



Biosecurity Control Measures for Abalone Viral Ganglioneuritis

A Code of Practice

February 2009

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Preferred way to cite this publication:

Gavine, F. M., Ingram, B. A., Hardy-Smith, P., and Doroudi, M. (2009). Biosecurity Control Measures for Abalone Viral Ganglioneuritis: A Code of Practice. Prepared as part of FRDC Project No. 2006/243.

ISSN 1329-7287

ISBN 978-1-74217-389-4

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Introduction

This Code of Practice has been developed to standardise and improve the biosecurity measures currently in place in the Victorian abalone industry. It was developed in consultation with industry as part of the FRDC Project “*Development of management strategies for herpes-like infection of abalone*” Project No. 2006/243. This Code of Practice is not a regulatory tool and as such does not stipulate minimum standards for compliance. Rather, it aims to minimise the risk of outbreaks and spread of abalone viral ganglioneuritis through implementing standard operating procedures (SOPs) in the following industry sectors:

- commercial harvesting operations,
- recreational divers and fishermen,
- aquaculture farms, and
- processors.

Abalone viral ganglioneuritis (formerly known as abalone herpes-like virus or ganglioneuritis) first appeared in southern Victoria in late 2005. It had never been recorded in Australia before. The disease can have a devastating impact on both wild and farmed abalone populations and it is therefore important that appropriate control measures are in place to minimise the impact of an outbreak.

Once abalone viral ganglioneuritis was identified as the cause of the disease outbreak, it was declared a notifiable disease under the *Diseases of Livestock Act*, 1994. Abalone aquaculture farms affected by the virus voluntarily stopped the movement of stock to other farms. The farms were subsequently de-stocked and the facilities decontaminated.

Although the source of the virus is unknown, early investigations concluded that the most likely source was live wild abalone brought onto a Victorian abalone farm (Hardy-Smith, 2006). Once clinical signs of the disease are expressed significant mortalities occur.

When the virus appeared in the marine environment in May 2006, the Victorian Department of Primary Industries (DPI) took steps to restrict entry into marine areas known to be infected with the virus. Initially, the area around Port Fairy in south-west Victoria was declared a Control Area and fishing and diving activities were restricted. The aim was to minimise the risk of human activity transferring the disease to unaffected abalone populations elsewhere in the State. To protect vulnerable stocks, the Control Area was replaced by a Fisheries Notice enforced by the *Fisheries Act* 1995 which extended the restricted area. The Fisheries Notice specifically prohibited:

- taking of abalone, other shellfish and sea urchins,
- use of commercial abalone fishing equipment, and
- collection of any substrate.

Since abalone viral ganglioneuritis is a newly identified disease very little is currently known about either the disease or its causative agent. This obviously places limitations on our understanding of the virus and effective methods of eliminating it. Initial studies conducted at the Aquatic Animal Health Laboratory (AAHL) in Geelong have shown that the virus is virulent and transmissible through the water column and direct contact with diseased abalone.

In September 2006, a panel of International and Australian experts on aquatic animal diseases were brought together by the Victorian Department of Primary Industries (DPI) and abalone industry groups in a separate process to this project. These experts considered the existing evidence and identified the following key knowledge gaps on the virus.

- **Origin:** It is not known whether the virus is exotic or endemic to Australian waters, but experts suspect that it is endemic as no probable linkages with an exotic source have been identified.

- **Range:** If the virus is endemic, it is not known whether the outbreak is localised (as a result of translocating infected animals) or the virus is widespread, but reached a critical dose when concentrated on the farm. Pre-clinical diagnostic techniques (*e.g.* PCR) must be developed before the distribution of the virus in Australian waters can be determined.
- **Mode of action:** Very little is known about how this virus infects abalone, what the infectious dose is, how long it survives outside of the host (including the water column) and if healthy abalone can carry the virus without showing symptoms.
- **Characterisation of the virus:** The virus has not been fully characterised. Key information on the types of cell infected is limited. It is suspected that mucous cells can carry the virus, but it is not known how important mucus and physical strands of decaying tissue are in disease transmission.
- **Other species affected:** It is known that the virus affects blacklip (*Haliotis rubra*) and greenlip (*H. laevis*) abalone and their hybrids. It is not known if the virus or vector is specific to abalone, if the virus infects other species or if other species act as carriers.
- **Deactivation of the virus:** Abalone viral ganglioneuritis belongs to a group of viruses that have a lipid envelope and are of intermediate to large size. This type of virus should not be difficult to destroy as the lipid envelope should be sensitive to many compounds including soaps, detergents and disinfectants. The only method currently available to conduct research on which compounds are most effective against this virus are *in-vivo* bioassays using live abalone.
- There are currently no abalone “cell lines” available that can be used to determine to what degree various compounds inactivate the virus.
- **Thermal tolerance.** The thermal tolerance range of the virus is unknown although it is known to survive freezing to –80°C (M. Lancaster, pers. comm.), similar to other herpes viruses.
- **Mechanism of the disease.** Once an animal is infected the disease can spread rapidly, particularly if there are dense populations of abalone. It is not known whether the rapid time frame is determined by rapid multiplication or an expression of some other response.

This Code of Practice has been developed to identify the key activities that should be undertaken by commercial harvesters, recreational divers and fishermen, aquaculture farms and processors to improve the biosecurity of their current operational procedures with respect to abalone viral ganglioneuritis. It recognises the key knowledge gaps described above. SOPs have been developed for each of the sectors using the outcomes of a risk assessment workshop that identified and prioritised key issues (see Gavine, *et al.* 2008). The control measures developed to address the identified issues form the basis of the SOPs.

Definitions

| | |
|-----------------------|--|
| AA | Approved Arrangement. Approved quality assurance program that processors must have to meet AQIS regulatory requirements. |
| AFAL | Abalone Fishery Access Licence (DNRE, 2002). |
| Approved veterinarian | A qualified and experienced aquatic health veterinarian approved by DPI. |
| AQIS | Australian Quarantine Inspection Service (Federal Government Department). |
| Batch certification | <p>A declaration that there has been no notifiable diseases or unexplained disease outbreak for the past 24 months (Anon, 2007). A certificate of stock health can be issued by an approved veterinarian. This will certify that a consignment is free from notifiable disease based on the following.</p> <ul style="list-style-type: none"> • A visit to the premises by the veterinarian to inspect the health status of the stock for the presence of clinically abnormal abalone and a review of relevant farm records and farm biosecurity. • Pathological examination of abalone that enables, at the 95% confidence level, certification that a notifiable disease is not present in the population of abalone tested, based on an assumed pathogen prevalence of 2% or above. This should occur where there has been no previous pathological testing of abalone. Abalone for this sampling must be collected by the approved veterinarian at the time of the visit to the premises. Bias in the sampling should be made towards animals showing clinical signs of disease or showing signs of weakness when handled. For a single batch test, the sample numbers required for these default values (<i>i.e.</i> 95% confidence, 2% prevalence) are provided in (OIE, 2006), <i>i.e.</i> 150 animals for these parameters. However, this assumes that the test used has 100% sensitivity and specificity. • Historical pathological testing of populations can be used as supportive evidence for certifying freedom from disease of abalone. The approved veterinarian may elect to reduce the number of abalone sampled for pathological testing at the time of the visit based on the assessment of the historical information. Such a reduction in number is acceptable provided that the resulting level of confidence for freedom of notifiable disease in the abalone population is at least equivalent to the level of confidence provided by the single batch test default values. If a reduction of sample size occurs, appropriate justification, based on scientific grounds, must be provided in the veterinarian's certificate of stock health. • For animals to be translocated from interstate, a certificate of stock health is required from a Competent Authority. In addition, a statement of compliance must be completed that explains the steps taken by the site to eliminate non-endemic abalone species from the consignment. |
| Cell Lines | Species-specific cells grown up in a laboratory. If viable virus is present in a solution that is added to a layer of cells sensitive to that virus then the virus can multiply within the cell(s) leading to death of the cell(s). This causes an identifiable change in the cell layer which can be observed under a microscope. |
| Competent Authority | An individual or organisation with the responsibility and competence for ensuring or supervising the implementation of the aquatic animal health measures recommended in the International Aquatic Animal Health Code (OIE, 2006). For Australia, this is the Department of Agriculture, Fisheries and Forestry. |
| Decontamination | To make an object or area safe for unprotected personnel (animals) by rendering chemical or biological agents harmless (OIE, 2006). |

| | |
|--------------|--|
| Detergents | A cleansing agent or a preparation containing a cleansing agent, which may be useful for medical purposes and may also possess antibacterial activity ¹ . |
| Disinfectant | Chemical compounds capable of destroying pathogenic microorganisms or inhibiting their growth or survival ability. |
| Disinfection | The application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of diseases of aquatic animals, including zoonoses; this applies to aquaculture establishments (<i>i.e.</i> hatcheries, fish farms, oyster farms, shrimp farms, nurseries, <i>etc.</i>), vehicles, vessels and different equipment/objects that may have been directly or indirectly contaminated. |
| HACCP plan | Hazard Analysis and Critical Control Point. An Internationally recognised system to manage food safety. |
| IVR | Integrated Voice Response System. |
| Non-endemic | Species that are not native to the jurisdiction to which they are being translocated. |
| PCR | Polymerase Chain Reaction – a diagnostic test that makes multiple copies of a specific sequence of nucleic acid. |
| PPB | Port Phillip Bay. |
| Quarantine | The holding or rearing of animals under conditions which prevent their escape or the escape of organisms and potential disease agents infecting or associated with them into the natural environment. |
| QRP | Quota Reference Points (DNRE, 2002). |
| SOPs | Standard Operating Procedures. |
| TAC | Total Allowable Catch. |

¹ Blakistons Pocket Medical Dictionary Fourth Edition

Code of Practice for the Wild Harvest Sector

Background

Commercial abalone harvesting operations in Victoria are managed under the *Fisheries Act*, 1995 in line with the Victorian Abalone Fishery Management Plan (DNRE, 2002). The fishery is predominantly blacklip abalone (*H. rubra*), with a small greenlip abalone (*H. laevigata*) fishery in the western zone.

The Victorian wild harvest sector has an annual value of \$50–60 million (Table 1) most of which is exported.

Table 1: Abalone production in Victoria (Anon, 2006).

| Year | Weight (tonnes) | Value (\$'000) |
|-------|-----------------|----------------|
| 02/03 | 1,281 | 53,658 |
| 03/04 | 1,463 | 46,549 |
| 04/05 | 1,491 | 60,181 |
| 05/06 | 1,217 | 49,735 |

The wild harvest sector employs over 250 people directly and many more indirectly in support industries.

The fishery is closely monitored through catch trends, population surveys and modelling. The fishery is intensively managed through gear restrictions, closures, legal minimum lengths, zonation of the fishery (Figure 1), limited access and catch quotas. Abalone are harvested by divers operating under an Abalone Fishery Access Licences (AFAL) which are exclusive to the zone for which they are issued and only one diver can be time nominated on a licence at a time. There are currently 71 licensed divers in Victoria (Anon, 2006).

Divers use a chisel-like, iron bar to prise the abalone from the rocks. The divers can stay under water for long periods by using hookah gear (air supplied through an air-hose connected to an air compressor on the support vessel). The abalone are transported to shore in sealed bins and subsequently transported to a processor that holds a Fish Receivers (Abalone) Licence.

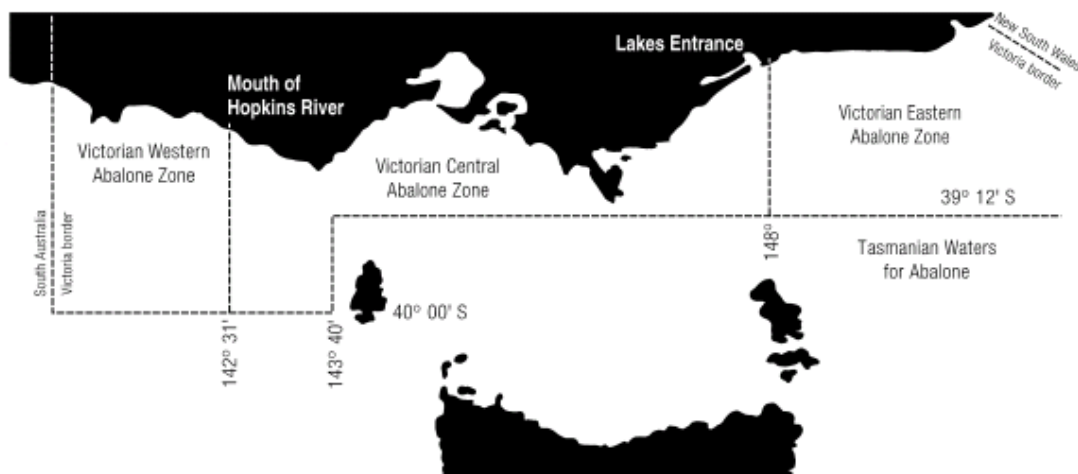


Figure 1: Management zones for the commercial harvest of abalone in Victoria (DNRE, 2002).

The movement of landed abalone is carefully tracked in Victoria to ensure that the Total Allowable Catch (TAC) is not exceeded. Within one hour of landing, the diver must register his catch through Fisheries Victoria's Integrated Voice Response (IVR) system. The diver must provide his ID number, total weight of the catch and reef code where they were harvested. The consignment is then assigned a code which is used to track the abalone through the supply chain. Apart from monitoring compliance with the TAC, this information is fed into a website to provide real-time information for divers on the catch history of individual reefs in the current season and past seasons.

Abalone divers can only offload their catch to a licensed abalone receiver. On receipt of the abalone, the processor or holding facility must access the IVR to get a confirmation number. The consignment must be left sealed for 1 hour so that it can be inspected by Fisheries Victoria, if required.

Risks and control measures for the wild harvest sector

The risk assessment process identified three major areas that had to be addressed by the wild harvest sector.

- Movement of contaminated equipment and personnel.
- The ability of divers to recognise animals showing clinical signs of disease.
- Compliance with the appropriate biosecurity protocols where there was contact with other industry sectors, *e.g.* aquaculture farms, processors and recreational diving.

Standard Operating Procedures for the Wild Harvest Sector

1. Identification and reporting of abalone viral ganglioneuritis

This protocol provides basic information for commercial fishermen and divers on how to identify and report the signs of abalone viral ganglioneuritis in abalone.

1.1 Identification of infected abalone

Abalone viral ganglioneuritis causes damage to the nerve tissues of abalone (the ganglia) and results in paralysis and death in most cases.

The virus seems to occur most often where there are dense populations of abalone, but other stress factors such as high water temperatures, spawning or the presence of other disease agents may pre-dispose abalone to becoming infected or showing clinical signs of the disease.

Infected abalone are lethargic and may have enlarged mouth-parts and a curled foot (see Appendix I). The presence of enlarged mouthparts alone is not sufficient to diagnose abalone viral ganglioneuritis (not always present in infected abalone); it is only an indicator of suspected infection. When clinically affected by the virus, the abalone are weak and easily removed from or they fall off the substrate.

1.2 Reporting and preserving samples for diagnosis

If commercial divers encounter abalone that they suspect may be infected with the virus they should take the following action.

1. Collect a sample of the suspect abalone and immediately cease fishing.
2. Place the sample in a sealed plastic bag, add oxygen if available, label and keep on ice (if possible).
3. Call the Disease Watch Hotline (Telephone 1800 675 888) and provide the following information.
 - Diver contact details.
 - Reef code and description of the area where the abalone was found (GPS co-ordinates and depth of water).
 - Basis for suspecting disease (clinical signs, number of dead or dying abalone).
4. A DPI Officer will be in contact to collect the sample, as appropriate.
5. The Diagnostic Laboratory at DPI Attwood (475–485 Mickleham Road, Attwood) prefers to receive chilled, live moribund abalone. If delivery time is more than a few hours, abalone should be fixed with 10% seawater formalin. Alternatively, frozen abalone will be accepted.

2. Decontamination procedures

This protocol describes the decontamination process for equipment and other resources used in the commercial harvesting of abalone. Items that should be de-contaminated under this protocol, include the following.

- Boats, including hulls and decks, anchors, anchor lines and mooring lines.

- Divers, diving equipment including wetsuits, fins, masks, buoyancy devices, hookah gear and other abalone harvesting equipment (especially baskets, nets and knives *etc.*).
- Transport vehicles and boxes.
- Personnel (other than divers).

This protocol also applies to individuals or organisations undertaking research or surveillance studies of wild abalone.

For more detailed information on decontamination processes, Ellard, (2006) and OIE, (2006) should be consulted.

Appropriate cleaning agents

Both detergents and disinfectants can be used in the decontamination process.

Detergents are normally a complex mixture of compounds that help to remove and disperse dirt. Detergents should be used for the removal of gross fouling and organic matter. The class of virus that causes abalone viral ganglioneuritis are susceptible to soaps, detergents and disinfectants. At a minimum all equipment should be washed with detergent. The following detergents are suitable.

- **Boats.** Detergents used for washing trucks or specifically designed for cleaning boats are available from a number of suppliers. These compounds are not classified as hazardous and are normally bio-degradable.
- **Wetsuits and other diving equipment.** Specialised wetsuit wash preparations are available, but a mild liquid soap or shampoo may also be used.
- **Baskets and nets.** Any of the above detergents should be suitable for soaking equipment.
- **People.** Soaps should be used to wash hands and laundry detergents to wash clothes.

To ensure the virus is killed or inactivated disinfectants should be used. Based on their efficacy against other aquatic disease agents, suitable disinfectants include (Ellard, 2006):

- iodine-based disinfectants; and
- chlorine-based disinfectants.

The efficacy of the disinfection process is affected by various factors including temperature, pH and the presence of organic matter (OIE, 2006). Although the efficacy of specific disinfectants against abalone viral ganglioneuritis has not been evaluated, disinfection is likely to be highly effective against the virus.

The manufacturer's instructions for the safe use of chemicals will be specified in the Material Safety Data Sheets for the chemicals. These should be requested when the product is purchased.

2.1 Decontamination of vessels

All commercial abalone dive vessels currently operating in Victoria are removed from the water at the end of each day. However, vessels in other jurisdictions or used for other purposes (research or surveillance) may remain in the water. The decontamination protocol for vessels that are removed from the water will be different from those that remain in the water.

Commercial vessels will not be routinely entering areas that are known or suspected to be infected with abalone viral ganglioneuritis, but research or surveillance vessels may deliberately enter these areas. It is possible that commercial vessels could encounter diseased abalone during their routine operations. With this in mind three protocols have been developed.

- General protocol for vessels removed from the water.
- General protocol for vessels remaining in the water.
- Protocol for vessels exposed to abalone viral ganglioneuritis.

2.1.1 General Protocol for Vessels Removed from the Water

This protocol applies under normal operating conditions where the boat has not been operating in areas recently known to have been, or suspected to be, infected with abalone viral ganglioneuritis.

1. Prior to leaving port all gross fouling and organic matter should be removed from the hull of the vessel. The hull of the vessel should be cleaned after each trip with freshwater and kept free of organic matter and marine organisms.
2. Decks, diving equipment and other equipment should be hosed down with freshwater, washed with disinfectant, rinsed with freshwater and left to air dry after each trip.
3. Operators should ensure that organic matter accumulated under carpets or in other difficult to reach places is removed and the area rinsed with freshwater.

4. Back bungs (if present) should be undone to allow any water to drain out of the boat onto land and any bilge areas should be rinsed thoroughly with freshwater.

2.1.2 *General Protocol for Vessels Remaining in the Water*

This protocol applies under normal operating conditions where the boat has not been operating in areas known to have been, or suspected of being, infected with abalone viral ganglioneuritis.

1. All decks, equipment and superstructures should be cleaned through scrubbing or with high pressure sprayers. The use of a detergent in this process is recommended.
2. All external areas must be rinsed with freshwater.
3. Decks, diving equipment and other equipment should be hosed down with freshwater, washed with disinfectant, rinsed immediately with freshwater and left to air dry after each trip.

2.1.3 *Protocol for Vessels Exposed to Abalone Viral Ganglioneuritis*

This applies when vessels are deliberately taken into areas where infection with abalone viral ganglioneuritis is known to occur, *or* when diseased animals are encountered during routine harvesting, surveillance or research operations.

1. Prior to leaving port, all gross fouling and organic matter should be removed from the vessel hull. This does not apply to vessels already in the water.
2. After the harvest has been offloaded, ideally the vessel should be slipped to allow for thorough cleaning. Cleaning should take place in a dedicated washdown area and no water should re-enter waterways. If it is not possible or practical to slip the vessel, then it should be cleaned down to the waterline on the hull.
3. All decks, equipment and superstructures should be rinsed with freshwater through scrubbing or with high pressure sprayers.
4. Detergent should be sprayed on all surfaces on the inside of the hull, gunwales and topsides (outside of the hull) and rinsed off with a hose or similar appliance.
5. Similarly the external hull of the vessel should be sprayed with detergent and rinsed with freshwater.

6. All pipework and pumps, particularly those used to pump water for abalone holding facilities should be rinsed with disinfectant.
7. Clean and soak all equipment (anchors, mooring lines, net bags and fenders *etc.*) in disinfectant for a period of 30 minutes.
8. Bilges and scuppers should be emptied while in the area of infection. If they are full of water on return to shore, they will require additional dosing with disinfectant before opening or pumping onto land.
9. All internal areas should be thoroughly cleaned and rubbish, clothing and equipment should be bagged in heavy duty plastic bags prior to their transport to shore. All bags should be sprayed externally with disinfectant.

2.2 **Decontamination of divers, wetsuits and dive equipment**

The appropriate level of decontamination for diving equipment will depend on the level of risk associated with the activities undertaken by the diver. This will result in more frequent decontamination rather than different procedures. The categories of decontamination for divers have been identified as follows.

- **General.** Applies to divers operating in areas where there is no history of infection and where no abalone suspected of infection have been observed.
- **Category 1.** Applies to divers involved in the observation or removal of dead or moribund abalone confirmed, or suspected, to be infected with abalone viral ganglioneuritis or operating within areas known to be infected, but with no direct contact with infected abalone.

2.2.1 *General Decontamination Protocol for Divers*

1. Remove gross contamination of organic material by rinsing divers, equipment and decks throughout diving operation.
2. At the end of diving rinse all equipment in freshwater to remove salt, including rinsing the inside of a buoyancy compensator device (BCD) if used.
3. All equipment must be washed or sprayed with a wetsuit cleaning solution or mild soap or shampoo to remove traces of organic matter. Dive suits must be washed inside and out (note that Virkon is not suitable for cleaning dive suits) and other equipment can be immersed in large plastic bins with disinfectant.

4. Gloves and catch bags need to be soaked in disinfectant.
5. Thoroughly rinse all dive equipment in freshwater and dry in well ventilated area.

2.2.2 Category 1 Decontamination Protocol For Divers

1. As for 2.2.1, but repeated after each dive, particularly when moving between sites.

2.3 Decontamination of transport vehicles and boxes

Vehicles will be used to transport the abalone in boxes to the processor or holding facility. As such, only the parts of the vehicle in contact with the boxes should need to be decontaminated, assuming personnel follow appropriate protocols.

2.3.1 General Protocol For Transport Vehicles And Boxes

1. All solid debris should be removed from trailers and transport boxes and harvest bins, and the area wiped with disinfectant. All residual mucous and faecal material must also be removed.

2.3.2 Protocol For Vehicles And Boxes That have Carried Infectious Animals

1. Remove the boxes and clean the underside of the boxes with a dilute detergent. Clean the area where they were placed in the vehicle using a dilute detergent.

2. All fixtures and fittings (aeration equipment, pipework etc) must be dismantled and rinsed with freshwater to ensure that infected material is removed.
3. The wheels, wheel arches, bodywork and undercarriage must be cleaned and disinfected.
4. The external surface of the vehicle should be soaked in a detergent and scrubbed down. Wastewater from this process should not be allowed to re-enter waterways. The truck should be left to air dry.

2.4 Decontamination Protocol For Personnel

Personnel other than divers must also undergo decontamination to ensure that the virus is not transmitted. Heaviest contamination of personnel will occur when infected animals are handled on-board the boat, where mortalities are collected and where there is exposure to mucous or faecal material from the abalone. The following steps should be taken to decontaminate personnel.

1. It is important that appropriate waterproof, protective clothing is worn at work.
2. Protective clothing should be cleaned with a sponge or low pressure pump while being worn to remove gross organics. The clothing can then be soaked in dilute detergent for the 30 minutes, rinsed and hung up to dry. Rubber boots should be scrubbed.
3. Personnel should regularly wash their hands in soapy water.

Code of Practice for Recreational Divers and Fishermen

Background

The activities of recreational divers and fishermen pose a risk of spreading the virus in the marine environment. The number of individuals that take part in recreational diving and fishing is significant and it is clear that this sector needs protocols to raise awareness of biosecurity issues and minimise the risk of groups or individuals inadvertently transferring the virus. Although the recreational sector was not specifically considered in the risk assessment process for this project, this protocol attempts to provide a framework for improving biosecurity in this sector.

After the outbreak of the virus in late 2005, the Department of Primary Industries (DPI) took steps to restrict entry of people to marine areas known to be infected with the virus by declaring Control Areas. Fishing and diving activities in the Control Area were restricted to minimise the risk of human activity transferring the disease to unaffected abalone populations elsewhere in the State. Control Area was replaced by a Fisheries Notice under the *Fisheries Act*, 1995 for stock protection purposes.

The Fisheries Notice prohibits the following activities in the area to which it applies:

- taking of abalone, other shellfish and sea urchins,
- use of commercial abalone fishing equipment, and
- collection of any substrate.

The purpose of this Code of Practice is to minimise the risk of the virus being spread between management zones within Victoria and interstate by human related activity. To be effective, this protocol must be communicated to recreational divers and fishermen through a comprehensive community engagement campaign.

Standard Operating Procedures for Recreational Divers and Fishermen

This protocol provides basic information on how recreational divers and fishermen can identify and report abalone that have been affected by the disease. It also provides guidance on decontaminating vessels, equipment and personnel.

1. Identifying and reporting abalone viral ganglioneuritis

It is vital that recreational divers and fishermen can identify abalone that could be infected with abalone viral ganglioneuritis and report that information through appropriate communication channels. This information will be used by Government Agencies to respond quickly and effectively to an outbreak of abalone viral ganglioneuritis in the wild in areas where it may otherwise have gone unrecorded.

1.1 Identification of infected abalone

Abalone viral ganglioneuritis causes damage to the nerve tissues of abalone (the ganglia) and results in paralysis and death in most cases. The virus seems to occur most often where there are dense populations of abalone, but other stress factors such as high water temperatures, spawning or the presence of other disease agents may pre-dispose abalone to becoming infected or showing clinical signs of the disease.

Infected abalone are lethargic and may have enlarged mouth-parts and a curled foot (see Appendix I). The presence of enlarged mouthparts alone is not sufficient to diagnose abalone viral ganglioneuritis (not always present in infected abalone); it is only an indicator of suspected infection. When clinically affected by the virus, the abalone are weak and easily removed from or they fall off the substrate.

1.2 Reporting the virus

If recreational divers and fishermen encounter abalone that they suspect may be infected with the virus they should take the following action.

1. Collect a sample of the suspect abalone and immediately cease fishing.

2. Place the sample in a sealed plastic bag, label and store on ice (if possible).
3. Call the Disease Watch Hotline (Telephone 1800 675 888) or Fish Reporting Hotline 13FISH (133474) and provide the following information.
 - GPS Co-ordinates of the reef and full description of the area where the abalone was found (including depth of water).
 - Contact details of diver or fishermen.
 - Basis for suspecting disease (clinical signs, number of dead or dying abalone).
4. A DPI Officer will be in contact to collect the sample, as appropriate.
5. The Diagnostic Laboratory at DPI Attwood (475–485 Mickleham Road, Attwood) prefers to receive chilled, live moribund abalone. If delivery time is more than a few hours abalone should be fixed with 10% seawater formalin. Alternatively, frozen abalone will be accepted.

2. Decontamination procedures

Key areas that need to be addressed to minimise the risk of disease transfer through recreational diving and fishing activities include the following.

- Decontamination of vessels, wetsuits, dive equipment, catch bags, boxes and people with soapy freshwater.
- Appropriate disposal of shells, meat and gut.

This SOP is principally aimed at recreational divers and fishermen who have been in areas or zones that have a history of infection with the virus and who may move vessels and equipment outside the zone. However, it is also applicable to all recreational divers and fishermen.

2.1 Decontamination of vessels

1. On return to shore, the vessel should be removed from the water and hosed down, preferably with freshwater and detergent to remove organic matter from inside and outside of the vessel. Clean the vessel away from the water's edge so that soapy water drains onto land and not into waterways.
2. Suitable detergents include truckwash and boatwash compounds that are made by a variety of manufacturers.

3. If you live or have accommodation in the area, decontamination can be done when returning home.
4. If from another area and there is the intention to take the vessel into waters outside of the fishing zone in which it was previously, the vessel can be taken to a car wash or service station with washdown facilities.

2.2 Decontamination of wetsuits and other dive equipment

1. Wetsuits should be washed with a specialised wetsuit wash preparation and freshwater, but if they are not readily available a mild liquid soap or shampoo will suffice.
2. Tanks, buoyancy vests, regulators and masks that have not come in contact with abalone can be washed down with soap-free freshwater.
3. Equipment that has come into contact with abalone (such as catch bags, gloves, knives and measuring devices) should be soaked in a bin containing soapy freshwater for 30 minutes and then rinsed.
4. All equipment should be allowed to dry before re-use.

2.3 Decontamination of people

1. After diving for abalone, ensure that all people who have come in contact with abalone wash their hands with soap and water.
2. Spray waterproof clothing with soapy freshwater and rinse, leave in the sun to dry.
3. On return home, ensure that clothes are washed with laundry detergent.

2.4 Appropriate disposal of shells and viscera

1. Abalone may only be shucked when the vessel returns to land.
2. Under no circumstances should shells or viscera be dumped in the sea. This is especially important if the abalone are moved to another area when landed.
3. Take abalone catch home and dispose of the waste with household rubbish.
4. Under no circumstances should abalone viscera be used as fishing bait.

Code of Practice for the Aquaculture Sector

Background

The Victorian abalone aquaculture industry has developed gradually over the past 5–10 years with production increasing dramatically from 2002 onwards (Table 2) (Anon, 2006). Growth between 2003/04 and 2004/05 slowed, with the value of the industry increasing by only 25% during that period (Table 2). Aquaculture production in 2005/06 was 160 tonnes with a value of \$5.6 million (growout and hatchery). In Australia, production has reached 300 tonnes with a value of \$12.2 million. It was expected to increase by 20% per year as more farms reach commercial levels (Fleming, 2005).

Table 2: Production of abalone in Victorian farms from 1999/00 to 2005/06 (Anon, 2006).

| | Nursery | Growout | |
|---------|---------------|-----------------|----------------|
| | Seed No (000) | Weight (tonnes) | Value (\$000s) |
| 1999/00 | Na | Id | Nv |
| 2000/01 | Na | 5 | 232 |
| 2001/02 | Na | 13 | 631 |
| 2002/03 | Na | 27 | 1,208 |
| 2003/04 | 5,597 | 102 | 3,554 |
| 2004/05 | 6,546 | 124 | 4,454 |
| 2005/06 | 4,425 | 160 | 5,597 |

There are currently five Private Land Abalone (PLA) and 16 Crown Land Abalone (CLA) licence holders licensed under the Fisheries Act 1995 authorising abalone aquaculture.

There are only around 12 sites that are growing abalone situated along the Victorian coastline (Figure 2).

Two broad types of aquaculture production systems are used in the Victorian industry, land-based farms and sea-based-cage farms. Blacklip, greenlip and a hybrid abalone are currently farmed in Victoria.

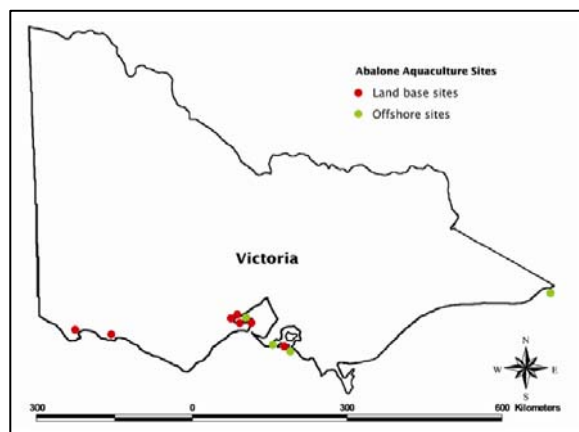


Figure 2: Location of land-based and offshore aquaculture farms licensed to culture abalone.

Land-based aquaculture systems

Land-based abalone aquaculture systems need access to large quantities of good quality seawater and require substantial coastal infrastructure. According to Hone and Fleming (1997), there are two types of land-based abalone farms: hatchery-based and growout only. Hatchery-based farms are vertically integrated comprising of hatchery, nursery and growout components. Growout farms on the other hand buy juvenile abalone (20–25mm, 1 year old) from hatcheries aiming to growout to market size in 2.5 years (Hone and Fleming, 1997).

Growout systems culture abalone in tanks of various designs and materials and require a regular exchange of seawater.

Longline or offshore culture systems

A number of licences and General Permits have been issued to investigate the feasibility of offshore culture of abalone. A variety of cage and barrel systems have been trialed. These systems have equipment located on the sea floor or suspended in the water column. In all cases, offshore abalone diets have involved feeding seaweeds. To date results have shown that whilst stock can be grown to commercial size in some

instances, problems have been encountered with feeding and infrastructure design. Currently there is no commercial production from these systems and as such a SOP has not been developed for this sector.

Ranching

Ranching involves the extensive growout of abalone with proprietorial or exclusive access rights to the planted abalone retained by the developer (DNRE, 2002). A small-scale commercial ranching operation has been authorised within the Kirk Point Werribee Aquaculture and Fisheries Reserve (KPWAFR). Since there is no commercial production from abalone ranching a SOP has not been developed for this sector.

Risks and control measures for the abalone aquaculture sector

The risk assessment process identified that major risks of spreading abalone viral ganglioneuritis were associated with the following:

- the movement (intentional or unintentional) of live abalone within the farm, between farms, and to and from the wild and processors,
- the movement of equipment and personnel,
- water movement, and
- inappropriate disposal of mortalities.

Standing Operating Procedures for Land-based Abalone Farms

This protocol comprises a series of SOPs that document appropriate procedures for biosecurity on abalone aquaculture farms. Biosecurity has been defined (Roberts, 2003) as:

“The protection of particular animals or particular areas from specific pathogens by exclusion or containment”.

Biosecurity involves using a group of tools developed for the prevention, control and eradication of infectious diseases. At a farm level, a biosecurity protocol includes the implementation of routine health management and sanitation procedures as well as a system for excluding disease agents. There are a number of guidelines that identify critical actions required to maintain the health and well-being of farmed stock whilst optimising production (*e.g.* Elston and Cheney, 2004; Bondad-Reantaso, 2005; Ingram, *et al.* 2005).

1. Health management of stock on abalone farms

Health management is focussed on the prevention, diagnosis and management of disease in a population of farmed animals. Of critical importance is the management of diseases caused by infectious organisms capable of transmitting disease between abalone and abalone populations. This is best achieved through an active on-farm monitoring and surveillance program that monitors and records the health of the farmed stock. It must be underpinned by sound animal husbandry techniques that aim to minimise stress and the likelihood of disease outbreaks occurring and spreading through the farm.

1.1 Health Surveillance Program

The surveillance program should be set up and run under the supervision of an aquatic veterinary surgeon or other competent authority. Limited information on the virus and the lack of a diagnostic test to identify its presence means that this protocol relies on vigilance and quick response by farm staff to effectively contain an outbreak of disease caused by abalone viral ganglioneuritis. With this in mind, a key component of a health surveillance program at an abalone aquaculture farm would be daily observation of all stock and recording of abnormalities and mortalities at least twice a week.

The surveillance program should be set up to facilitate batch certification (see definitions) of outgoing stock to other farms, if required, or to complement a formal health monitoring and surveillance program if in place. Record keeping is a critical part of managing the health of stock. It is important to establish a stringent monitoring and recording program to build up a history of events associated with each holding facility or batch of stock. This facilitates disease diagnosis and long-term health management of the stock and the associated epidemiological investigation should a disease event occur.

1.2 Identification and reporting of abalone viral ganglioneuritis

1. Figure 3 shows a decision support process to assist farmers in determining if the virus is a likely cause where moribund or dead abalone are observed in the culture units.
2. Where clinical signs of disease (Appendix I) are present, samples must be submitted for diagnostic testing to confirm the presence or otherwise of abalone viral ganglioneuritis and other pathogenic organisms.

3. If abalone viral ganglioneuritis is confirmed at the farm (which will generally occur within 5 days), discussions will take place with the Chief Veterinary Officer regarding management of the farm. The aim is to limit the spread of disease to other farms and the wild (assuming endemic infection does not already exist in wild stock). Means to achieving this end include restricting movements of stock off farm except to processors; harvesting or culling and processing of stock; and drainage, drying and disinfection of culture units housing infected abalone.
4. Where abalone viral ganglioneuritis is not suspected (and other pathogenic causes have been ruled out), moribund and dead abalone should be immediately removed from the culture unit and disposed of according to the Disposal of Mortalities Protocol.

1.3 Stock Management

Stock management is a critical component of animal husbandry and health management and the following factors should be considered to reduce animal stress and the potential spread of disease.

1. Separation and/or physical isolation of areas on farm. Individual sheds or groups of sheds should be kept physically separate and be managed separately, by different staff members to prevent the spread of disease.
2. Manage stocking densities to minimize stress and maintain optimal water quality.
3. The feeding of commercial pelleted diets specifically formulated for abalone at an appropriate rate to sate stock. Diets should be sourced from a known and reliable manufacturer.
4. Housing different age classes of abalone separately to reduce the potential for disease to spread.

2. Quarantine procedures

Quarantine facilities are required for all new stock of unknown health status (particularly wild or uncertified stock). These facilities should be completely isolated from the rest of the farm (separate room or building) until the health status of new stock can be determined. Key features of a quarantine facility include the following.

1. Water used in the facility must not be allowed to mix with the water of other culture systems within the farm.
2. Equipment used in the quarantine area should not be used in other areas of the farm and appropriate sanitation procedures should be employed.
3. The health status of the stock should be certified before accepting new stock onto the farm. For stock from other aquaculture farms, this can be in the form of batch health certification (see definitions) or by farms being part of a formal health monitoring and surveillance program. In addition, knowledge of the source farm and the risks associated with rehydration stops (which should be kept to a minimum) will allow an assessment to be made on the relative risks of the translocation. For certified stock each batch must be put in separate culture facilities from existing stock and dealt with on its own for a period of 6 weeks.
4. Knowledge of the health status of wild broodstock brought onto the farm will be impossible to obtain. In this instance, water from the quarantine tank(s) should be drained to a holding tank and disinfectant added before release to the drainage system. Alternatively, water exiting the quarantine tanks should be treated with ultraviolet light or ozone after being filtered to 20 µm. The health of the stock should be closely monitored throughout the 42-day quarantine period.

Requirements for batch certification of incoming stock have been stipulated by OIE (2006) and are part of the Victorian Government's Translocation Protocol for Abalone (Anon, 2007).

DECISION SUPPORT PATHWAY FOR ABALONE DISEASE STATUS

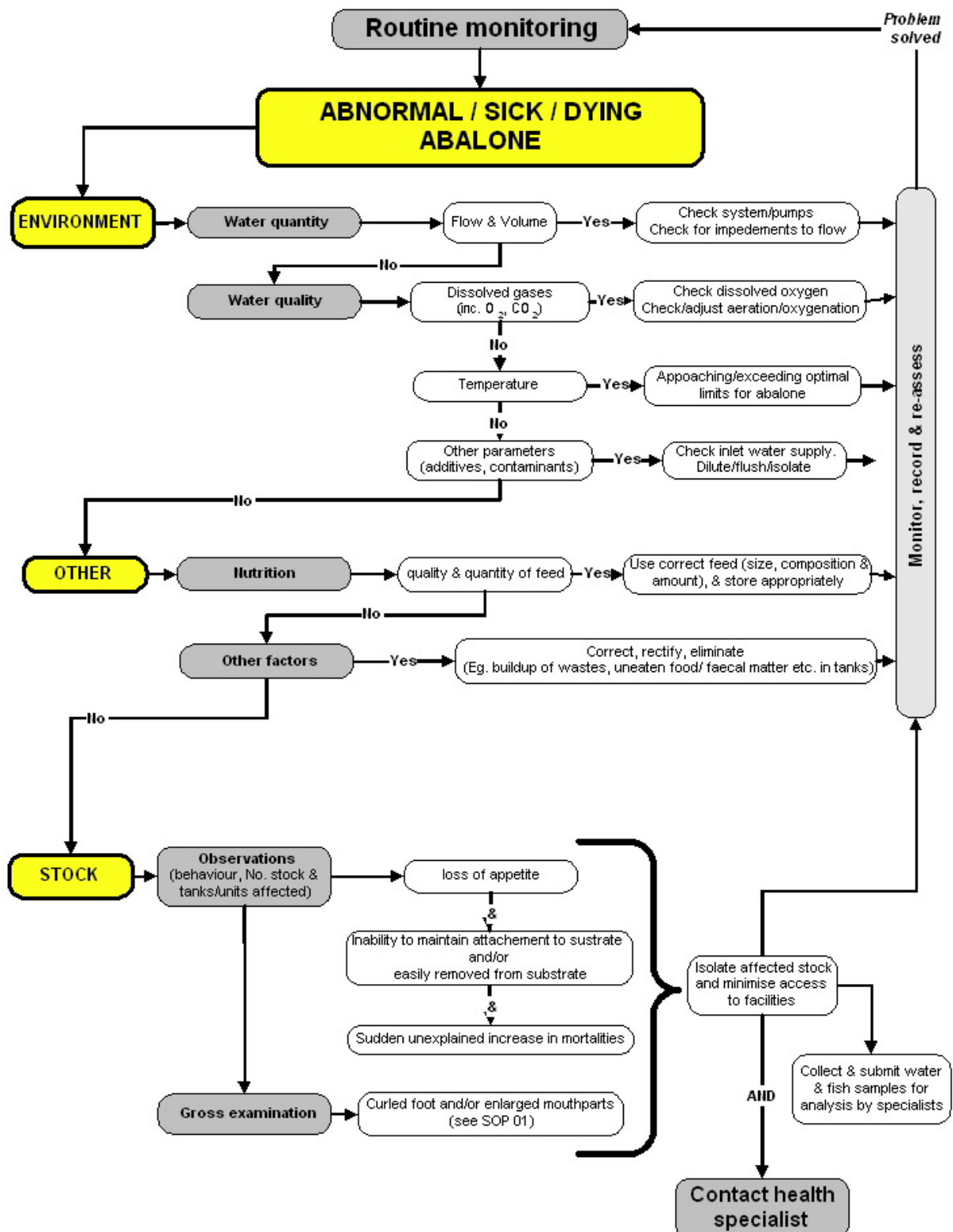


Figure 3: Decision support pathway for abalone disease status.

3. Sanitation procedures

Sanitation consists of specific procedures involved in managing the aquaculture system to reduce the incidence and spread of disease. Sanitation procedures to minimise the incidence and spread of abalone viral ganglioneuritis include the following.

3.1 Routine cleaning of culture units

Farms should develop their own procedures for cleaning their culture units thoroughly and train staff accordingly. The following should be included in those procedures.

1. Culture units should be cleaned regularly (ideally daily, but often enough to maintain good health of the abalone) to prevent the build up of organic matter and fouling organisms. Accumulations of organic matter can lead to a deterioration in water quality which can make the stock more susceptible to disease outbreaks.
2. Each culture unit (or group of culture units within one section) should have its own brooms and other cleaning equipment to minimise disease transfer between units.
3. Culture units should remain empty for as long as possible between batches of stock. Drying out culture units when empty is recommended.

3.2 Periodic cleaning of pipework and wastewater channels

All land-based pipes and wastewater channels must be cleaned regularly to limit the formation of biofilms and the accumulation of organic matter. During cleaning, the pipework should be drained and external fouling removed. Ideally, a “pigging system”² should be used as well as flushing lines with a disinfectant (e.g. chlorine solution).

Wastewater from this cleaning process should be directed to the settlement tank and treated with disinfectant prior to release. The Environmental Protection Authority (EPA) will need to approve the method of disinfection to be used.

3.3 Footbaths

Footbaths filled with disinfectant are vital to restrict the transport of all pathogens (not just abalone viral ganglioneuritis) on footwear onto the farms and between different areas within the

farm. Footbaths should be placed at the entry to the site and at strategic locations throughout the site (e.g. in doorways at the entry of buildings). They should be protected from the weather (so that rain does not dilute the disinfectant and the sun does not degrade the disinfectant) and preferably placed on a hard surface (so that mud does not form around the footbath and get stuck to footwear). It is necessary to replace footbaths regularly. Some disinfectants (e.g. Virkon) change colour when they are losing their effectiveness so operators are reminded to change them.

3.4 Disinfection of influent and effluent water.

Given the current design and system of operating land-based abalone farms, it is likely that disinfection of influent and/or effluent water could only be practically applied on a small scale to discrete parts of the farm (i.e. hatcheries, broodstock holding facilities).

The EPA would need to approve any chemical disinfectant used for this purpose because it will form a component of the discharge license. The farmer would be required to carry out a risk assessment prior to implementing a disinfection program.

4. Exclusion of disease agents

4.1 Entry and movement of personnel, contractors and visitors

To minimise the risk of introduction and spread of abalone viral ganglioneuritis, the farm operators should carefully control who enters the site and the areas that they can access when on-site. This applies equally to staff, contractors and visitors.

1. Contractors and visitors should enter the site only through the main gate or a single dedicated entrance.
2. They should be required to sign in, decontaminate their footwear in the footbaths provided, or be provided with alternative footwear (e.g. clean gumboots).
3. Where possible, visitors should be assigned to discrete areas within the farm.
4. Visitors, contractors and staff should clearly understand the areas that they have access to and the areas that are off-limits.
5. Signs should be placed at the entry to each building to remind staff, contractors and visitors of the biosecurity protocol on-site.

² Pigging systems are where a range of foam projectiles are forced through pipes using compressed air. They are highly effective at removing biofilms and organic matter.

4.2 Movement of equipment

1. Non-essential equipment that has been in contact with the external marine environment (such as staff dive suits and equipment) should not be stored on site.
2. All other equipment and vehicles should be decontaminated prior to entry onto the site if they have come from another abalone farm, processor or if they have been in contact with the marine environment.

5. Preventing disease agents from exiting the farm

5.1 Preventing escapes

Abalone are often found in the pipework, outlet channels and settlement ponds of farms. Uncontrolled abalone present two major risks to the abalone farmer and the marine environment.

1. Abalone in pipework and in settlement tanks can re-enter the farm and spread infection to healthy stock. It is therefore recommended that there is air gap between the tank and drain to prevent re-entry of escaped abalone.
2. There is an increased risk that abalone in settlement tanks or ponds can escape to the wild or interact with wild stock. They can represent a reservoir of disease that can re-infect stock on the farm or spread it to the marine environment. Pipes, outlet channels and settlement tanks and ponds should be regularly cleaned out to ensure that no abalone populations establish in this area.

5.2 Disposal of mortalities

1. Abalone mortalities must be recorded at least twice per week and removed from culture units daily.
2. The EPA regulates the disposal of abalone wastes through its Waste Management Guidelines (EPA, 2007). Since abalone wastes are Prescribed Wastes under *Environment Protection (Prescribed Waste) Regulations 1998* they must be disposed of to a licensed landfill.

3. Under certain circumstances, the EPA may agree that some abalone mortalities may be disposed of through burial. However, the burial pits must be built to the EPA's specification and may need to be lined. In addition, lime may need to be added after each batch of mortalities is added and then soil or sand should be added and kept at least three feet below normal ground level.
4. The EPA may require farmers who wish to bury mortalities to carry out a groundwater assessment.

5.3 Effluent treatment

1. The discharge of effluent from abalone aquaculture farms is licensed by the EPA. The EPA regulates the volume of effluent that can be discharged and the quality of the effluent as part of the farm's licence conditions.
2. Most land-based aquaculture farms have a settlement pond or tank to remove solid debris from the effluent flow prior to discharge. These tanks or ponds must be cleaned regularly to maintain efficient removal of solids from the effluent flow.
3. The settlement tanks or ponds can also provide habitat for abalone that have escaped from the culture units. Grates should be placed at the outlet to prevent escape to the wild. Settlement tanks and ponds should be regularly treated to kill escaped abalone.

Code of Practice for Abalone Processors

Background

Abalone processors must hold a Fish Receiver's (Abalone) Licence to receive abalone in Victoria (DNRE, 2002). There are currently 15 licensed processors in Victoria (Figure 4), most of which are in the Central zone. In addition to receiving abalone collected within the zone that they are located, Victorian processors receive abalone from other Victorian zones, other states and aquaculture farms. Some processors also deal with other species from Victoria, interstate and overseas.

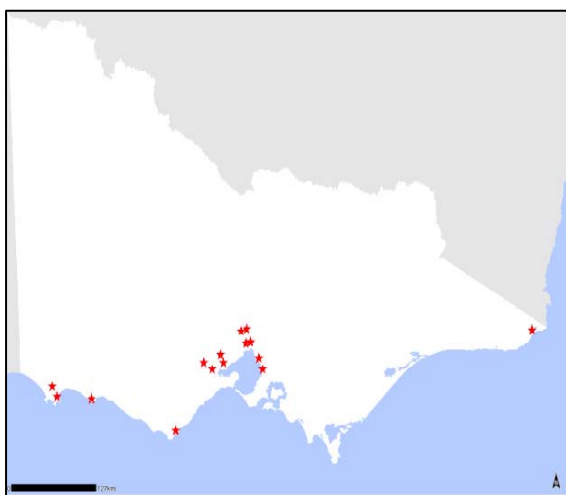


Figure 4: Location of abalone processors.

The abalone industry in Australia is highly export orientated with a total of 4,004 tonnes of product exported in 2004/05 with a value of \$263 million (ABARE, 2006). Around 50% (2,032 tonnes) was exported as fresh, chilled or frozen product and the remainder (1,972 tonnes) was exported as processed product in cans.

To export abalone, processors must be registered with the Australian Quarantine Inspection Service (AQIS) and comply with the requirements of the AQIS Fish Export Program. The Fish Exports Program manages and facilitates exports according to legislation, the most important of which are the *Export Control Act 1982*, the *Export Control (Prescribed Goods – General) Order 2005* and the *Export Control (Fish and Fish Products) Orders 2005*. It is a condition of AQIS registration that the processor facility

has an approved quality assurance program in place, known as an Approved Arrangement (AA), which meets the requirements of the *Export Control (Fish and Fish Products) Orders 2005*. The AA had to be approved and in place by July 2007. It consists of a documented system that encompasses management commitment, good manufacturing practices, process control and through chain traceability.

An AA must contain a Hazard Analysis and Critical Control Point (HACCP) plan that is an internationally recognised system used to manage food safety. This plan may not cover additional risks presented by abalone viral ganglioneuritis. The purpose of this Code of Practice therefore is to develop additional SOPs that will address issues concerning the potential spread of the virus through processors. The virus is not known to be a concern for human health.

Risks and control measures for abalone processors

The risk assessment processes highlighted the key risks associated with processors.

- The movement of live, infected animals from processors to farms. Risks exist where the processor or holding facility is used as an intermediate point through which farmed or wild abalone are moved around the state or between states. This has been used as a means of sourcing broodstock for abalone farms in the past. It is a high risk area for the transfer of the virus and some states (e.g. Victoria) have excluded it as a legitimate means of sourcing broodstock in their translocation protocols (Anon, 2007).
- Inappropriate disposal of shells (multi-species, multi-origin). Shells left exposed in the open could lead to the potential spread of the virus through predators and scavengers having access to these shells. Risks are higher if shells are disposed of directly to the aquatic environment.
- Inappropriate disposal of viscera. The disposal of viscera at the margins of sand-based sites may result in marine contamination. In addition, there have been recorded instances of viscera being dumped in the sea.

- The movement of dead and semi-processed animals between processors.
- Movement of contaminated equipment, vehicles and personnel.
- Multi-species, multi-origin processing – returned equipment has risk of disease transfer. Gastropods and other molluscs originating from overseas and being processed at the same facility could result in cross-contaminated equipment returned to farms or wild harvester.
- Inappropriate disposal of process effluent water, such as direct discharge to the coastal environment.

Standing operating procedures for abalone processors

1. Identification of abalone viral ganglioneuritis

Abalone processors may receive abalone known to be infected with abalone viral ganglioneuritis from farms that have had an outbreak of the disease. The Chief Veterinary Officer confirmed that this is a legitimate means of dealing with infected animals.

They may also receive abalone not known to be infected from either farms or the wild, but exhibit clinical signs when they arrive at the processing plant. In the latter case, it is vital that plant workers can identify the clinical signs of disease so that they can prevent further movement and the origin of the consignment can be traced.

1.1 Identifying the disease in live animals

Abalone viral ganglioneuritis causes damage to the nerve tissues of abalone (the ganglia) and results in paralysis and death in most cases. Infected abalone are lethargic and may have enlarged mouth-parts and a curled foot (Appendix I).

1.2 Reporting the virus

Processors that suspect a consignment of abalone may be infected with abalone viral ganglioneuritis should take the following steps.

1. Collect a sample of the suspect abalone and place the sample in a sealed plastic bag, add oxygen if available, label and store on ice (if possible).
2. Call the Disease Watch Hotline (Telephone 1800 675 888) and provide the following information:
 - name and contact details,

- source of consignment (including code for wild abalone), and
 - basis for suspecting disease (clinical signs, number of dead or dying abalone).
3. A DPI Officer will be in contact to collect the sample, as appropriate.
 4. The Diagnostic Laboratory at the DPI Attwood Centre (475–485 Mickleham Road, Attwood) prefers to receive chilled, live moribund abalone. If delivery time is more than a few hours abalone should be fixed with 10% seawater formalin. Alternatively, frozen abalone will be accepted.

2. Protocol for preventing the spread of abalone viral ganglioneuritis through processors

This protocol describes Standard Operating Procedures for abalone processors to minimise the risk of spreading the virus through the activities of those operations. Although most of the processors are already tightly regulated in terms of food safety by AQIS, this protocol addresses the gaps in procedures, including the following.

- Inappropriate disposal of shells, viscera and rejected product.
- The movement of dead and semi-processed animals between processors.
- Movement of contaminated equipment, vehicles and personnel introduces virus between processors.
- Transfer of virus to uninfected wild areas through inappropriate disposal of process effluent water.

This protocol describes key factors that should be considered when disposing of rejected product and processing wastes to reduce the risk of transferring the virus during normal day-to-day operations of processors.

2.1 Disposal of shells, viscera and rejected product

In 2001, an audit of the waste produced by seafood processors in Victoria was carried out as part of an FRDC funded project (Gavine *et al.*, 2001). This audit showed that most abalone processors had established markets for both the shell and gut wastes they produced. The shells were sold and exported overseas and the viscera were sold or given away for bait or fertiliser. One company manufactured abalone sauce from the gut waste and two companies in the Central zone had the waste picked up by a disposal company. There have been instances of abalone

viscera being dumped into the marine environment which is a high risk activity for the spread of the virus. This activity has since been stopped.

Appropriate methods of disposing of shells, viscera and rejected product include the following.

2.1.1 Shells

1. **Export shells to overseas markets.** Shells must be washed and dried prior to export. Drying should take place in an area that excludes scavengers (*i.e.* enclosed or with appropriate bird netting).
2. **Disposal to municipal landfill.** Wastes from food processing plants (including shells) are prescribed wastes under the *Environment Protection (Prescribed Waste) Regulations 1998*, and must be disposed of to an approved landfill. This can be undertaken by a contractor if required. Fees will be applicable to this form of disposal.

2.1.2 Viscera

1. Manufacture of abalone sauce. Viscera can be processed into a value-added product known as abalone sauce. Cooking processes need to be approved and logged for the AQIS audit.
2. Sold to knackeries or rendering plants. Viscera should be frozen prior to transport to make movement of the material easier. The viscera will be processed using a heat process and form basic inputs for stockfeeds, fertilisers and other products.
3. Disposal to municipal landfill. Viscera must be disposed of to an approved landfill (EPA, 1997). This can be undertaken by a contractor if required. Fees will be applicable to this form of disposal.

Under no circumstances should abalone viscera be given away or sold unprocessed to fishermen to use as bait in marine waters.

2.1.3 Rejected products

1. **Disposal to municipal landfill.** Rejected product must be disposed of to an approved landfill (EPA, 1997). This can be undertaken by a contractor if required. Fees will be applicable to this form of disposal.

2.2 Movement of dead and semi-processed animals between processors

This was identified at the risk assessment workshop as a potential route of viral transmission between processors. In order to avoid cross-contamination, the unnecessary movement of stock should be avoided. Where the stock is known to have been contaminated with the virus, it should be fully processed and canned or treated as rejected product (see above).

2.3 Decontamination of equipment, vehicles and personnel

2.3.1 Boxes and crates

Boxes and crates that are used to transport the animals between commercial divers, processors and aquaculture farms were identified as a key risk area for potential cross-contamination. Processors should make sure that the boxes are clean before they leave the premises by undertaking the following measures.

- A dedicated wash area should be set up.
- Boxes and crates should be cleaned with a chlorine based foaming disinfectant (such as chlorofoam) and a quaternary ammonia based sanitiser.
- Boxes and crates should be dried before return to commercial divers or farmers.

2.3.2 Vehicles

All solid debris should be removed from trailers and vehicles and the area wiped with disinfectant. All residual mucous and faecal material must also be removed.

Where the vehicle has carried infected (or suspicious) animals, the following should be adopted.

1. Remove the boxes and clean the underside of the boxes and the area where they were placed in the vehicle using a dilute detergent.
2. All fixtures and fittings (aeration equipment, pipework *etc.*) must be dismantled and rinsed with freshwater to ensure that infected material is removed.
3. The wheels, wheel arches, bodywork and undercarriage must be cleaned and disinfected.
4. The external surface of the vehicle should be soaked in a detergent and scrubbed down. The truck should be left to dry in sunlight.

2.3.3 *Personnel*

1. It is important that appropriate protective clothing is worn at work.
2. Protective clothing should be cleaned with a sponge or low pressure pump while being worn to remove gross organics. The clothing can then be rinsed and hung up to dry. Rubber boots should be scrubbed.
3. Personnel should regularly wash their hands in soapy water.

2.4 **Disposal of process effluent water**

1. Ideally, effluent water from the processing plant (including washdown water and process water) should be contained on site in settlement pits before the liquid fraction is discharged to the sewer.
2. The settlement pit should be pumped out on a regular basis and disposed of to landfill.
3. Where the effluent water is discharged to the marine environment, the effluent must be stored in a settlement pit and disinfected prior to release.

References

- ABARE, (2006). *Australian Fisheries Statistics 2005*. Australian Bureau of Agriculture and Resource Economics, Canberra, 2006.
- Anonymous (2006). *Fisheries Victoria Commercial Fish Production Information Bulletin 2005*. Primary Industries Research Victoria (PIRVic), Queenscliff, Victoria, Australia.
- Anonymous, (2007). *Victorian Abalone Aquaculture Translocation Protocols*. Fisheries Victoria Management Report Series No. x.
- Bondad-Reantaso, M.G., Berthe, F. (2005). Molluscan pathogens of concern in ASEAN. In: NACA (Ed.), *The Way Forward: Building Capacity to Combat Impacts of Aquatic Invasive Alien Species and Associated Trans-boundary Pathogens in ASEAN Countries*. Network of Aquaculture Centres in Asia-Pacific, pp. 179–195.
- DNRE, (2002). *Victorian Abalone Fishery Management Plan*. Department of Natural Resources and Environment. 2002.
- Ellard, (2006). *Decontamination*. AQUAVETPLAN Operational Procedures Manual. Aquatic Animal Health Program FRDC. (<http://www.stors.tas.gov.au/au-7-0037-00184>)
- Elston, R. A. and Cheney, D. P. (2004). Shellfish high health program – Building success through health management and disease prevention. *World Aquaculture* **35** (2): 48–52.
- EPA, (1997). *Classification of wastes*. EPA Publication No. 448.3. Information Bulletin, Environmental Protection Authority Victoria, May 2007.
- Fleming, A. (2005). Abalone Aquaculture. FRDC subprogram leaders report. *FRDC R&D News*, **13**, (4), 42–43.
- Freeman, (2001). Aquaculture and related biological attributes of abalone species in Australia – a review. Fisheries Resources Report Western Australia 128, 1–48.
- Gavine, F. M., Gunasekera, R. Gooley, G. J. and De Silva, S. S. (2001). *Value-adding to seafood, aquatic and fisheries waste through aquafeed development*. FRDC Project No. 1999/424.
- Gavine, F. M., Ingram, B. A. and Doroudi, M. (2007). *Development of management strategies for herpes-like virus infection of abalone*. Final Report FRDC Project No. 2006/243.
- Hardy-Smith, P. (2006). *Report on the events surrounding the disease outbreak affecting farmed and wild abalone in Victoria*. Confidential report for the Department of Primary Industries, Victoria. Panaquatic Health Solutions Pty Ltd. 47pp.
- Hone, P. W. and Fleming, A. (1997). Abalone. In: RIRDC (1997). *The New Rural Investors: A Handbook for Farmers and Investors*. RIRDC, Canberra.
- Ingram, B. A., Gavine, F. and Lawson, P. (2005). *Fish Health Management Guidelines for Farmed Murray cod*. Fisheries Victoria Research Report Series No. 32.
- OIE (2006). *Aquatic Animal Health Code 2006*. (http://www.oie.int/eng/normes/fcode/en_somm_aire.htm)
- Roberts, R. J. (2003). Biosecurity – Pandemics and the aquatic environment. In: Lee, C. S. and O' Bryen, P. J. (2003) eds. *Biosecurity in aquaculture production systems: Exclusion of pathogens and other undesirables*. The World Aquaculture Society, Baton Rouge, Louisiana, United States.

Appendix I: Clinical signs of abalone viral ganglioneuritis

