Australian Bounty Seafoods

BIOSECURITY
&
DISEASE MANAGEMENT PLAN

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NB This document is subject to continual update as the farm and external conditions evolve

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Introduction:

Optimal farm design, appropriate husbandry, water quality management, biosecurity protocols and regular health monitoring all help to minimise the incidence and severity of disease outbreaks on aquaculture farms. At times, intensive farmed animal populations may experience disease problems, often resulting in stock losses.

Segregation of higher risk stock is part of a standard biosecurity strategy to minimise disease transfer in an abalone farm. This abalone farm has employed world's best practice of having as part of its development a dedicated quarantine facility for the management of broodstock. The use of a quarantine system facilitates the isolation of broodstock from growout stock to prevent vertical and horizontal disease transfer. Segregation allows time to complete disease testing of potential broodstock, prior to production of juvenile stock for growout. A physically separated facility provides control of water such that it can be recycled and disinfected prior to release from the farm to the environment. Through these measures the broodstock can be maintained in a quarantine facility and have their tested disease status monitored providing progeny for growout, with a minimal risk profile for disease transmission, or outbreak.

Whilst rigorous systems are put in place to enhance disease prevention, this farm recognises the importance of disease management, given that there is always the risk of disease presenting in farming systems.

Perkinsus and Abalone Viral Ganglioneuritis (AVG) are the only reportable Australian National List of Reportable Aquatic Animal Disease and World Organisation for Animal Health (OIE) diseases reported to occur in Australian abalone, and this management plan has Perkinsus and AVG as its prime focus. However, the principles of biosecurity, disease prevention, detection, containment and eradication of Perkinsus and/or AVG are applicable to disease management in general.

1 Broodstock Quarantine and Biosecurity Standards

Monitoring of marine exotic organisms

A1. A subset (150 or 2%,whichever is less) of all potential abalone broodstock must be inspected on arrival at the aquaculture site for the presence of attached marine exotic organisms and the results of these inspections recorded in a logbook. The person conducting this specialized inspection should be aware of, and familiar with the identity of exotic species that may be a threat or be of interest to the department. Specialist equipment may be required including magnifying systems and lighting.

In the event of a suspected marine exotic the NSW DPI must be informed of the suspected marine exotic presence within 24 hours. The suspect marine exotic(s) organism will be removed, preserved in formalin and made available to NSW DPI on request for identification purposes.

New broodstock quarantine

On arrival, all batches of "new" abalone must be quarantined from any other farm stock for a minimum period of 8 weeks. Quarantine involves: separate sea water supply from the header tanks, feeding and cleaning system; effective spatial or physical barriers to reduce cross contamination by splashing and aerosol; effluent disinfection and arrangements for controlling access by personnel. On arrival at the broodstock shed, all newly collected broodstock should be immediately inspected (with a subset being inspected by a staff member familiar with exotic pests as per A1) and any stock with injuries or other serious afflictions culled. The shells of broodstock retained on the basis of good appearance, health and vigor are cleaned under running seawater with a wire brush and or an abalone knife to remove biofouling. Utmost care is needed not to damage soft tissues or the respiratory pores of the shell. In healthy blacklip abalone, cleaning will expose the prominent red/maroon layer of the outer shell surface. Once cleaned, the shell may be treated with crushed sea salt for several hours to desiccate any undetected boring mud-worms that otherwise will multiply and spread to other broodstock within the conditioning units. An option to the use of salt is to suffocate the mud-worms by coating the shell with surfboard wax. Retain the abalone in quarantine for a further 1 or 2 days before peeling off the wax and rescrubbing the shell.

Healthy individuals should be placed in a quarantine tank supplied with temperature controlled, 10 micron filtered seawater. Incoming water will also be treated with a UV dose of more than 60,000μWs/cm^2 to inactivate any Perkinsus zoospores. The tank lights should be covered with 90% shade-cloth and the abalone provided with daytime shelters. Newly acquired broodstock should be retained in quarantine for at least 8 weeks to allow them to acclimatize to captivity and for the full effects of injury and stress to become evident.

A2. All abalone broodstock batches received at the land-based aquaculture site must be held in a fully enclosed (walls and roof to control aerosol risks) and secure broodstock holding facility (lockable and vermin proof).

A3. Each abalone broodstock batch (wild or farmed) delivered to the broodstock holding facility must be retained in labelled separate culture vessel(s) without co-mingling with other stock with the exception of mandated sentinel blacklip abalone stock.

Abalone translocated from the wild to the farm represent the highest risk of disease introduction and so are required to be held in a biosecure quarantine facility with effluent treatment for at least eight weeks before being considered for movement elsewhere on the farm. It is often not an option to sacrifice wild abalone to screen for diseases. To help detect any diseases present in the wild abalone, farmed sentinel abalone must be placed in the quarantine units containing the wild stock (this will commence once the farm has produced stock of suitable age) for the duration of the quarantine period (minimum eight weeks) and monitored as follows.

- A batch of at least 50 farmed abalone >30 millimeter shell length will be placed in the holding units with each batch of translocated wild abalone. Note that stock are fed a conditioning diet to satiation every 2 to 3 days and that any uneaten food is siphoned off and tanks cleaned beforehand. Records of food addition, residue, behaviour and mortality will routinely be made at this time.
- If more than two of the farmed sentinel abalone in a holding unit have died or become moribund since that holding unit was last inspected, then this shall be regarded as a mortality event and the following procedures followed. As detailed in A6 below, there will be zero discharge of untreated liquid or solids effluent from the enclosed broodstock facility to the marine environment.

  If there is an obvious non-infectious cause of abalone dying (e.g. equipment failure), then the farm is required to correct the problem and continue to monitor the affected population daily for at least 10 days. If mortalities do not decrease within 10 days of the problem being fixed, then the farm must follow the procedure outlined below. The event should be recorded, detailing the problem that led to increased mortalities, the remedial action taken and the subsequent response of the abalone population.

  If there is no obvious non-infectious cause of abalone dying, or if mortality continues to increase, then the farm must take the following actions:

  (also refer to latest version of DPI Disease Fact Sheet, as shown in Appendix 2)

- Isolate the affected unit(s) by further restricting access of people, shifting to recirculation only mode (thus not releasing water) and reducing diet to maintenance level. With careful monitoring of food supply and water quality along with pH and salinity adjustment the system is sustainable (with some stress and minimal growth) for some time depending on biomass present.
- Submit moribund abalone (at least five if available) from the affected unit(s) for pathology analysis to an auditor-approved laboratory experienced in aquatic animal pathology.
- Submit apparently unaffected abalone (at least five) from the same production unit and from a completely unaffected unit matched as closely as possible with respect to size, age, parentage, etc.
- Seek advice from an aquatic health expert.
- Continue to monitor and record the behavior and mortality of the abalone population daily.

- If the level of mortalities continues above historic baseline levels, or if similar increased mortalities occur in other growout units/cages on the farm, the farm must immediately consult with their aquatic health expert to decide a course of action and notify the competent authority (as defined by OIE, 2009).
- In cases where the aquatic health expert's determination is that the disease cannot be effectively mitigated or treated, the animals in the affected production unit(s) must be culled and the complete unit(s) disinfected.
- A report on the mortality event shall be filed in the farms management system when the event occurs. The information must be made available to appropriate government authorities as required by development conditions, regulations and law detailing the course of events. The report shall include the results of the pathology testing, a record of any instructions from the farm's veterinarian or relevant authorities, and the farm's response to these.
- Before the wild stock is released from quarantine, abalone should be submitted for pathology analysis and found free of significant infectious diseases. These abalone should include in order of priority (1) any moribund wild abalone, (2) any moribund farmed sentinel abalone, and (3) a selection of farmed abalone including any that show signs of ill health. During the quarantine period farm staff must attempt to identify moribund abalone and preserve them for pathology testing including histology and PCR assays.

A4. Footbaths will be located at all entry and exit points and maintained so as to provide for effective disinfection of footwear at all times. Footbaths will be able to be drained, and cleaned to remove any organic matter which may inactivate disinfectants used in the baths. Baths will be located such that it is not likely to be able to enter or leave, without using the footbaths.

A5. Hand glove dispensers, bins and sanitisers will be located at main entry and exit points. Signage reminding staff regarding the importance of correct sanitation for biosecurity will be placed at each entry and exit.

A6. There will be zero discharge of untreated liquid or solids effluent from the enclosed broodstock quarantine facility to the marine environment. Treatment will be by filtration and U.V. treatment within the quarantine, farm broodstock and hatchery facilities as detailed in A7 below and in addition to this, water released from these facilities will be ozone treated and sent to holding tanks till release to the settlement ponds. This higher level of treatment is because stock sourced from off farm poses the greatest threat of pest and disease to the farm via any pathogen release, either on farm or to the external environment. This level of biosecurity will thus minimize the risk of pest or disease reintroduction to the external environment.

A7. Liquid wastes within the farm, including water used to transport abalone, must be disinfected using methods listed in AQUAPLAN or World Organisation for Animal Health manuals.

- **Filtration < 400 micron removes mudworm larvae**

- **Perkinsus zoospores bearing hypnospores are inactivated by UV dose of more than 60,000μWs/cm²** .

These are the minimum protocols for discharge treatment. .

The use of sufficient ozone on all quarantine effluent water is suggested. Ozone is a disinfectant known to reduce a range of fungal, bacterial, protozoan and viral loads in water. For the purpose of ensuring the biosecurity of a quarantine room ozone can be utilised to achieve disinfection of effluent water at the point of exit from the quarantine area. There is no current published level of ozonation recommended for AVG as there are numerous variables in effluent water which influence the quantity of ozone required to, achieve complete disinfection.

The efficacy of ozone in achieving disinfection is related to the pathogen load, ozone concentration, contact time to water, and the organic loading in water. Higher ozone concentration, longer contact time and low turbidity/organic loads in water will increase the efficacy of ozone treatment.

It is recommended that an ozone expert be engaged in designing the ozonation system to ensure sanitation of water based on achieving residual ozone levels of 1mg/L at point of discharge from contact vessel (as published in DAFF decontamination manual).

In the event that a new disease presents itself as a local threat these guidelines will be updated, if required, to ameliorate the threat within the farm. Diseases and pests will be controlled in release water should disease outbreaks occur.

A8. All filtered residues, filters and other solid waste outputs will be disinfected and disposed of in a manner listed in AQUAPLAN or World Organisation for Animal Health manuals.

A9. A record of all wastewater treatment (disinfection) processes must be maintained and made available to NSW Department of Primary Industries (DPI) staff on request.

A10. All staff are required to disinfect hands and farm footwear prior to entry and exiting each facility housing abalone. Staff will also be required to comply with the visitor's entry regulations (B11), to ensure that there is negligible risk that their clothing, or person, could be a vector for disease introduction.

A11. Authorised staff must undertake daily monitoring of all broodstock for the presence of disease, morbidity and or any unusual behaviour which may indicate the presence of disease.

A12. Daily monitoring must be recorded in a bound book with numbered pages.

A13. Record books must be kept for a period of 3 years after the date of the last entry.

A14. The farm manager and veterinarian must be contacted immediately by phone and email should unusual behaviour or increased mortalities be observed. A note should be made in the daily monitoring book at the time of first observation. Licence conditions may specify that NSW DPI is also required to be notified if mortality reaches a certain threshold specified in the licence.

2 General Land-Based Abalone Farm Bio-security Standards

Disinfection / hygiene practices

B1. All culture unit(s) used to hold abalone must be maintained to ensure that any buildup of organic matter such as faeces, uneaten feed, mortalities and fouling organisms does not compromise the health of the abalone and contribute to an increased risk of disease.

B2. Culture units used to hold abalone must be exposed to cleanout, dry out and disinfection between consignments of stock.

B3. All waste water outlet channels must be regularly inspected, cleaned and maintained free from escapee abalone and mortalities.

B4. Footbaths must be provided at all entry and exit locations and maintained so as to provide effective disinfection of footwear at all times.

B5. All dead and moribund abalone must be removed from the culture units as soon as practical but at least every second day. If the numbers of these animals are below the expected base line level then 5 of the moribund will be preserved in formalin for testing to demonstrate a track record for the farm of active surveillance, and this builds towards demonstration of freedom from diseases. The rest are to be frozen before disposal to an appropriately licensed landfill such as the Port Stephens Bedminster composting facility. If greater numbers than baseline levels of mortalities occur, with no obvious noninfectious cause, then 5 of the moribund stock are to be preserved in formalin for shipment and investigation.

B6. All mortalities must be disposed of in a manner approved by the NSW Environmental Protection Authority, which will represent a minimal risk for disease transfer to the environment.

Staff movements

B7. Any equipment, protective clothing or footwear brought on to the aquaculture site that may have come into contact with farmed or wild abalone or water used to hold farmed or wild abalone must be cleaned with an effective disinfectant (using methods listed in AQUAPLAN or World Organisation for Animal Health manuals) prior to entry into the farm's biosecure quarantine or grow-out facilities.

B8. Any farm equipment, protective clothing or footwear used on the aquaculture site will be discouraged from use on another aquaculture site, holding facility or processing facility. Should use be necessary then equipment must be cleaned and disinfected prior to use off-site.

B9. Use of dedicated equipment, protective clothing and boots for specific areas (e.g. broodstock facility, nursery, growout etc.) of the aquaculture site will be mandatory.

B10. Staff movement will not be permitted from the quarantine facility to growout facilities without undergoing clothing change and disinfection.

B11. Restrict public access and movement throughout the aquaculture site. A sign-in book will be required for all visitors to the farm. No entry will be permitted without completing the sign-in procedure. Visitors will be required to complete a biosecurity questionnaire, and provide their contact details should traceback be required. If they have been in contact with wild abalone, or farmed abalone in the previous 24 hours, they will not be permitted access to any areas of the farm containing stock, equipment or feed. Entry to facilities may be permitted by passing through a change of clothes into farm provided overalls and boots, through a one-way entry.

Stock monitoring

B12. Undertake daily inspections of all abalone stock for the presence of disease, morbidity or any unusual behaviour which may indicate the presence of disease.

Record keeping

B13. Retain accurate records of all inspections. Records will include the number (and species) of abalone held in each culture vessel, stocking rates, feed rates, growth rates, mortalities, incidence of significant stressors and other stock health observations.

B14. Maintain an accurate record of all translocation movements onto and off the aquaculture site including the location and contact details of the supplier or receiver, date of supply and the numbers and species of abalone translocated.

B15. Records in e format and derived books must be kept for a period of 3 years after the date of the last entry.

2.1 Disinfection Protocols

C1. For the purposes of disinfecting wet suits, gloves, abalone tools and other associated equipment, there are a range of suitable disinfection techniques. Prior to any disinfection, organic material that is without biosecurity implications should be removed and appropriately disposed of at an appropriately licensed landfill such as the Port Stephens Bedminster composting facility, before applying the disinfectant to the equipment.

C2. The common disinfectants are listed below.
(i). A solution of Calcium hypochlorite $Ca(OCl)_2$ prepared daily at a minimum active concentration of 7g/litre. When using Calcium hypochlorite or Virkon™ the exposure (contact time) shall exceed 10 minutes applied by immersion.
(ii). Virkon™ powder at a concentration of 20g/litre or equivalent.
(iii). Disinfection of equipment using commercially available cleaning products such as Truckwash™, Napisan™ or equivalent requires longer contact periods and product directions must be followed.

(iv).The farm intends to use a solution of Sodium hypochlorite NaClO (swimming pool bleach) @ 10% (100g per litre). This will be used as a stock solution to make up disinfection solutions (24 hour treatment) for equipment.
(v). The farm intends to use a solution of 2 Molar Sodium thiosulphate to neutralise residual bleach.
(vi). The farm intends to use a solution of 1% Sodium hydroxide (NaOH) as a disinfectant for footwear baths.
(vii). The farm intends to use a solution of 2% iodine as a disinfectant hand rinse.

Incoming water used within the farm will generally be filtered to reduce the incidence of Perkinsus hypnospores, mud worm and calcareous tube worms occurring within the farm. Additional treatment of incoming water for the broodstock/ hatchery/ quarantine facilities is outlined in A1.

Note that broodstock/ quarantine and hatchery *recirculated* water shall be filtered to ~ 10 micron with a filter to remove solids and mucous. Recirculated water from the hatchery/ quarantine facilities will further be sterilised by UV treatment, with a dose of more than 60,000µWs/cm^2. The waste water from these systems will also be ozone treated and sent to holding tanks till release to the settlement ponds. Ozone systems should be used in accordance with the conditions outlined in:
http://www.dpi.nsw.gov.au/fisheries/aquaculture/publications/water-quality-management/ozone-in-recirculating-aquaculture-systems.

When to apply disinfection

C3. When collecting broodstock or diving in areas where abalone are likely to be present, disinfection of gloves and abalone tools must occur between dives at the same location and complete gear disinfection must occur when moving between dive locations, and before entering any biosecure part of the farm.

Harvesting crates must be labelled and disinfected before being brought back into the farm if they have been taken to a processor, or off-site.

2.2 Perkinsosis and AVG Disease Management Plan

Nature of the diseases

Perkinsosis and AVG are diseases of abalone (of the genus *Haliotis*) that have the potential to cause mortality in both farmed and wild abalone populations.

Perkinsus olseni (causes Perkinsosis)

Host species

Haliotis rubra, Haliotis laevigata, Haliotis cyclobates and *Haliotis scalaris*. Molecular studies (nucleotide sequence of the internal transcribed spacers (ITS) in the ribosomal gene cluster (rDNA)) indicated that *P. olseni* occurs in many species of molluscs from Australia and is homologous to *Perkinsus olseni* (=*atlanticus*) in clams from Portugal, Japan and Korea.

Perkinsus olseni was experimentally transmitted and highly infectious to a range of molluscs in the laboratory including two lamellibranchs, *Pinctada sugillata* and *Anadara trapezia*.

Disease characteristics

Perkinsus is a genus of protozoan parasites of commercial importance around the world. Infection causes microabscesses and abscesses to form in the flesh of affected animals. A typical abscess is spherical and can measure up to 8mm in diameter. In heavily affected animals, abscesses occur throughout the foot and mantle. This disease has been previously reported in Australia, affecting *H. rubra.*

Transmission of this parasite occurs directly between individual molluscs. Prezoosporangia that escape from rupturing pustules (abscesses) or decaying dead abalone undergo further development to zoosporangia in seawater. Within nine days at 20 °C and three days at 28 °C, hundreds of motile, biflagellated zoospores (about 3 by 5 μm) exit from the zoosporangium. The zoospores are infective to abalone as well as other molluscs (Goggin et al. 1989). On Taylor Island, South Australia, field studies using molecular detection techniques indicated that infections of *P. olseni* in wild *Haliotis rubra* were positively correlated with both water temperature and size of abalone. Also, the parasite was being maintained by *H. rubra* with negligible contributions from other susceptible abalone species or other molluscs (Lester et al. 2001). Subsequent data and analysis by Hayward et al. (2002) indicated that the transmission of *P. olseni* among the wild *H. rubra* appeared to be reduced and infections were less severe in 2002. This apparent reduction in disease was attributed to lower maximum summer sea surface temperatures (cooling of almost 3 °C to below 20 °C).

Histopathological lesions

Cross-section through tissues showing *P. olseni* in the connective tissue of the adductor muscle and mantle, and free in brownish masses in the haemolymph. Three stages of *P. olseni* are found in the connective tissues of the host: 1) immature trophozoites (2 - 3 μm in diameter), 2) mature trophozoites (3 - 18 μm in diameter) with large vacuoles (up to 10 μm diameter with some containing a weakly eosinophilic vaculoplast) commonly called the "signet-ring" stage, and 3) tomonts (dividing cells, 12 - 35 μm in diameter) containing 2 to 32 developing immature trophozoites. Abalone will respond to infection by an accumulation of haemocytes that eventually develops into the pustule. Parasites that do not die within the necrotic pustules develop further into the large prezoosporangium (60 - 95 μm in diameter).

Abalone Viral Ganglioneuritis

Host species

In Australia, it has been reported in *Haliotis laevigata* and *Haliotis rubra* and hybrids of these species*:*

Haliotis rubra, Haliotis laevigata, Haliotis diversicolor, Haliotis diversicolor supertexta, Haliotis discus hannai, Haliotis discus discus, Haliotis madaka. Commercial species of Australian abalone such as *H.laevigata* and *H.rubra* are susceptible to some strains of an abalone herpes-like virus known to be found in Australia, which can cause the disease, AVG. There are some other viral diseases of abalone described internationally, and not within Australia at this time, which have some features in common which AVG, such as the Taiwanese herpes-like abalone virus. Australian abalone may be susceptible to these viruses also.

Disease characteristics

First identified in farmed abalone in Victoria in 2005 during farm inspections, the virus has also been found in the wild abalone fishery, where it has caused widespread mortality. In 2010, AVG was reported in Tasmanian abalone within a processing/holding facility. The infection is then believed to have spread to a nearby abalone farm, where upon detection, the stock were voluntarily destroyed.

The disease is caused by a herpes-like virus that affects the nervous tissue of animals, and can progress to cause mortality. Several strains of the virus have been documented with molecular techniques in Tasmania and Victoria, which appear to have differing virulence. The susceptibility of abalone to each strain appears to vary with their geographic origin, and concurrent exposure to environmental/husbandry stressors. The virus has been documented to spread through direct contact (abalone to abalone) and through the water column. Transmission via fomites such as people, mucus, shells, offal and contaminated equipment is also suspected as a pathway for transmission.

AVG has the potential to cause large mortalities in commercial and wild stock. Affected animals exhibit a range of clinical signs including reduced pedal movement (they will often slide or fall off their hides), 'curling of the foot' (a concave elevation of lateral foot margins), swelling and protrusion of the mouth parts and excess mucus production. Affected animals will show varying degrees of clinical signs, with some only exhibiting cessation of feeding.

Due to the potential for high rates of morbidity and mortality associated with the virus, risk mitigation is of upmost important in all facets of the operation to prevent entry of the virus as well as spread into wild populations which may surround the operation.

Histopathological lesions

Abalone affected with AVG demonstrate inflammation (increased infiltration by haemocytes) and necrosis confined to neural tissue (cerebral, pleuropedal and buccal ganglia, branches of the pedal nerve and peripheral nerves).

2.3 Diagnostic Techniques and Monitoring

Disease diagnosis begins on the farm. The two diseases of highest concern are Perkinsosis and AVG. It is important that farmers are able to recognise suspicious visual signs for early detection.

Suitable equipment including water quality test kits and meters (DO, temperature, pH, KH, GH, nitrates/nitrites/ammonia), a microscope and a dissecting kit, can aid in the diagnosis of disease. Further laboratory diagnostic testing is often required to determine the cause of morbidity and mortality. Early disease detection can allow the consulting veterinarian to advise on management, treatments and further investigations where necessary. As a result, farmers can quickly begin a response without delay.

Visual Observations

1. Behavioural changes e.g. Abalone having problems gripping onto their hide or slab
2. Cessation of feeding is a strong indicator of disease
3. Changes in colour i.e. pigmentation
4. Changes in mucous production
5. Irregularities in flesh consistency i.e. are there any nodules, ulcers, abscesses noted?
6. Abnormal swellings or protrusions e.g. AVG will caused swelling of the mouth parts and an everted radula

Where there is suspicion of infection/ emergency disease, **refer to latest version of DPI Disease Fact Sheet, as shown in Appendix 2.**

Histology

Histological samples should be collected routinely for disease monitoring; and are necessary during a disease outbreak. Histopathology is a useful tool that allows microscopic examination of tissue.

When the disease cannot be diagnosed on-farm, samples of the infected stock should be delivered to a diagnostic laboratory. The importance of packaging appropriate samples for diagnostic purposes cannot be over-emphasised. The selection and packaging of the samples together with the accompanying information can determine the success or failure of the diagnostic investigation.

Sample submission

In the first instance, samples should be submitted to the relevant state government laboratory. The laboratory should be contacted directly to ensure that samples are collected using techniques that will satisfy its requirements. In the event that the laboratory cannot be contacted (e.g. out of hours), formalin-fixed should be submitted for histopathology. For analysis by polymerase chain reaction (PCR), fresh, or frozen tissues (or, if this is not possible, tissue preserved in 95% ethanol) should be submitted.

Also refer to Appendix 2 - "Packing abalone for disease testing".

Specimen Selection

Many pathogens (disease producing organisms) die or leave soon after the death of the host animal or their presence may become masked by decomposition. Consequently, stock found dead in the water are of less value for diagnostic purposes, than obviously sick animals which are still alive. Ideally, a range of clinically affected individuals should be sampled including those in early stages of disease, those displaying aberrant behaviour and moribund (nearly dead) individuals. Samples that are representative of the population (inclusive of moribunds) should be collected and sent to state laboratories. The consulting veterinarian will specify the number of samples needed for testing.

Live affected animals (preferably moribund) are the most desirable and reliable for diagnosis. If this is not possible, the specimens should be kept on wet ice and sent unfrozen. A final option is to send the specimens preserved in alcohol or formalin.

Shipment of Specimens

Live specimens – Pack live abalone into plastic lined foam box. The box should then be packed in a watertight container, sealed and clearly labelled "Scientific Specimens - Perishable" followed by the delivery address. During hot weather, the specimens may be kept cooler by using crushed ice or cooler packs situated next to the stock. Deliver direct to the laboratory if possible or overnight express courier transport is suitable.

Iced specimens -After collecting the stock, wrap in a damp cloth or paper towel. Place the sample in a plastic bag and cover with crushed ice. Shipment should be in a well-insulated container with a generous quantity of coarse crushed ice. Place in a watertight container and clearly label. Do not ship iced stock if delays are expected, as decomposition will render the sample unsuitable for diagnosis. Specimens should be received for examination within 24 hours.

Preserved specimens -Place the specimens in a plastic bottle using at least 10 times the volume of fixative as tissue. If the stock is more than 10mm thick, an incision should be made every 10mm through the foot, across the length and width of the animal to allow the penetration of the preservative into the body cavity. Fill the container with 10% buffered formalin. Seal the container, place it within another watertight container and label correctly.

Information to Accompany Specimen

It is important to provide as much information as possible with the specimens. Specimen forms should be sent with every sample and the following should be clearly indicated:

- Farm name; address; phone number and date;
- Consulting veterinarian contact details;
- Species of stock; age and size;
- Water quality including pH; temperature; dissolved oxygen; ammonia/nitrate/nitrite; salinity;
- Size and type of production facility e.g. pond; slab tank; hatchery;
- Stocking density;
- Date mortality began and mortality rate;
- Clinical signs e.g. poor feeding, visual signs and any changes noted on necropsy (post mortem) of deceased and moribund stock;
- Diet; size and manufacturer; ration; storage ;
- Recent changes in husbandry: harvesting; grading; changes in diet; chemical; water exchange rates; treatments; new stock importation and their respective dates;
- Environmental changes- e.g. weather conditions; algal blooms in water source.

3 Control and Eradication

A number of different control measures may be effective in minimising the impact of a disease outbreak. This section provides background information to enable the choice of the most appropriate control measure following detection of Perkinsosis and AVG, however can also be applied to any unknown or exotic diseases.

There are essentially two main control options should Perkinsosis and/or AVG be detected:

- *Eradication* — eradication (highest level of control measure and cost); and
- *Containment, control and zoning* — containment to areas with known infection, prevention of further spread and protection of uninfected areas.

The general principles for the control and eradication of Perkinsosis and AVG include:

- Rapid detection and identification of infection;
- Rapid definition of the nature and extent of the problem;
- Rapid definition and implementation of control measures;
- Prevention of spread of disease by controlling stock movement; and control of potential vectors of disease i.e. vermin; equipment; personnel; water bodies (both incoming and outgoing water)
- Maintenance of good management practices and high standards of hygiene.

The most appropriate response will depend on the following (AQUAVETPLAN, 2004):

- **The stage of disease outbreak:** This takes into account the extent of the disease outbreak i.e. if wild populations are involved; disease spread on-farm; and the time period in which the disease has been within the property
- **The disease agent**: Epidemiology, biology and stability of the agent (this will be advised by the reporting veterinarian- where known, or a precautionary approach is appropriate if the agent is unknown)
- **Site specific features** i.e. effluent holding; harvesting/treatment facilities; input/output control of water; movement of farm vehicles/equipment and personnel; possible disposal of affected stock
- **Proximity of other establishments and the environment surrounding the property** i.e. can the outbreak be contained to one property; what other populations may be at risk; monitoring of populations in the surrounding area; possible poaching activities around the area and the wild-catch industry (both commercial and recreational)
- **Economic impacts**: The investment at risk; value of the stock; is emergency harvesting viable or can the disease be controlled so that stock is able to be grown-out; will the disease have an impact on consumers and markets i.e. can it be sold for human consumption in both domestic and international markets
- **Effectiveness of the control measure employed**: This will depend on the pathogenesis of disease- are there known effective treatments available; the likelihood of carriers being in the affected population; withdrawal periods for treatment and environmental impacts of chosen medication(s)

- **Implications of disease or control measures to industry/trade relations**: Normally dealt with at the state/commonwealth level. Both diseases of concern (*Perkinsus Olseni* infection and AVG) are listed on the OIE reportable disease list. Both diseases are not exotic to Australia. Some countries may require imports that are certified free from relevant infection. The Australian Quarantine and Inspection Service are responsible for the health certification of all exports and should be contacted for further information about export requirements.
- **Cost of control:** Short and long-term consequences; cost-benefit ratio; these issues are likely to be decided at a higher level (i.e. Director of Fisheries/Chief Veterinary Officer)

Semi-closed land-based systems options

In 'semi-closed systems' (i.e. the broodstock and quarantine facilities), the movement of abalone can be controlled and there is control of the distribution and flow of water. According, the impact of any antibiotic or disinfectant treatment is able to be more controlled in a semi- closed system than in an open or semi-open system.

The majority of the farm is a 'semi-open system' (with the exception of the broodstock/ quarantine facilities). However, the farm has integrated the ability to rapidly isolate and contain the water flow within individual farm components if required- i.e. to become 'semi-closed' or 'closed' systems. For example, a single Grow-Out Shed can be quickly isolated to only allow water to be recirculated within the system, without allowing water to be discharged or shared with other facilities on the farm. Isolating the sub-systems in this manner is an effective means of containment.

In semi-closed systems, the critical step in deciding how to proceed will be an assessment of the extent of disease spread that has taken place.

3.1 What Steps can be Taken to Control Losses while Waiting for Results?

A veterinarian should be notified if a disease outbreak occurs. Advice may then be given regarding the types of samples to be collected. A site visit may also be requested if the veterinarian believes it to be necessary. Laboratories will require varying time periods to process and communicate findings.

Bacteriology (culture and sensitivity, bacterial isolation); Virology (identification of a viral agent); Histopathology (stained and processed tissues for microscopic examination by a veterinary pathologist) may take between 2 to 14 days for completion. Parasitological examination; gross pathology from necropsy and water quality analysis should be available sooner.

- While waiting on results, the best approach is to remove mortalities from the tank daily, change to full recirculation mode, with the reduction of feed levels to maintenance levels resulting in nil water out flow.

- Should a tank of abalone exhibit symptoms consistent with AVG, such as protruding radula, water flow should be stopped from that tank (such that effluent discharge ceases from affected tank(s)), and disinfection procedures commenced, whilst awaiting the laboratory results.

- Affected ponds or tanks should be isolated and equipment quarantined from other ponds or tanks.
- All wetted equipment must be system dedicated and thoroughly cleaned (using an effective disinfectant) and dried between uses.
- A disinfecting agent must be selected from the AquaVetPlan manual, http://www.daff.gov.au/__data/assets/pdf_file/0008/617183/decontamination-manual.pdf

  which will be effective against the suspected agent of disease. Guidelines should be followed from the manual which outlines the concentrations needed, and the durations of exposure to achieve thorough disinfection.

- Stock must not be transferred off-farm for stocking farms or waterways.
- Where stock are sent to a processor, the processor should be informed and suitable disinfection protocols put in place for equipment returning to the farm, other farms, or commercial divers, who use the same processor.
- Personnel must be made aware of the situation and any new protocols which may be implemented. Additional protocols may be advised by the field-veterinarian.

- For market size stock, food safety issues should be considered.

3.2 Methods to Prevent Spread and Eliminate Pathogens

3.2.1 Quarantine and Movement Controls

The following quarantine and movement controls could be implemented immediately upon suspicion of infection.

Establishment of quarantine areas

Definitions of specified areas for quarantine control include the following:

- *Declared premises or area* — includes restricted area and control area
- *Restricted premises or area* — an area around infected premises or areas that are likely to be subject to intense surveillance and movement controls. Movement of potential vectors of disease out of the area will be prohibited. Multiple restricted areas can exist under one control area.
- *Control premises or area* — a buffer between the restricted area and free areas. Restrictions in this area will likely reduce the risk of disease spreading to surrounding areas. The extent of the control area can change as the outbreak is

confirmed. Permits are required to move animals and specified products out of the control area.

- *Free premises or area* — non-infected area (free of pathogen)
- *Infected premises or area-* an area in which the disease has been confirmed
- *Suspect premises or area-* an area where the emergency disease is suspected but not yet confirmed
- *Dangerous contact premises or area-* an area which has had contact with an infected premises/area e.g. animal movements or vehicle movements.

The declaration of the above areas will be performed with the collaboration of the field-veterinarian and Chief Veterinary Officer and Government staff.

In the declaration of quarantine areas, the following factors need to be taken into account:

• Processes involved;
• Environmental factors;
• Processing options (animals and products);
• Natural vs. artificial barriers or boundaries;
• Nature of the outbreak; and
• Presence of native abalone populations.

The following practices must be considered when implementing control strategies:
• Possible poaching activities within the area;
• Recreational abalone fishing within the area;
• Abalone harvesting and transportation to processing plants;
• Discharge of processing plant effluent;
• Movement of farm vehicles and personnel; and
• Disposal of dead abalone.

Movement controls

Movement controls may be guided by the field veterinarian and can be reviewed as the disease investigation progresses. Movement controls could include:

- Bans on the movement of live abalone and abalone products into, within, or out of restricted and control areas;
- Bans on the movement of live abalone and abalone products into non-infected areas;
- Restrictions or bans on movement of people, vehicles or equipment within the farm containing abalone within the declared area;
- Restrictions on discharge or disinfection of effluent water

The implementation of bans and restrictions will be a dynamic process, determined by the location and extent of the disease outbreak and whether the aim is to eradicate the agent or to control its spread. The feasibility of the restrictions and bans and the extent to which they are enforced will depend on the location of infection control response option chosen. Permits will be necessary for any types of movement and must be reviewed by the state.

3.2.2 Tracing

Tracing the spread of an agent is the process of retrospectively determining its mode and pattern of spread. Tracing investigations are crucial in determining all confirmed and potential locations of the agent, as well as in defining restricted and control areas.

The information gathered from tracing will assist in determining the most appropriate response action. The immediate steps required are to trace-back all contacts with infected abalone, premises and sites (to establish the origin of the outbreak) and to trace-forward all contacts with infected abalone, premises and sites (to establish the current location and potential spread of infection).

The following must be traced:

- Abalone — broodstock and seed (movement, rehydration, and origin of stock);
- Abalone products — abalone for consumption, effluent and waste products from processing (particularly distribution and the end location/disposal of waste);
- Water — input and output as well as disinfection procedures employed on-farm;
- Vehicles — transport vehicles, feed trucks, visitors cars, boats;
- Materials/Equipment — feed, tanks, floating installations (where appropriate), tools and instruments;
- Personnel — farm workers, sales and feed representatives, tradesmen, veterinarians, scientists, technicians and visitors (anyone allowed on-site); and
- Abalone diving industry — movement of divers (recent dive sites, deliveries of broodstock).

Neighbouring abalone populations

Any neighbouring abalone farms or hatcheries and fish processing plants may become, or may already be, infected. Maps showing the location of neighbouring abalone farms, processing aquatic industries that may be infected or contaminated and waterways, and hydrographic data, are necessary to monitor the potential spread of disease. The location of susceptible abalone species and animal reservoirs in the vicinity of the infected site should also be noted. Other sites of infection may be identified if a number of facilities share common water.

3.2.3 Surveillance

Surveillance is the continuous investigation of a given population to detect the occurrence of disease for control purposes. If the disease has been identified, targeted surveillance will likely be employed (where a single disease is of concern). Surveillance, using screening for clinical signs and laboratory testing, is necessary for the following:

- Define the extent of infection;
- Support tracing activities;
- Detect new outbreaks;

- Establish restricted and control areas to which quarantine and movement restrictions are applied;
- Establish disease-free and infected areas;
- Monitor the progress and success of a control or eradication strategy.

The local disease control centre (LDCC) is an operational unit which is established by State Government when investigating a disease outbreak and will advise and co-ordinate surveillance and disease investigation at a local level.

3.2.4 Treatment of Infected Abalone

Treatments and decontamination of the premises may be guided by the attending field-veterinarian.

Reducing water temperatures may reduce parasite transmission and disease expression, but farms do not typically have the ability to regulate water temperatures, hence such therapies are rarely able to be applied in practice.

Treatment of stock with medication may require a prescription or permit from the Australian Pesticides and Veterinary Medicines Authority, depending on the product, outlining the handling of medication(s); storage; withholding period; dosage; treatment length as well as specific instructions for administration. Accurate records will need to be kept of medications. Antibiotics are of no value against parasitic and viral diseases like Perkinsosis and AVG.

Disease outbreaks in abalone culture facilities should be controlled by:

- Isolating infected tanks by a change to full recirculation mode, with the reduction of feed levels to maintenance levels resulting in nil out flow.
- Removal of populations of infected, and in contact, abalone
- Followed by washing equipment in fresh water (Goggin and Lester 1995).

Further decontamination guidelines are outlined below. Commercial UV irradiation equipment that gives a dose of 60,000μWs/cm^2 is useful to prevent the passage of viable *P. olseni* in incoming water (Lester and Hayward 2005), and may be utilised.

3.2.5 Destruction of Abalone

Harvest and destruction must be hygienic and there must be no spillage of the waste produced by these activities which could release infective material off-site. The most appropriate method of destruction will depend on the following factors:

1. Size and number of abalone;
2. Deadline for harvest or destruction, which depends on the pressure of infection and the risk of further spread;
3. Slaughter facilities — site, equipment and methods available; and
4. Experience and availability of personnel (OHS)

5. The end use of the destroyed animals
6. Type of system

In a semi-closed system (i.e. broodstock and quarantine facilities), the preferred method of destruction is by processing (freezing or canning). If removal of the animals from the tank is not readily possible, then the addition of isoeugenol or benzocaine (anaesthetic) into the water may be necessary- this can be administered at a therapeutic dose which will allow movement of animals; or a lethal dose.

Information on anaesthetics that are registered for use in abalone can be found in the Public Chemical Registration Information System of the Australian Pesticides and Veterinary Medicines Authority. This database contains details of agricultural and veterinary chemical products that are registered or permitted for use in Australia, including the product name, active constituents, details of which animals the product can be used on, guidance on dose rates, duration of exposures and disposal. Some products will only be available for use on veterinary prescription.

3.2.6 Disposal

A disposal site must be selected for those animals which are not to be processed for human consumption.

Disposal must be immediate to decrease infection pressure on the site. They should be removed as soon as possible and disposed of, together with other waste, to prevent further spread of infection. Burial sites must be chosen carefully to prevent contact (both current and future) with waterways, groundwater or vectors. For example, dispose of at an appropriately licensed landfill such as the Port Stephens Bedminster composting facility

In certain circumstances, the CVO or DF will allow emergency harvest of clinically affected animals if they are still fit for human consumption. Transport of affected animals to a processor will need to comply with the state/territory regulations. Specific instructions will be provided.

3.2.7 Decontamination

Effective decontamination is a process that requires both physical and chemical cleaning methods. Disinfection protocols may need to be determined on a case by case basis, involving discussions between the farm manager and the state or territory chief veterinary officer (CVO) and/or director of fisheries. The protocol should take into consideration:

- The source and location of infection:
    - What is the pathogen of concern?
    - What is the primary source of infection?
- The construction materials of the buildings or structures on the site
    - What types of materials and equipment require decontamination?

- The design of the site and its proximity to other buildings or waterways:
    - Are there any environmental pollution risks?
- Current disinfection protocols; with reference to the Abalone Aquaculture Dialogue Standards
- Availability of approved, appropriate and effective disinfectants.

The decontamination process should have the following stages:

1. Planning- risk assessment (see Section 4); design of effective procedures which are practicable (risk management); training and education of all personnel (communications)
2. Implementation of new protocols- cleaning, disinfection and waste treatment
3. Testing for effectiveness- quantitative testing to ensure that adequate decontamination is achieved.
4. Auditing/review of the procedures implemented and changing protocols where necessary to improve efficacy.

3.3 Environmental Considerations

Environmental considerations in the control of Perkinsosis and/or AVG include the following:

1. Discharge of infected, or potentially infected, effluent into catchment areas or natural waterways may lead to further spread of infection and the establishment of reservoirs of infection in wild populations and waterways.
2. The use of disinfectants or antibiotics may impact on the environment, especially if used in larger than normal quantities or concentrations, as is possible in a disease control situation. The local environmental protection agency may need to be consulted
3. The destruction and disposal of infected material may have an impact on the environment, and this must be minimised while preventing the dissemination of infection.

3.4 Sentinel and Restocking Measures

Restocking should only occur once it has been ascertained that Perkinsosis and/or AVG is no longer likely to be present in the water body or aquaculture system. This may involve the holding of disease free, susceptible sentinel abalone in cages at different locations in the water body. It may be difficult to ascertain that the disease is no longer present, as sentinel abalone may not be exposed to the organism if there are low population densities of infected abalone in the water body. The length of exposure time for sentinel stock would also be critical.

Abalone used for restocking must be disease free. Health certification is recommended, and screening for disease.

3.5 Public Awareness

Any public awareness campaign must emphasise education, surveillance and cooperation from industry, governments and the community in order to control potential outbreaks of Perkinsosis and AVG. Such campaigns should also emphasize that the disease does not pose a human health risk.

3.6 Feasibility of Control

The feasibility of controlling an outbreak of disease depends upon both the nature of the outbreak (including whether it occurs in an open, semi-open or semi-closed system) and the control management strategy adopted.

3.7 Eradication

Eradication is more likely to be successful in a closed system than in open or semi-open systems. Individual tanks are easily isolated, emptied and disinfected.

Managing unexposed abalone during eradication

Young (pre-market sized) unexposed abalone may be allowed to grow out, provided that there has been no risk of infection, and animals are able to be maintained in a biosecure facility with negligible risk of cross-contamination. Testing may be required to determine disease status of biosecure stocks. Market size abalone from uninfected biosecure systems, which are not expressing clinical signs of disease may be harvested for human consumption. Strict hygiene protocols for the farm, transportation and processing would be required to ensure the infection does not spread from the farm to other locations.

Managing exposed or potentially exposed, clinically normal abalone during eradication

Rapid removal of these populations from the water is essential. Normal, or controlled, grow-out is not an option in an eradication campaign for exposed or potentially exposed, clinically normal farmed abalone populations. These populations may harbour sub-clinical disease, and so pose a high risk of subsequently transmitting the disease, or expressing the disease should their carrier status lapse into a disease state.

There are two options for the destruction of these abalone:

- The abalone may be harvested for human consumption. Due to the time involved this activity will carry a risk of further transfer of infection, which may jeopardise the success of an eradication strategy unless it is carried out under strict control measures. It may occur with the direction of the Director of Fisheries DPI NSW. Disinfection of the effluent water from potentially exposed animals prior to discharge would be prudent. Combined with change to full recirculation mode, with the reduction of feed levels to maintenance levels resulting in nil water out flow.
- Abalone that cannot be harvested for human consumption (i.e. not market size) should be immediately destroyed (under strict control measures). This can occur very rapidly and is

therefore effective at decreasing the infectious load on a site and minimising the potential spread of infection.

Control measures necessary to prevent further spread of infection include:

- disinfection of all equipment and personnel involved in harvesting, destruction and processing;
- application of quarantine restrictions and procedures to the infected site, including for personnel, equipment and vehicles;
- on-site processing — possibly the only option if quarantine restrictions are in place. This may occur in carrying out the directions of Fisheries DPI NSW.
- strict movement and disinfection procedures for the transport of abalone to off-site processing plants, which will then become infected sites that are subject to quarantine procedures;
- holding, treatment and safe disposal of harvest or processing effluent (including holding water and any waste material); and
- ensuring that the final product will not result in the spread of infection (e.g. inactivation by cooking).

Managing Groups of abalone exhibiting visual signs of disease during eradication

Immediate removal, destruction and disposal of all diseased and dead abalone are essential to the success of an eradication strategy. The AQUAVETPLAN destruction and disposal manuals provide guidance on suitable techniques to undertake these activities.
http://www.daff.gov.au/animal-plant-health/aquatic/aquavetplan/destruction
http://www.daff.gov.au/animal-plant-health/aquatic/aquavetplan/disposal

The AQUAVETPLAN decontamination manual can then be used to ensure the site is disinfected prior to considering restocking.
http://www.daff.gov.au/__data/assets/pdf_file/0008/617183/decontamination-manual.pdf

3.8 Containment, Control and Zoning

AQUAVETPLAN outlines this process in the Control Centres Manual which is part of a generic response to an emergency aquatic animal disease event.
http://www.daff.gov.au/animal-plant-health/aquatic/aquavetplan/control-centres

Managing unexposed abalone within zoned areas

The implementation of a zoning policy, and associated control measures, to maintain uninfected zones may be necessary. The status quo in relation to stock movement and farming are likely to remain in areas zoned free from disease. NSW DPI may alter biosecurity measures during or after reviewing disease outbreaks.

Exposed or potentially exposed, clinically normal abalone within zoned areas

A successful zoning program will rely on the implementation of movement restrictions for exposed or potentially exposed abalone that prevent spread of disease (e.g. Perkinsosis or

AVG) to uninfected zones. The feasibility of a zoning program will depend on farm management practices, the extent to which infection has already spread, and the location of reservoirs of infection. This can only be assessed at the time of the outbreak, taking into account movement restrictions required on abalone, people, vehicles and boats, and market access for the abalone products and byproducts. Should potentially exposed young abalone be allowed to grow out, they should be treated as infected, or sub-clinical carriers. Hence movement to declared free areas should be avoided.

In a declared area, normal or controlled grow-out and slaughter may be undertaken when eradication is considered by NSW DPI to not be feasible, and management practices can reduce the mortality rates to acceptable levels for cost recovery in an emergency harvest situation. These measures are likely to be feasible only in a semi-closed system where discharge of pathogens in effluent water is able to be controlled. The other circumstance which may permit continued farming would be where NSW DPI had assessed the risks/consequences of pathogen discharge to be negligible to the environment.

To prevent spread of infection, care must also be taken when processing and transporting final products to the designated market.
Treatment of exposed or potentially exposed but clinically normal abalone may be possible, depending on the disease, as outlined in Section 2.2.

Immediate destruction of the abalone is an option for containment, control and zoning, as it is very effective at decreasing the infectious load on a site and minimising the spread of infection.

Managing clinically diseased abalone in zoned areas
Populations of clinically (visually) diseased abalone, along with infectious wastes (mucous, dead abalone and contaminated water), are considered to be the main sources for disease transmission to the environment and constitute the greatest risk for spreading the infection to uninfected zones, or within the containment area. Immediate destruction is recommended for populations of clinically diseased abalone. Burial sites should be chosen carefully to prevent contact with waterways, following guidelines in the AQUAVETPLAN Disposal Manual e.g. disposal at an appropriately licensed landfill.

3.8.1 Trade and industry considerations

Perkinsosis is already endemic across much of the NSW coast. Hence an outbreak on a farm does not constitute an exotic disease outbreak. It may however alter the trading disease status of the farm, which may prevent translocation of stock to other farms. Farms are required to follow State translocation policies for movement of live aquatic animals, and may require laboratory testing and veterinary health certification depending on the originating farm and destination for the stock.

Perkinsosis has not been identified to be a problem in the oyster, pipi or mussel industries, throughout the endemic area where the pathogen has impacted on the wild abalone population (Port Stephens-Jervis Bay/Merimbula-hot spot). Hence, it is unlikely that an

outbreak of this disease would have a major impact on other mollusc industries, or trade. It is required to be reported to the State Authority, as the disease is listed by the OIE and the Australian National List of Reportable Aquatic Animal Diseases.

AVG has been detected in a wholesale facility in NSW, but not in any farmed or wild stock at this time. AVG remains a high risk for NSW, particularly where broodstock or seedstock may be translocated outside of their biogeographic population, into a new area. Strains of AVG appear to be limited to certain regions in wild stocks in Tasmania and Victoria. AVG is not known to infect other molluscs, so is unlikely to cause significant disturbance to other mollusc industries. Detection of AVG is required to be reported to the State Authority, as the disease is listed by the OIE and the Australian National List of Reportable Aquatic Animal Diseases. Such a report may alter trading arrangements for live abalone, depending on the conditions required by the importing country. Given Australia is already reporting to OIE as AVG positive, and it has not established zones, or compartments of freedom for trading purposes at this time, it is unlikely that a further positive AVG detection would cause a major disruption to trade.

Export markets

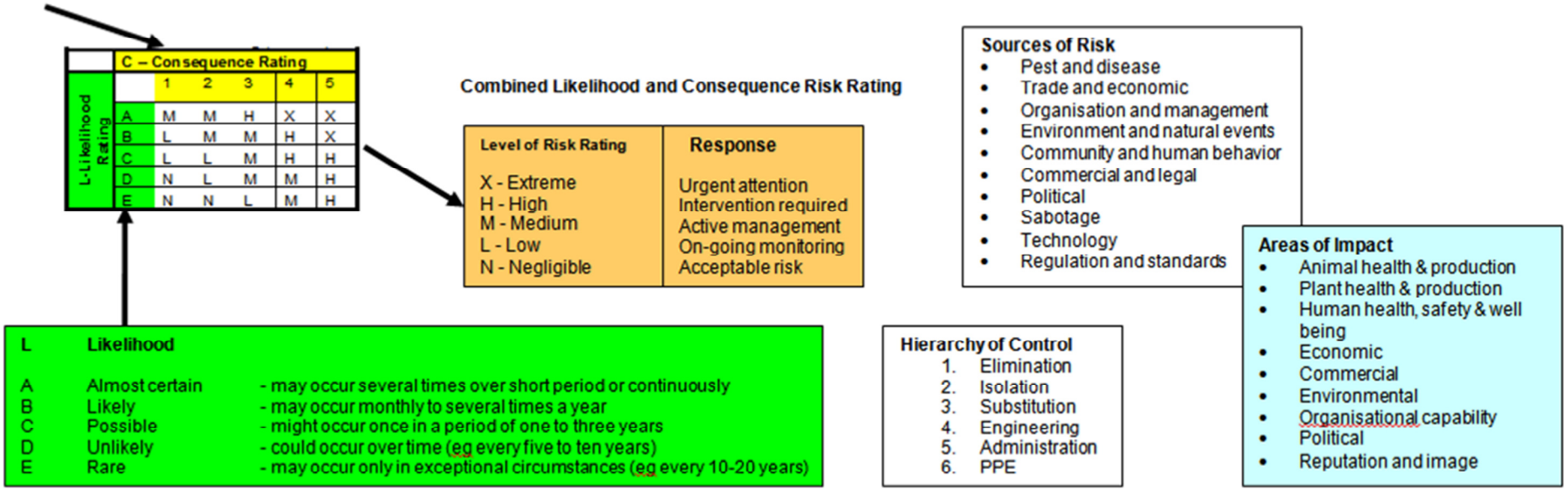
Both diseases (*Perkinsus Olseni* infection and AVG*)* are listed by the OIE. Some countries may require imports to be certified free from relevant infection. The Australian Quarantine and Inspection Service is responsible for the oversight of health certification of all live animal exports and should be contacted for further information about export requirements. The requirements for certification are set by the importing nation.

4 Risk Identification and Treatment Methodology

The following information and template, read in conjunction with the risk analysis methodology at Appendix 1, outlines the risk identification and treatment methodology utilized within the farm to address disease risk issues. This methodology is proposed by NSW Aquatic Biosecurity. Farm management measures have been assessed using this methodology, and the results are provided in the Risk Identification & Treatment Plan within Section 4.1, following.

Consequence Description for each Area of Impact

Rating	Consequence	Animal health & production	Plant health & production	Human health, safety & well being	Economic	Commercial	Environmental	Organisational capability	Political (govt & business sector)	Reputation & image
1	**Insignificant**	No loss	No loss	No injuries	No economic loss	No financial loss	No environmental impact	Organisational capability intact, negligible impact on objectives	No political/ organisational impact	No damage to reputation/image
2	**Minor**	Limited illness/injuries &/or deaths on single enterprise	Limited damage/loss on single enterprise	Minor injuries; no public health risk; short term well being impact	Few businesses locally affected or single/few properties	Low financial loss; single/few properties affected	Minor,/recoverable short-term isolated/localised environmental impact	Local capability affected, minor impact on objectives, easily remedied	Local political / organisational impact	Recoverable / short term local damage to reputation/image
3	**Moderate**	Some illness/injuries/deaths on multiple properties across a locality	Some damage/loss on single property – multiple paddocks	Limited public health risk &/or injuries requiring medical & mental health treatment	Widespread industry impact; multiple industries / properties per district	Medium financial loss; multiple properties per district	Moderate, medium term, medium spread environmental impact	Regional capability affected, some objectives affected	Regional political / organisational impact	Medium term / regional damage to reputation/image
4	**Major**	Considerable illness/injuries/deaths on multiple properties across a region	Considerable damage/loss on multiple properties across a region	Major public health risk &/or major injuries/well being impact	High economic /trade risk to region &/or state	High financial loss	Serious, long term, widespread environmental impact	State capability affected, important objectives not achieved	State political / organisational impact	Long term/ state damage to agency reputation/image
5	**Catastrophic**	Significant illness/injuries/deaths on multiple regions	Considerable damage/loss across multiple regions	Significant public health risk &/or human deaths/ long lasting well being issues	Major national economic implications	Major national financial loss	Irreversible environmental impact	National capability affected, most objectives not achieved	National political / organisational impact	Long term / (inter) national damage to reputation / image irreversibly impacted

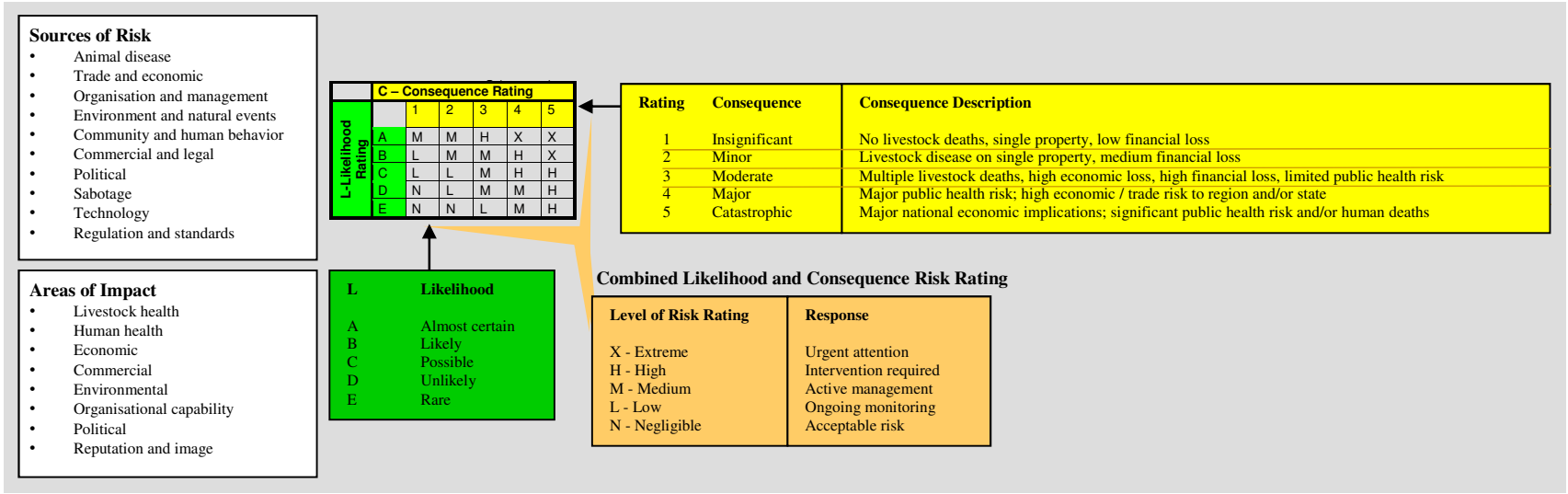

C – Consequence Rating
L-Likelihood Rating
1 2 3 4 5
A M M H X X
B L M M H X
C L L M H H
D N L M M H
E N N L M H
Combined Likelihood and Consequence Risk Rating
Level of Risk Rating
Response
X - Extreme
H - High
M - Medium
L - Low
N - Negligible
Urgent attention
Intervention required
Active management
On-going monitoring
Acceptable risk
Sources of Risk
Pest and disease
Trade and economic
Organisation and management
Environment and natural events
Community and human behavior
Commercial and legal
Political
Sabotage
Technology
Regulation and standards
Areas of Impact
Animal health & production
Plant health & production
Human health, safety & well being
Economic
Commercial
Environmental
Organisational capability
Political
Reputation and image
L Likelihood
A Almost certain - may occur several times over short period or continuously
B Likely - may occur monthly to several times a year
C Possible - might occur once in a period of one to three years
D Unlikely - could occur over time (eg every five to ten years)
E Rare - may occur only in exceptional circumstances (eg every 10-20 years)
Hierarchy of Control
1. Elimination
2. Isolation
3. Substitution
4. Engineering
5. Administration
6. PPE

Risk Identification and Treatment Template

1 Specific Risk	2 Source(s) of Risk	4 Current Risk Treatment
	3 Area(s) of Impact	

5 Current Risk Profile			6 Proposed Risk Treatment	7 Risk Profile After Treatment			8 Comment**
5a L Likelihood	5b C Consequence	5c Risk Rating		7aL	7bC	7cRisk Rating	

Mandatory requirement if assessed level of risk rating is **X** (extreme) or **H** (high)


Sources of Risk
• Animal disease
• Trade and economic
• Organisation and management
• Environment and natural events
• Community and human behavior
• Commercial and legal
• Political
• Sabotage
• Technology
• Regulation and standards
Areas of Impact
• Livestock health
• Human health
• Economic
• Commercial
• Environmental
• Organisational capability
• Political
• Reputation and image
C – Consequence Rating
L-Likelihood Rating
1 2 3 4 5
A M M H X X
B L M M H X
C L L M H H
D N L M M H
E N N L M H
Rating Consequence Consequence Description
1 Insignificant No livestock deaths, single property, low financial loss
2 Minor Livestock disease on single property, medium financial loss
3 Moderate Multiple livestock deaths, high economic loss, high financial loss, limited public health risk
4 Major Major public health risk; high economic / trade risk to region and/or state
5 Catastrophic Major national economic implications; significant public health risk and/or human deaths
L Likelihood
A Almost certain
B Likely
C Possible
D Unlikely
E Rare
Combined Likelihood and Consequence Risk Rating
Level of Risk Rating Response
X - Extreme Urgent attention
H - High Intervention required
M - Medium Active management
L - Low Ongoing monitoring
N - Negligible Acceptable risk

4.1 Risk Identification and Treatment Plan

1 Specific Risk	2 Source(s) of Risk	4 Current Risk Treatment
Brood stock acquisition	Introduction of disease including viruses e.g. AVG and parasites e.g. Perkinsus with the new stock Abalone feed	
	3 Area(s) of Impact Animal health and production Economic Environmental, if non-endemic disease is released locally	

5 Current Risk Profile			6 Proposed Risk Treatment	7 Risk Profile After Treatment			8 Comment**
5a L Likelihood	**5b C** Consequence	**5c Risk Rating**	Follow documented quarantine procedure Incoming water to be treated by aging for 5 days, UV and filtration treatment In brief, maintain area as controlled access only Inspect new stock Retain bio-fouling Retain quarantine 8 weeks No release of untreated water treatment to include disinfection by ozone as indicated above Treat shells for infestation Use of abalone feed that is free of abalone products Independent audit of Biosecurity plan Testing of potential broodstock and other selected animals Maintenance of stock in spatially separated tanks and equipment All wetted equipment must be system dedicated Use of effluent pond to dilute outflow Positioning of outlet pipe away from wild abalone fishery areas Maintain records and samples of all mortalities and contact appropriate experts if there is an unexplained death rate	**7aL**	**7bC**	**7cRisk Rating**	Proposed facility is approximately 10 kms from nearest wild population. AVG has not been found in wild or farmed NSW populations and populations of abalone infected with Perkinsus appear to be recovering. Broodstock will only be obtained locally. Filtration < 400 micron removes mudworm larvae Perkinsus zoospores bearing hypnospores are inactivated by UV dose of more than 60,000µWs/cm²
C	3	M		E	2	N	

Mandatory requirement if assessed level of risk rating is **X (extreme) or **H** (high)

1 Specific Risk	2 Source(s) of Risk	4 Current Risk Treatment
Brood stock conditioning	Introduction of disease including viruses e.g. AVG and parasites e.g. Perkinsus with incoming water or materials Abalone feed	
	3 Area(s) of Impact Animal health and production Economic Environmental, if non-endemic disease is released locally	

5 Current Risk Profile			6 Proposed Risk Treatment	7 Risk Profile After Treatment			8 Comment**
5a L Likelihood	5b C Consequence	5c Risk Rating	Follow documented broodstock procedure Incoming water to be treated by aging for 5 days, UV and filtration treatment In brief, maintain area as controlled access only All wetted equipment must be system dedicated No release of untreated water Use of abalone feed that is free of abalone products Independent audit of Biosecurity plan Testing of broodstock and other selected animals Maintenance of stock in spatially separated tanks Use of effluent pond to dilute outflow Positioning of outlet pipe away from wild abalone fishery areas Maintain records and samples of all mortalities and contact appropriate experts if there is an unexplained death rate.	7a L	7bC	7cRisk Rating	
C	3	M		E	2	N	

1 Specific Risk	2 Source(s) of Risk	4 Current Risk Treatment
Spawning	Introduction of disease including viruses e.g. AVG and parasites e.g. Perkinsus from the water supply or contaminated materials. Also from infected broodstock, esp. via mucus.	
	3 Area(s) of Impact Animal health and production Economic Environmental, if non-endemic disease is released locally	

5 Current Risk Profile			6 Proposed Risk Treatment	7 Risk Profile After Treatment			8 Comment**
5a L Likelihood	**5b C** Consequence	**5c Risk Rating**	Follow documented spawning procedure All incoming water is treated by aging for 5 days, UV and filtration treatment All wetted equipment must be system dedicated Routine decontamination of personnel at all entry points Fertilised eggs washed in sterilized water No release of untreated water Independent audit of Biosecurity plan Testing of broodstock and other selected animals Maintenance of stock in spatially separated tanks Use of effluent pond to dilute outflow Positioning of outlet pipe away from wild abalone fishery areas	**7a L**	**7bC**	**7cRisk Rating**	
C	3	M		E	2	N	

1 Specific Risk	2 Source(s) of Risk	4 Current Risk Treatment
Larval Rearing	Introduction of disease including viruses e.g. AVG and parasites e.g. Perkinsus from the water supply or contaminated materials. **3 Area(s) of Impact** Animal health and production Economic Environmental, if non-endemic disease is released locally	

5 Current Risk Profile			6 Proposed Risk Treatment	7 Risk Profile After Treatment			8 Comment**
5a L Likelihood	**5b C** Consequence	**5c Risk Rating**	Follow documented larval rearing procedure All incoming water is treated by aging for 5 days, UV and filtration treatment All wetted equipment must be system dedicated Routine decontamination of personnel at all entry points No release of untreated water Independent audit of Biosecurity plan Testing of broodstock and other selected animals Maintenance of stock in spatially separated tanks Use of effluent pond to dilute outflow Positioning of outlet pipe away from wild abalone fishery areas	**7a L**	**7bC**	**7cRisk Rating**	
C	3	M		E	2	N	

1 Specific Risk	2 Source(s) of Risk	4 Current Risk Treatment
Juvenile rearing	Introduction of disease including viruses e.g. AVG and parasites e.g. Perkinsus from the water supply or contaminated materials	
	3 Area(s) of Impact Animal health and production Economic Environmental, if non-endemic disease is released locally	

5 Current Risk Profile			6 Proposed Risk Treatment	7 Risk Profile After Treatment			8 Comment**
5a L Likelihood	**5b C** Consequence	**5c Risk Rating**	Follow documented juvenile rearing procedure Independent audit of Biosecurity plan Testing of broodstock and other selected animals Maintenance of stock in spatially separated tanks Use of effluent pond to dilute outflow Positioning of outlet pipe away from wild abalone fishery areas Maintain records and samples of all mortalities and contact appropriate experts if there is an unexplained death rate.	**7a L**	**7bC**	**7cRisk Rating**	
C	3	M		E	2	N	

1 Specific Risk	2 Source(s) of Risk	4 Current Risk Treatment
Growout	Introduction of disease including viruses e.g. AVG and parasites e.g. Perkinsus from the water supply or contaminated materials	
	3 Area(s) of Impact Animal health and production Economic Environmental, if non-endemic disease is released locally	

5 Current Risk Profile			6 Proposed Risk Treatment	7 Risk Profile After Treatment			8 Comment**
5a L Likelihood	**5b C** Consequence	**5c Risk Rating**	Follow documented growout procedure Independent audit of Biosecurity plan Testing of broodstock and other selected animals Maintenance of stock in spatially separated tanks Use of effluent pond to dilute outflow Positioning of outlet pipe away from wild abalone fishery areas Maintain records and samples of all mortalities and contact appropriate experts if there is an unexplained death rate.	**7a L**	**7bC**	**7cRisk Rating**	
C	3	M		E	2	N	

5 Reading List

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http://www.dpi.nsw.gov.au/responses/avg2011
http://www.dpi.nsw.gov.au/responses/avg2011/reporting

APPENDIX 1- Risk Analysis Methodology

Risk analysis is necessary to prevent disease entering on-farm and for food safety. A risk analysis consists of the identification of a hazard, assessment of the risk, management and communication.

Risk assessment: the scientific process of collecting and interpreting information from multiple sources to characterise and estimate a risk associated with a hazard.
The assessment of risk can be undertaken in a quantitative or qualitative manner. Below is a flow chart adapted from AS/NZS 4360:1999 standards which portrays the process of risk assessment and review (Crawford, 2003).

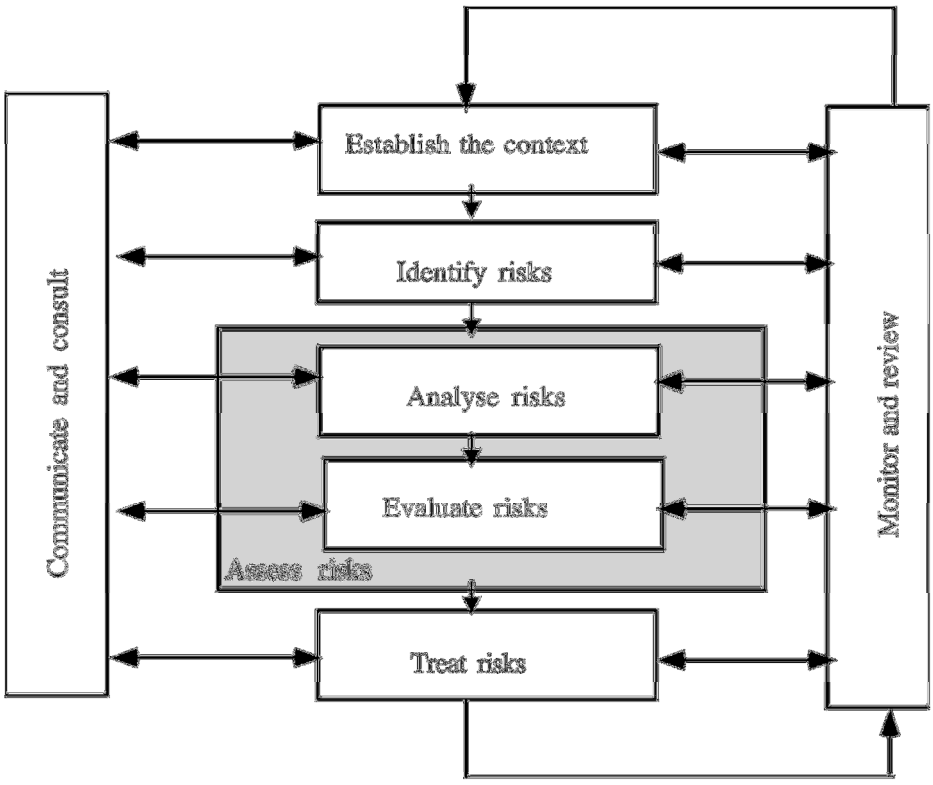

Fig. 1. Risk management overview process (adapted from AS/NZS 4360:1999).

1. **The likelihood estimation:**
    a. High (6): The event would be very likely to occur (>55%)
    b. Moderate (5): The event would occur with an even probability (approx. 50%)
    c. Low (4): The event would unlikely occur (20-45%)
    d. Very Low (3): The event would be very unlikely to occur (1-19%)
    e. Extremely low (2): The event would be extremely unlikely to occur (0.9-1%)
    f. Negligible (1): The event would almost certainly not occur (<0.1%)
2. **Consequences assessment:**
    a. These are outcomes or impact of a given event
    b. Often 4-5 consequences should be listed ranging from negligible to severe and given a value from (0-5):

Below is a general consequence descriptor which can be used as a guide for the development of a risk ranking/assessment table:

Level	Descriptor
Low (1)	Establishment of the disease has mild biological consequence and would be amenable to control or eradication and/or; May harm economic performance at an enterprise level but be of limited significance at an industry level and/or; Effect on environment would be minor or temporary.
Moderate (2)	Establishment of the disease has moderate biological consequences and disease may be amenable to control or eradication, at a significant cost and/or; May harm economic performance at an industry level and/or; May affect the environment, but not seriously and may be reversible.
High (3)	Establishment of the disease would have serious biological consequences (high mortality or morbidity etc) with effects that would be felt for a prolonged period and would difficult to control or eradicate and/or; Will significantly harm economic performance at an industry level or regional level and may cause serious harm to the environment.
Catastrophic (4)	Establishment of the disease would significantly harm economic performance at a national level and/or; May cause long-term or irreversible harm to the environment.

The overall assessment of risk involves the multiplication of the two values i.e. Consequence X Likelihood = Risk Value.

Below is a table of Risk Rankings and outcomes:

Risk Rankings	Risk Values	Likely Management Response
Negligible, Acceptable	1 – 5	Risks are acceptable and are managed through current procedures.
Moderate, Management	6 – 10	Risks are acceptable provided Risk Reduction measures are implemented to reduce risk to acceptable level.
Extreme, Unacceptable	11 – 24	Risk is unacceptable. Risk management measures will be required to achieve “acceptable risk”, or it may not be possible to meet the “acceptable risk” at all.

Risk management: The process of evaluating information generated in the risk assessment to select and implement measures that can be applied to reduce the level of risk. This is performed after a risk assessment.

Risk communication: Process of informing relative parties about the consequences associated with the risk factors assessed as well as possible routes of management. Effective communication between all personnel involved is necessary to find practicable risk mitigation measures. Constant review is necessary, and it is recommended that monthly meetings be held to help improve efficiency and efficacy.

APPENDIX 2 - NSW Department of Primary Industries Factsheet July 2012 – Primefact 1246

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0012/440220/Reporting-suspected-disease-in-abalone.pdf

NSW GOVERNMENT Department of Primary Industries

FACTSHEET

Reporting suspected disease in abalone

Aquatic Biosecurity and Risk Management

Abalone viral ganglioneuritis

Abalone viral ganglioneuritis (AVG) is a viral disease which affects the nervous system of abalone and can result in curling of the foot, swelling of the mouth, weakness and death in abalone. AVG affects both blacklip and greenlip abalone and hybrids.

AVG was detected for the first time in NSW in a retail outlet in November 2011. AVG is not known to be present in any wild abalone stocks in NSW.

AVG is a notifiable disease in NSW, and live abalone holders (eg. processors, retail outlets and restaurants) are required by law to notify DPI of suspected disease in abalone.

If you observe abalone which show signs of disease please report it immediately to the NSW Department of Primary Industries (DPI) Fishers Watch Hotline on 1800 043 536.

NSW DPI will arrange and pay for the collection of any samples which are sent to the diagnostic lab for disease testing.

Signs of sick abalone

Abalone infected with AVG may appear sickly, weak or have died. Other signs of the disease include one or more of the following:

- Protrusion of the mouth part.
- Edges of the foot curling inwards resulting in exposure of clean shiny shell around shell edges.
- Stiffness or rigidity of the abalone and/or the abalone can be easily removed from reef or holding tanks and does not right itself if inverted.
- In wild abalone stocks, the presence of fresh clean shells or shells containing partial abalone flesh may indicate recent mortalities.

Diseased greenlip abalone displaying symptoms of AVG (Photo: DPI Victoria)

Diseased blacklip abalone displaying symptoms of AVG (Photo: DPI Victoria)

1. Details to record if you observe sick abalone

If you observe suspected diseased abalone in a retail premise (or in the wild), record as many of the following details as possible:

- Names of suppliers and consignment details of abalone stock received within the previous 10 days.
- The area where the abalone was collected (state, reef name, GPS points, etc).
- The number and type (e.g. green, blacklip or hybrid) of abalone affected by disease.
- Your contact details.

Immediately report the occurrence to the **DPI Fishers Watch Hotline on 1800 043 536** and you will be advised on how to prepare abalone for disease testing.

If you have sick abalone in your premises, you should **isolate the tanks immediately stopping discharge of any water** unless water disposal is through sewer system.

2. Storing abalone for disease testing

- Collect up to 5 live sick abalone and if this is not possible, freshly dead abalone for disease testing.
- Place each sick and/or freshly dead abalone in separate/individual plastic bags in a cool place out of direct sunlight and refrigerate as soon as possible; **do not freeze**.

3. Packing abalone for disease testing

When you report diseased abalone to the DPI Fishers Watch Hotline, you will receive advice on how to pack and submit the abalone.

Abalone should be packed as follows:

- Place each abalone in an individual sealed plastic bag.
- No water should be in the bag with the abalone; however it should be moist when packaged.
- Allow some air (or oxygen if available) to remain in the bag. You may place this plastic bag in a second sealed bag to prevent water leaking.
- Place the plastic bags containing the abalone samples in an esky or foam box with ice or an ice brick.
- Include the name, address and phone number of the person submitting the samples in an envelope or plastic zip lock bag inside the esky or box and also attach a copy in an envelope or plastic zip lock bag to the outside of the esky or box.
- Ensure to also include the date and exact location where the abalone was collected (eg. the name of the retail premises, processor or reef).
- NSW DPI will give you instructions on how to fill in the lab submission form which can be found on the webpage http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/77714/vet-specimen-submission-form.pdf.
- **NSW DPI will arrange and pay for the collection of the samples by courier**. The packed samples should be addressed to:

  State Veterinary Diagnostic Laboratory
  Elizabeth Macarthur Agricultural Institute
  'Camden Park'
  Woodbridge Road
  Menangle NSW 2568

For more information on AVG and to minimise disease risks associated with abalone see:

- *General hygiene to prevent spread of abalone disease*, NSW Department of Primary Industries Primefact 1146. This Primefact provides important information on preventing the spread of AVG by reducing risks that may be associated with transport vehicles, containers and any equipment which may come into contact with abalone.
- **The NSW DPI webpage:** http://www.dpi.nsw.gov.au/fisheries/pests-diseases/animal-health/wildfish-shellfish

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