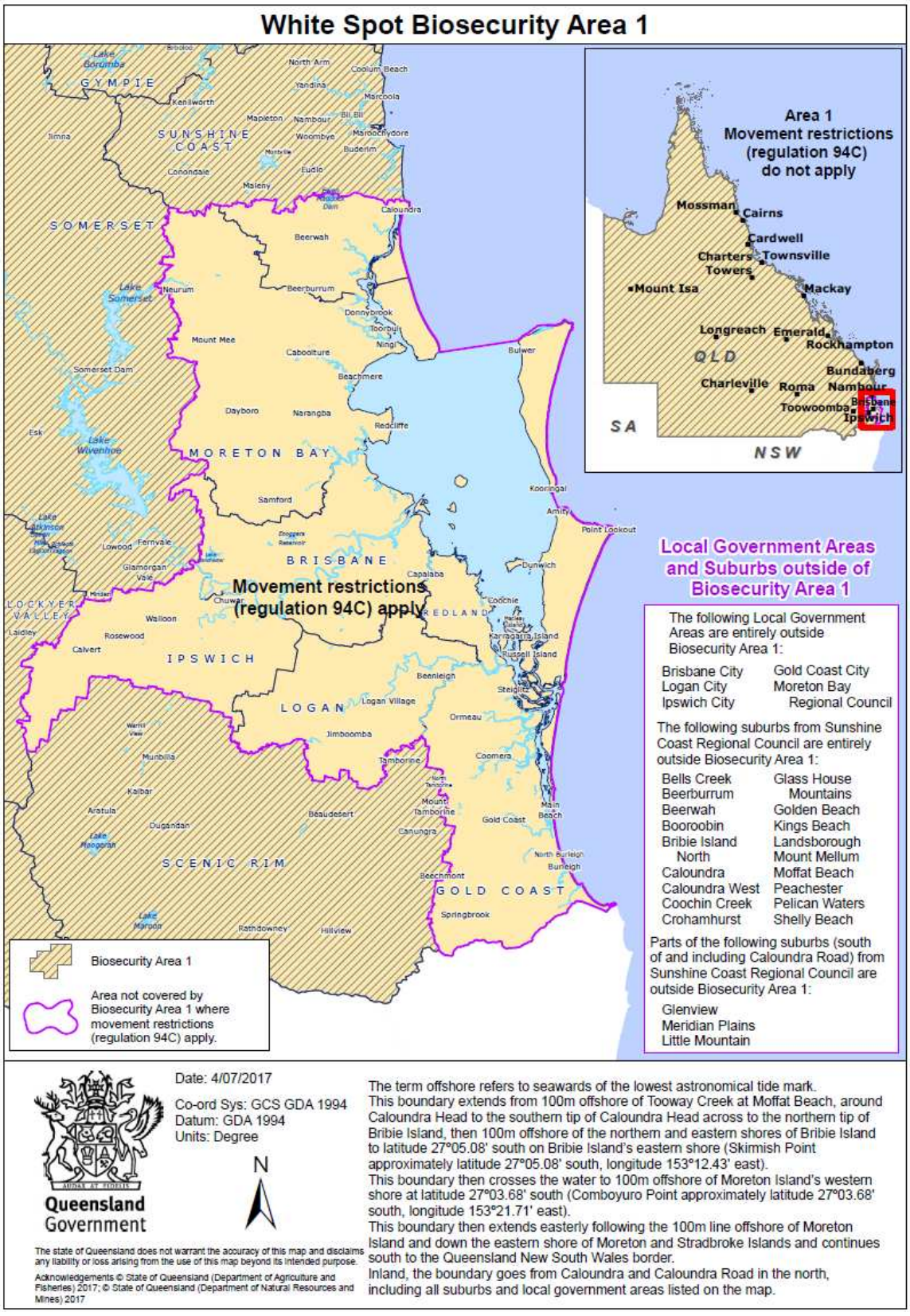


Figure 1. Movement control zone for White Spot Disease in Moreton Bay, SE QLD.

What is biosecurity ?

- Biosecurity is about prevention of the introduction and spread of diseases.
- Prevention is the ideal goal first and foremost. Unfortunately, biosecurity breaches do occur and new diseases can emerge or be introduced via various pathways.
- If a significant new or exotic disease agent is found in a new area, there are several options available to biosecurity authorities under the Queensland Biosecurity Act 2014 to attempt to manage the situation and try to minimise damage to industries and the environment.
- These options include eradication, containment and asset based protection (Figure 2).

Eradication

- If a new disease emerges or an exotic disease is introduced into a new area, the first step is to try to eradicate it to return to freedom from that disease.
- Eradication efforts may involve destruction of infected fish, shellfish or other animals that are potential hosts or carriers of an unwanted disease agent, and/or decontamination of affected fish farms, boats, processing facilities or equipment in contact with infected hosts in an attempt to eliminate or reduce the amount of viable disease agents that occur in the environment.
- The aim of eradication is to remove the disease agent from the environment altogether, or reduce the numbers of hosts or disease agents to the point where the disease can no longer effectively be transmitted to infect new hosts and 'fizzles out".
- Commercial fishers and processors will be adversely affected by eradication efforts in the short-term.
- However, the long-term benefits of returning to business as usual are much greater than the "short-term pain" involved with eradication.

Containment and Zoning

- Containment is an important part of eradication efforts and/or longer term disease management because diseases can be spread a long way very quickly by humans, much faster than they can be spread by natural movements of infected animals.
- Containment of a disease is usually undertaken by restricting the movements of animals, people and equipment from areas where the disease occurs. This is because disease agents can survive in for long periods in infected animals (whether they are diseased or not), as well as for shorter periods on the surfaces of clothing and equipment in contact with infected animals or water containing infected animals.
- Zoning arrangements are usually implemented in the affected geographic area in order to facilitate containment (Figure 1).

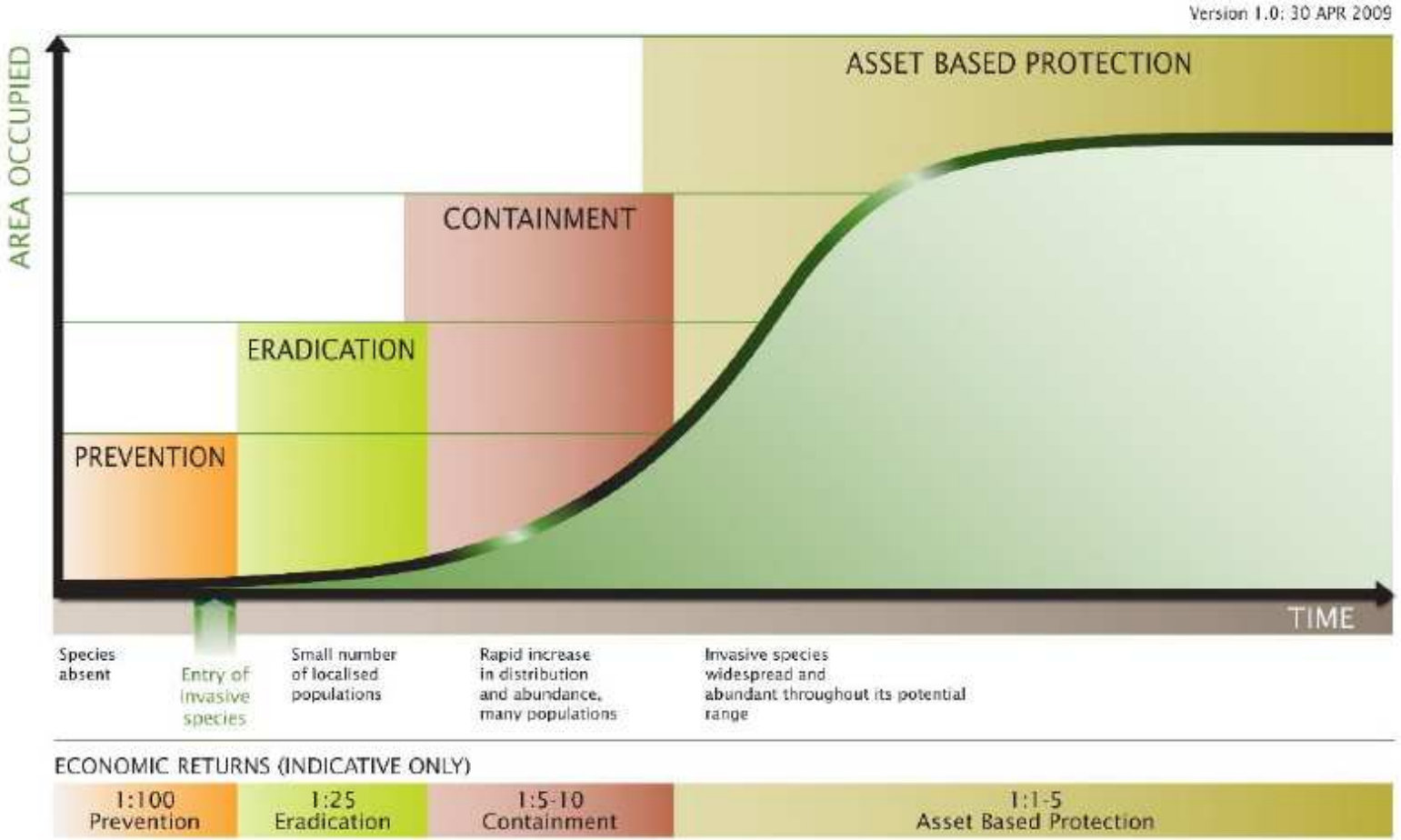


Figure 2. Biosecurity is firstly about prevention (most cost effective), but eradication and containment/zoning are also extremely important to try to limit spread of a disease once it is introduced. Diagram from Victorian Government (2010).

Different products present different biosecurity risks

The risk of translocating (moving) diseases from one place to another are not equal amongst different commodities. The relative risks are ranked as follows:

Risk profile	Product/process
Highest	Live animals
	Dead (uncooked)
	Frozen (uncooked)
	Contaminated equipment/clothing
Lowest	Cooked product

- Movements of live animals pose the greatest risk of spread of diseases.
- The second greatest risk is movement of dead (uncooked) animals, followed by frozen uncooked products.
- Diseases can also be spread on contaminated clothing, boats, vehicles and equipment.
- The lowest risk of disease spread is via movement of cooked products, as the heat from the process of cooking inactivates virtually all disease agents.

Why do I need to take biosecurity seriously?

- Our biosecurity systems are only as strong as the weakest link in the chain.
- The spread of serious, internationally significant aquatic diseases such as White Spot Disease to new areas can cause massive and permanent disruption and economic losses to fisheries and aquaculture businesses.
- Strict controls on the movement of infected animals and contaminated equipment are required to prevent rapid movement of these diseases to new areas.
- It is important that fishers and farmers abide by these containment /zoning controls. These rules are put in place with the future best interests of our primary industries in mind.
- Every person in Queensland has a general biosecurity obligation under the Queensland Biosecurity Act 2014, and there are large penalties (up to and exceeding $350,000) for non-compliance with these regulations.

Diseases of significance to the Spanner Crab Fishery

Table 1 lists the notifiable diseases that are of significance to the Spanner Crab Fishery.

Table 1. The notifiable diseases of concern that affect species captured in the Spanner Crab Fishery. Red font = exotic disease (not in Australia). Green font = occurs in Australia. *** = already occurs in Queensland.**

Spanner Crab Fishery – Target Species	Notifiable disease risks (Biosecurity Act 2014)	Other potential disease risks
Spanner crab (*Ranina ranina*)	White Spot Disease (WSD)*	*Haematodinium* spp.* Microsporidians* Shell disease*

For more information on each of these diseases, including the affected host species, see the disease information sheets on the following pages.

Learn more about diseases of fish and shellfish in your fishery

Another way to learn more about the range of diseases of aquatic animals of significance to Australia, download the **Aquatic Disease Field Guide App** that is available for iOS, android and windows devices at the following locations:

iOS - https://itunes.apple.com/au/app/aquatic-disease-field-guide/id1217061785?mt=8

Android -https://play.google.com/store/apps/details?id=au.gov.agriculture&hl=en

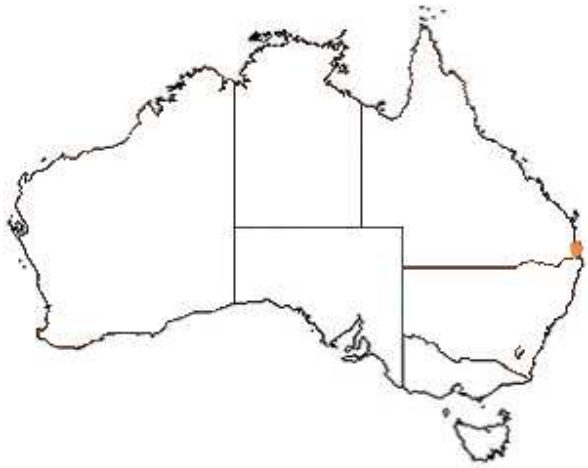
Windows - https://www.microsoft.com/en-au/store/p/aquatic-disease-field-guide/9p3vc2ww8nb2

White Spot Disease (WSD)

Disease agent: White Spot Syndrome Virus (WSSV), a virus of the genus *Whispovirus* within the family Nimaviridae.

Presence in Australia: Exotic

Presence in Queensland: South East QLD



White spot disease was confirmed in Moreton Bay in December 2016, and an emergency response to contain and attempt to eradicate the disease is ongoing.

Signs of Disease:

Crustaceans infected with this virus may exhibit the following signs:

- white spots (calcium deposits) in the carapace
- reddish tinge to tail or appendages
- unusual swimming near the water surface
- loose carapace with external fouling
- delayed or no clotting of haemolymph
- high mortalities

White Spot Disease (WSD):

Top. A farmed black tiger prawn from the Logan River, Moreton Bay with WSD.

Below. Note the numerous white calcium deposits on the cuticle of the carapace. These are classical signs of WSD, however prawns infected with the virus may not have any white spots.

Photo: Ben Diggles

Host Species affected may include:

Prawns (all) Crabs (all)
Lobsters (all) Freshwater crayfish
Bait worms (polychaetes)

Imported seafood including:
Uncooked prawns (all)
Uncooked crabs Uncooked lobsters
Uncooked crayfish

Ornamental crustaceans including:
Shrimps Crayfish

At risk fisheries in QLD may include:

Crayfish and Rock Lobster Fishery
Bait Worm Fishery
Blue Swimmer Crab Fishery
Mud Crab Fishery
Spanner Crab Fishery
East Coast Otter Trawl Fishery
River and Inshore Beam Trawl Fishery

Introduction Pathways to avoid:

Do not use imported seafood (particularly imported uncooked prawns or crabs) or ornamental crustaceans for bait or berley or release ornamental crustaceans into waterways.

Basic decontamination information:

This disease agent can be inactivated by the following treatments: Dessication (drying out for 3 hours), temperatures above 70°C for over 5 minutes , 75 mg/L benzalkonium chloride for 10 minutes, 200 mg/L chlorine for 10 minutes, 200 mg/L iodine for 10 minutes, 30% ethanol for 1 minute, UV light > 250 mJ/cm^2 or 5 mg/L/min ozone.

What to do if this disease is suspected:

If you suspect this disease is present please contact the Department of Agriculture and Fisheries (13 25 23) or the National 24 hr Emergency Animal Disease Hotline (1800 675 888) immediately.

How to collect and store samples for diagnosis:

If you are taking samples to help authorities to test for this disease, whole crustaceans should be provided alive (if possible) or chilled and on ice, or frozen.

Learn more

For more information about WSD and other diseases of aquatic animals of significance to Australia, download the **Aquatic Disease Field Guide App** available for iOS, android and windows devices at these locations:

IOS	ANDROID	WINDOWS
https://goo.gl/9UJNp9	https://goo.gl/T4Tn1X	https://goo.gl/Y8Vibj

Biosecurity Protocols for Queensland Fisheries

This section provides information on biosecurity obligations and protocols of relevance to fisheries in Queensland.

Your General Biosecurity Obligation. What to do during a disease outbreak in your fishery.

The Queensland Biosecurity Act 2014 came into effect on 1 July 2016. The new Act included introduction of a general biosecurity obligation (GBO), which requires every person to take reasonable and practical steps to prevent or minimise biosecurity risks to the economy, agricultural and tourism industries, and the environment. People do not need to know about all biosecurity risks but they are expected to know about the risks associated with their day-to-day work and hobbies.

To meet their GBO, people in Queensland need to:

- take all reasonable and practical steps to prevent or minimise each biosecurity risk
- minimise the likelihood of the risk causing a biosecurity event, and limit the consequences of such an event, and
- prevent or minimise the adverse effects the risk could have, and refrain from doing anything that might exacerbate those adverse effects.

Under the new act, everyone in Queensland needs to take an active role in managing the biosecurity risks under their control. If a person's activities are likely to pose a biosecurity risk, they are expected to know about the risks posed by what they do, and to ensure they do not spread pests, diseases or contaminants.

A biosecurity risk exists when dealing with any pest, disease or contaminant, or with something that could carry one of these. This includes moving or keeping a pest, disease or contaminant, or animals, plants, soil and equipment that could carry a pest, disease or contaminant. A biosecurity event is caused by a pest, disease or contaminant that is, or is likely to become, a significant problem for human or animal health, social amenity, the economy or the environment of Queensland.

Reporting a suspected notifiable disease

If you suspect one of the diseases listed in this document is present in your fishery or processing facility, please contact the Department of Agriculture and Fisheries (13 25 23) or the National 24 hr Emergency Animal Disease Hotline (1800 675 888) immediately.

Collecting samples for diagnosis

Fishers and processors are often in the best position to provide high quality samples to authorities to help them identify if a significant disease is present in a fishery. However, due to the uncertainty of identifying any particular disease based on visual signs (i.e. the appearance of the infected animal), diagnosis of diseases requires collecting samples and sending them to specialist laboratories for further analysis. Because some diseases of aquatic animals can also pose a risk to human health, people are advised to call the Department of Agriculture and

Fisheries (13 25 23) or the National 24 hr Emergency Animal Disease Hotline (1800 675 888) first to obtain advice. In some cases, the relevant State or Territory agency taking your call will put you in contact with fisheries or veterinary authorities who will be able to provide advice on what is required to ensure the correct samples are taken without endangering the health of the person taking samples.

In general, if you are taking samples to help authorities to test for diseases of concern, whole fish or shellfish should be provided alive (if possible) so that a full range of tests can be applied. If this is not possible the next best samples are usually chilled on ice (but not frozen). Some testing procedures require fixation of samples in special fixatives (e.g. ethanol, formalin) and if these are required, Biosecurity QLD or Department of Agriculture and Fisheries staff may advise of these requirements. For more information, see "Submitting samples to the Biosecurity Sciences Laboratory" on the internet at https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/land-management/health-pests-weeds-diseases/sample-testing/submitting or email bslclo@daf.qld.gov.au.

Zoning and compartmentalisation - how it could affect your business

If an important disease is introduced or emerges in a new region, zoning arrangements are likely to be implemented in order to try to contain the disease within a certain geographic area. Zoning is a tool used for trade facilitation and as a disease management tool. A zone is defined by geographical separation of different countries or parts of a country (Figures 1, 3). For example, in the case of the White Spot Disease incursion into Moreton Bay, the zone chosen to delimit the disease was a geographic area where infected animals were known to be present or likely to be present, which incorporated the entire Moreton Bay region and its river catchments because the disease can effect hosts in both freshwater and marine areas (Figure 1).

Disease surveillance is then used to determine the extent of the incursion and help facilitate trade in the regions outside the affected zone. Surveillance is also undertaken within the infected zone in order to monitor the extent of disease spread. Under international rules, if a properly designed surveillance program does not detect the disease agent of concern within a zone over a period of 2 years, the zone can be declared free of the disease for the purposes of trade.

A similar concept to zoning is compartmentalisation, however unlike a zone which is defined by geographical separation, a compartment is defined by strict adherence to a clearly defined biosecurity management system within a distinct population of animals held isolated within an infected zone (Figure 3). Individual farms, processing facilities or holding facilities can qualify as compartments if they have effective biosecurity plans in place and 2 years of surveillance that demonstrates freedom from the prescribed disease(s) of concern. Both zoning and compartmentalisation are used for trade facilitation and as disease management tools.

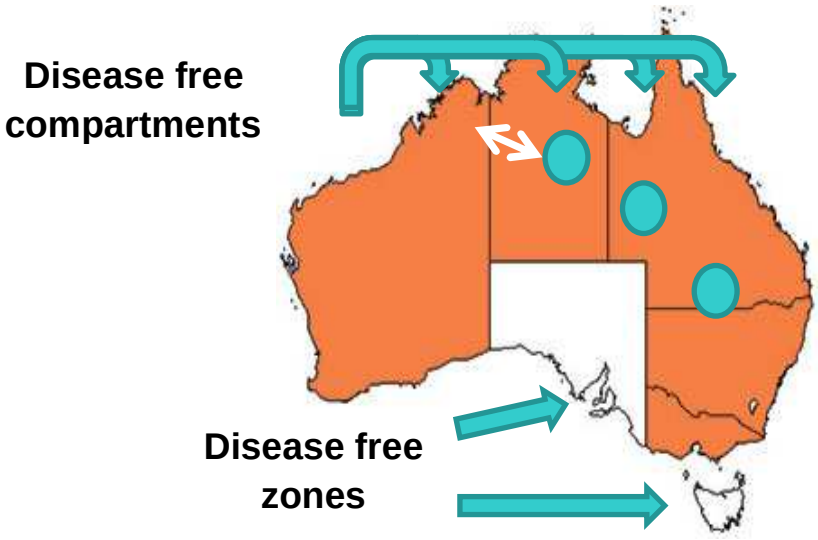


Figure 3. Diagram depicting disease free zones (white areas, SA and TAS) within a country with infected geographical zones (WA, NT, QLD, NSW, VIC) for a hypothetical disease agent. The green circles show disease free compartments that can be established within infected zones. Graphics courtesy of Federal Department of Agriculture and Water Resources.

Decontamination of equipment

To prevent accidental movement of diseases from infected zones or compartments, it is important that fishing, crabbing and trawl equipment is clean and disinfected before leaving movement control areas.

Desiccation (drying out) is an effective method of decontaminating used equipment, and most pathogens are inactivated by drying out for 5 to 7 days (please refer to Table 2 (page 18) or the information sheets for each disease agent for specific details). However, in some circumstances fishers may need to leave a movement control zone and not have the opportunity to completely dry out their boats or equipment. In these cases, sanitising agents need to be used to disinfect boats or equipment to inactivate any disease agents that may be present.

Certain types of sanitising detergents are ideal for disinfecting fishing, crabbing and trawl equipment that may have been in contact with diseased hosts. Detergents such as benzalkonium chloride are often preferred compared to hypochlorite (e.g. chlorine), iodophore (e.g. iodine), or aldehyde (e.g. formalin) based chemicals as they destroy some pathogens at relatively low concentrations, are biodegradable (less toxic to the environment), and are readily available in bulk (see Table 1, page 17). However, the effectiveness of a given chemical will vary depending on the type of disease agent being treated - some disease agents are more sensitive to certain chemicals because the structure of the disease agent is more sensitive to the mode of action of the chemical. The type of sanitising agent and its relevant concentration will therefore vary depending on the identity of the disease of concern (Table 2). For more information, readers are referred to the relevant disease identification sheets in the fishery-specific biosecurity plans, or the Aquavetplan decontamination manual (available at http://www.agriculture.gov.au/animal/aquatic/aquavetplan/decontamination).

Decontamination procedures

1. Use a high-pressure or high-volume hose to remove solids and organic matter from equipment, such as nets, crab pots and boat decks. The water used for washing down or soaking equipment can be either freshwater or seawater.

    a. For land based decontamination this should be done in a nominated wash down area

    b. For vessels at sea simply wash back into the water

2. After cleaning, apply the diluted detergent/sanitising agent to all surfaces for the prescribed time using a broom, sponge or scrubbing brush. Leave the detergent/sanitising agent in contact with the equipment for the prescribed time period. Items such as small nets may be easier to submerge into a bucket or large vat filled with the sanitising agent.

3. After the prescribed contact period has elapsed, rinse thoroughly with clean water. Follow the instructions on the label for directions for proper disposal of chemical sanitising agents.

Mixing your sanitising agent

Various chemical sanitising agents are purchased in concentrated form and need to be diluted prior to use. The manufacturers recommended dilutions may be used for some applications, however many disease agents will require different concentrations to those shown on the label. Usually the concentration of a chemical is expressed as milligrams of active ingredient per litre (mg/L, which is the same as parts per million (ppm)).

If a chemical is provided as 100% active ingredient, the concentration used in mg/L is easily worked out as follows: 1 ml of chemical in 10 litres of water = 100 mg/L

Other common dilutions for a 100% active ingredient chemical are as follows		
10 mg/L = 0.1 ml in 10 L	100 mg/L = 1 ml in 10 L	250 mg/L = 2.5 ml in 10 L
50 mg/L = 0.5 ml in 10 L	200 mg/L = 2 ml in 10 L	500 mg/L = 5 ml in 10 L

Many chemicals are purchased already diluted such that their concentration of active ingredient is less than 100%. These usually need to be further diluted to the final concentration, which can be calculated as follows:

Minimum quantity of product (ml) added to 10 Litres of water:

target mg/L = target ÷ (% active ingredient in product) = ml added

100 mg/L = 100 ÷ (% active ingredient in product) = ml added

Worked examples

Table 1 (page 17) contains the calculations required to dilute a range of commercially available sanitising products to provide a minimum 75 mg/L dose of a detergent (benzalkonium chloride) for use to inactivate White Spot Syndrome Virus (WSSV) on boats and fishing equipment.

Other products containing benzalkonium chloride (BC) can be used provided they are applied as follows:

Minimum quantity of product added to 10 L of water = 75 ÷ (% active BC ingredient in product)

Minimum quantity of product added to 100 L of water = 750 ÷ (% active BC ingredient in product)

Example1: Product X contains 10% benzalkonium chloride.

I want to make up a solution of 10 litres of 75 mg/L benzalkonium chloride.

Target 75 mg/L = 75 ÷ 10 (% active) = 7.5 ml of Product X into 10 L of water

Example 2: Product Y contains 2.5% iodine active ingredient.

I want to make up a solution of 20 litres of 100 mg/L iodine for sanitising a crab pot.

Target 100 mg/L = 100 ÷ 2.5 (% active) = 40 ml of Product Y into 10 L of water

for 20 L (instead of 10L) x 2 = 80 ml of Product Y into 20 L of water.

Table 2 (Page 18) summarises the concentrations of various different sanitizing agents used for decontaminating the various disease agents which are listed in the disease information sheets contained in the fishery specific biosecurity plans.

Table 1. Available benzalkonium chloride sanitisers for inactivating White Spot Syndrome Virus *.

Benzalkonium Chloride Product	(%) active	Min. amount* in 10L**	Min. amount* in 100L**	Manufacturer /Importer	Distributors	Approximate Price
Barquat DM-50	50%	1.5 ml	15 ml	Lonza Water Treatment www.lonzawatertreatment.com.au, Ph. 03 9417 2428	ordersaustralia.water@lonza.com	
Redox Quaternary Ammonium Compound	50%	1.5 ml	15 ml	Redox Pty Ltd Ph. 07 3268 1555 www.redox.com, john.Hornby@redox.com	Redox Brisbane 776 Boundary Road Richlands QLD 4077	$900 / 200L
Form Quat	20-30%	2.5 - 3.75 ml	25 - 37.5 ml	Formula Chemicals Ltd www.formulachemicals.com.au Ph 02 98074266	www.generalsanitation.com.au	
Phytoclean	10%	7.5 ml	75 ml	Phytoclean Pty Ltd Ph. 0412 885 556 http://www.phytoclean.com.au/	Fernland Agencies Yandina QLD 4561 Ph:1800672794	$75 / 5L, $200 / 20L, $1450 / 200L
Quat Sanitiser	5%	15 ml	150 ml	Mountain Cleaning www.mountaincleaning.com.au Ph 02 6622 8733		
Septone Spice Septone Forest Pine	3%	25 ml	250 ml	Septone Ph. 1800 177 989 www.septone.com.au	Signet.net.au Blackwoods Cleaningshop.com.au	$20-25 / 5L $75-100 / 25L
Disinfectant, General CMCP298	2%	37.5 ml	375 ml	www.livingstone.com.au Ph. 02 83447300	www.livingstone.com.au	$16 / 5L $37 / 25L

* inactivation of WSSV requires a minimum of 75 mg/L of benzalkonium chloride in water for 10 minutes.

** can use either freshwater or seawater

Table 2. Decontamination summary table

Finfish Diseases	Drying out	Heat	UV mj/cm^2	Ozone mg/L/min	Chlorine (mg/L)	Ethanol	Iodine (mg/L)	Formalin	Benzalkonium chloride (mg/L)	Sodium hydroxide	Virkon S
Channel Catfish Virus	>2 days	>60°C 1 hr	>0.2		540/ 30min		250/ 30min			>6 hr pH >12	
Grouper Iridoviral Disease	>200 d				200/ 2 hrs	70%/ 2hr		200mg/L 2h			1%/ 1min
IPN	✓	>80°C 10min	>250	0.5	50/ 30min		10/ 2.5min	2%/ 5min		20min pH>12	1%/ 10min
ISKNV-like viruses	✓	>50°C 30min	5		200/ 30min					30min pH>11	
Red Sea Bream Iridovirus	✓	>56°C 30min	5		200/ 30min					30min pH>11	
VER	>7 days	>60°C 30min	>200	0.5	100/ 5min		100/ 30min	0.2%/ 6hrs	50/ 10min	>24 h pH>12	
VHS	>10 d	>50°C 10min	>10		50/ 1min	40%/ 2min	100/ 10min		125/ 5min	>2hr pH>12.2	0.1%/15min
Aeromonas salmonicida – atypical	✓	>50°C 2min	>6	0.5	2/ 1min		2.6/ 5min		300/ 2min		0.5%/10min
Bacterial Kidney Disease	✓	>65°C 15min	>20		10/ 1min		25/ 5min			>6 hr pH >12	1%/ 10min
Enteric Septicaemia of Catfish***	✓	>60°C 1 hr	>5		50/ 1min	30%/1min	50/ 1min			>6 hr pH >12	
ERM – Hagerman Strain	✓	>75°C 1min	>5	0.7	250/ 2 hrs		25/ 15sec			>5 hr pH>12	1%/ 10min
EUS***	✓		>210		100/ 5min		100/ 5min				
Furunculosis	✓	>60°C 1 hr	>6	0.5	2/ 1min		2.6/ 5min		300/ 2min	10min pH>12	0.5%/10min
Crustacean Diseases											
Infectious Myonecrosis	✓	100°C >1min									
Monodon slow growth syndrome	✓	100°C >1min									
Taura Syndrome	✓	100°C >1min									
White Spot Disease	>3 hrs	>70°C 5 min	>250	5	200/ 10 min	30%/1min	200/10 min		75/ 10 min	25min pH>12	
Yellowhead Virus (YHV1)	✓	>60°C 15min		0.5	30/ 60 min						
AHPND	✓	>60°C 1min	>5	1.9	250/ 30 min		25/ 2 min				1% 10min
Milky Haemolymph Disease	✓	>60°C 5min						3.5%/20min			
Necrotising hepatopancreatitis	✓	>60°C 5min						3.5%/20min			
Enterocytozoon hepatopenaei	✓	100°C >3min			25/ 10 min	70%/10min					
Mollusc Diseases											
Acute viral necrosis of scallops	>7 days	>50°C 5min					1000/5min	10%/30min	800/ 10 min	20g/L 10min	1% 15min
Iridoviruses	✓										
OsHV-1µVar (POMS)	>7 days	>60°C 10min					1000/5min	10%/30min	800/ 10 min	20g/L 10min	1% 15min
Bonamia ostreae, *Bonamia* spp.*	✓	>60°C 15min									
Marteilia refringens	✓				200/4 hrs						
Marteilioides chungmuensis	✓										
*Mikrocytos mackini**	✓	>60°C 15min									
*Perkinsus marinus***	>7 days	>60°C 1 hr	28		300/30 min						
Perkinsus olseni	>7 days	>60°C 1 hr	240		300/30 min						
QX Disease	✓				200/4 hrs						
Winter Mortality*	✓	>60°C 15min									
Akoya Oyster Disease											
Oyster Oedema Disease											

✓ = likely to be effective, but duration not recorded, * = also 10-50 mg/L (0.001-0.005%) acetic acid (vinegar), ** = also freshwater for 30 min, *** = also >3-4 ppt salt.