

# **A review of the Abalone Virus Ganglioneuritis (AVG)**

**November 2007  
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## **Abalone Virus Ganglioneuritis (AVG)**

### ***Victoria Australia***

In May 2006 a herpes-like virus was detected for the first time in a subpopulation of wild abalone in Taylors Bay, Victoria, Australia. Since that time the spread of the virus has been closely monitored and is showing a consistent movement along the coast of Victoria of 5-10km per month. It has most recently been observed infecting black lip and green lip abalone populations along almost 200km of the Victoria Coastline (figs 1&2)<sup>β</sup>. Stock abundance surveys conducted since the outbreak of the virus have suggested declines in the abundance of infected populations of 40-95%<sup>‡</sup>. In February 2007 the abalone divers in south west Victoria were forecasting a \$5million loss in this season's earnings as a result of the virus. In an attempt to mitigate the spread and impact of the virus both, mandatory and voluntary closures of areas of coastline to commercial and/or recreational harvest<sup>β</sup> have been imposed.



Figure 1 Area of Victoria coast in which wild abalone populations are or have been infected by ganglioneuritis virus (red)

### ***Order of Events<sup>‡,β</sup>***

October to December 2005:

- Wild abalone broodstock were collected from a variety of sources and translocated onto three land-based aquaculture farms located in Victoria, Australia. The farms were Coastal Seafarms (CS) located in Portland<sup>β</sup>, Southern Ocean Mariculture (SOM) located in Port Fairy<sup>β</sup> and Great Southern Waters located in Bellarine Peninsula.

December 2005:

- Abalone were moved between CS and SOM and onto a marine abalone farm (Abonex), located in Westernport Bay.
- High mortalities of abalone occurred on CS and SOM.
- Abalone mortalities occurred on Abonex. The animals displaying the same symptoms as those seen in mortalities occurring in CS and SOM.

January 2006:

- Abonex had removed all but a few survivors from their lease.
- A number of tanks at SOM had been destocked and the disease outbreak appeared to have been arrested

- Large numbers of abalone were continuing to die at CS
- March 2006:
- Disease had re-emerged on SOM
- April 2006:
- New infection had occurred on a second marine farm (Kilcunda Abalone Farm) in Westernport Bay, located 640m from Abonex.
- May 2006:
- The disease was detected for the first time in the wild abalone population in Taylors Bay, the coastal lagoon from which SOM pumps its water.
  - SOM totally destocked
- June 2006:
- CS totally destocked
  - Two abalone zones adjacent to SOM were declared a Control Area prohibiting diving
- August 2006:
- Control area redefined to include 25km of coastline
- September 2006:
- Western Abalone Divers Association (WADA) organised an international review of the situation by core experts including Dr Mike Hine from MAF, NZ and Dr Judith Handler from DPIWE, Tasmania.
- July 2007
- Approximately 200km of coastline from Cape Bridgewater to Peterborough have been infected by the abalone virus ganglioneuritis.

### ***Virus Origin***

There is believed to be a high likelihood that infected abalone on the SOM farm were the source of virus infection into wild abalone stocks in Western Victoria.\* There is good evidence to support the working assumption that the virus spread quickly between farms due to unmonitored and unregulated movements of animals. It is believed the virus spread from the SOM farm into the wild abalone populations of Taylors Bay as a result of inadequate biosecurity protocols (including disposal of live abalone, waste water, shell and offal) on the farm, or as a result of inadequate biosecurity waste disposal protocols from other seafood processing facilities.\*

How the virus got onto the farms is not as yet known and may well never be known. There are a number of working assumptions some more likely than others, however determining the original source is extremely difficult. Molecular probes that can detect the virus particles in abalone are in the process of being developed and these may assist in determining the original origin, or at least allow some of the working assumptions to be disregarded with the high likelihood of being false.

### ***Working assumptions – the virus is endemic***

1. The virus may be endemic in at least some abalone populations, in at least some areas of Australia. It is believed there is a high likelihood this assumption could be correct. If endemic to some areas of Australia, translocation of wild animals could have introduced naïve abalone populations (both farmed and wild) to a virus to

which they have no inherent resistance<sup>1</sup>. The behaviour of the virus in Victoria is that of a new disease in a naïve population (i.e. a population that has not been previously exposed to the pathogen) and similar naive populations are expected to exist in other areas. No pest and disease testing of the source broodstock was undertaken prior to any collecting or translocation of the animals. Therefore there is no knowledge of the health status of the abalone pre-movement.\* Also, herpesviruses often integrate into the genome of their hosts and can be vertically transmitted from parents to progeny. The virus can also remain latent within the host. In such cases infected abalone appear clinically healthy, but are carriers of the virus. There is strong evidence that vertical transmission and latency occur in oysters with herpesvirus infections (Mike Hine pers comm.).

***Working assumptions – the virus is of exotic origin***

2. There is believed to be a moderate to low possibility that the virus is exotic and a result of cross species infection. Infection of the broodstock while in transit from the wild to their final destination has not been excluded as a possibility. In transit wild abalone broodstock were routinely held and ‘rehydrated’ at a commercial live holding facility. This facility holds a wide range of live sea-food in-transit for export or import purposes, which raises the possibility of exposure of the wild abalone to cross species infection.\*
3. There is believed to be a low to moderate possibility the virus is exotic and could have entered the wild abalone population via contamination of sea water. Contamination of the seawater occurring as a result of inadequate disposal of processing wastes (viscera, shell etc) from commercial sea food processing plants.\*
4. Research suggests the virus in Victoria’s abalone is similar to a virus infecting Taiwanese abalone and causing the same clinical signs of infection as seen in the Australian animals. Whether or not the infection in the Taiwanese or Australian populations is linked in anyway is currently not known.\* Imported feed from Taiwan into Australia being the source of the virus is one working assumption that has been considered (see below).
5. There is believed to be a low possibility the virus is exotic via an unidentified source including, imported feed for farmed abalone, or via ballast water discharge from shipping.\* In 2004 a batch of abalone feed containing fishmeal, seaweed powder, soybean powder, gluten, vitamins and minerals was imported from Taiwan into Australia. The feed caused some mortalities and in early 2005 its use was apparently discontinued. The expert panel organised by WADA discounted this as a likely source of infection due to: 1) the heat treatment the feed would have undergone prior to importation; 2) the time between feed use and the current outbreak and 3) the different pathology in the mortalities caused by the feed compared to those caused by AVG.<sup>¥</sup> However there is speculation over how effective the heat treatment can be and it is believed by some that this assumption should not be discarded at this stage.<sup>¥</sup>
6. The abalone farms where the AVG virus was observed infecting both farmed and wild animals have been moving towards farming blacklip-greenlip abalone hybrids. There is a high likelihood that greenlip and blacklip abalone carry their

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<sup>1</sup> Unlike humans abalone apparently do not have immune systems that are capable of developing recognition of a new disease, so it is to be hoped that the current population will have some level of natural resistance<sup>¥</sup>.

own species of very similar herpes viruses. There is a possibility that while hybridizing the abalone species, the two herpes virus species could have also been hybridized. This could result in a new virus species to which all abalone host species are susceptible.<sup>‡</sup>

### ***The Virus***

The virus causes inflammation of the nervous tissue, resulting in the edges of the foot curling inwards, swelling and protrusion of the mouth (figs 3&4)<sup>¶</sup> and excess mucus production.<sup>‡</sup> Active signs of the viral infection include: infected animals losing muscle control and sliding or falling off their home scars on the reef, and large amounts of intact moribund abalone, shiny empty shells and loose meats rolling around in the wash.<sup>‡</sup>



Figure 3 & 4 Australian abalone infected with ganglioneuritis virus

The virus is spread laterally through direct contact between infected and healthy abalone. It is not known if or how the virus is excreted from an infected animal. If it is excreted it is not known if it is excreted in the mucus/from the gut, in the urine etc.\* However from the histopathology work done it appears the gut is the most likely source of excretion (Mike Hine pers comm.). The virus can spread without a host through the water column however it is not known how long it survives in this medium. It is not known at this stage if the virus is transmitted vertically from parent to progeny.

There is believed to be a moderate to high likelihood that stress, age, crowding or slow water flow may modify the prevalence of the virus on farms compared to infected wild areas. It is not known yet whether or not water temperature affects the severity of outbreaks.

Herpes virus species can remain latent in the host for long periods of time so observing no sign of viral symptoms doesn't mean the virus is not present in the population.

### ***Risk of AVG to New Zealand paua species***

The presence of the ganglioneuritis virus in Victoria, and the continual persistence and spread of the virus within the wild abalone populations along the Victoria coastline raises concern about the level of risk of this virus infecting New Zealand's abalone populations. The greenlip, blacklip and hybrid abalone species of Australia appear to show equal susceptibility to the virus and there is no reason to suspect New

Zealand's species of abalone are not susceptible to infection from this virus (pers com Colin Johnston Senior Veterinary Advisor, MAF, NZ).

There is currently research underway in Australia, New Zealand (MAFs Investigative Diagnostics Centre in Wallaceville) and France (IFREMER) with the aim to characterise the virus and improve understanding of its behaviour and prevalence among different host species, to sequence the AVG genome, to develop molecular probes for the virus and to improve histopathological methodologies for detecting the virus in host tissue. Australia and New Zealand researchers are working together to best utilise available resources to help improve our knowledge of the virus, and to assist in mitigating further spread and impact of the virus on currently uninfected abalone populations in both Australia and New Zealand.

However New Zealand's best defence is to stop any ganglioneuritis virus incursion occurring. It is sensible at this stage in our knowledge of how the virus spreads to assume that vectors for the virus could include the following:

- Commercial diving equipment of abalone divers that have abalone quota in both New Zealand and Victoria.
- Water sports equipment that has been used in the area of infection along the Victoria coastline. Equipment would include: surfing or body boarding gear (boards, wetsuits, rash shirts, booties etc), diving and snorkling gear and fishing gear.
- Any footwear or clothing that has been worn on a land-based aquaculture facility in Victoria or South Australia.
- Any live or dead abalone from the infected area.
- Any shells, stones or other beach material that has been collected from along the Victoria coastline.
- Imported abalone feed. Until the possible assumption that the virus could have entered the land-based farms in Australia via abalone feed imported from Taiwan has been discounted with a high degree of confidence, any abalone feed imported into New Zealand should also be considered a potential vector.

Mitigating the risk of the virus entering New Zealand on any of these vectors is best done by educating the general public about the virus and by carefully inspecting all potential vectors at the boarder control point of entry into New Zealand.

Spread of the virus can be mitigated if all surfing, diving and fishing gear is suitably washed and completely dried before leaving the infected area, or before entering an uninfected area, including New Zealand. This also includes all footwear and clothing worn on any aquaculture facility within Australia. The Tasmanian Department of Primary Industries and Water are being fully proactive in attempting to stop the virus spreading into Tasmania. The DPIW Tasmania have published a leaflet providing information on the virus and instructions on moving abalone and disinfecting, washing and drying all water sport equipment and clothing etc (Appendix One).<sup>§</sup>

Any live or dead abalone or any shells, stones, corals etc from the infected area of coastline could also be potential vectors. Removing any live or dead abalone or any other beach material from the infected area and discarding it into an uninfected area (including New Zealand) can increase the risk of spreading the virus.

Protocols at boarder control should include:

- Requiring that a traveller declare whether he/she has been surfing, diving, swimming or fishing along the Victoria coastline;
- Requiring that a traveller declare whether he/she has been on any aquaculture facility or in contact with any abalone stocks in Victoria Australia;
- Requiring that a traveller declare whether he/she is bringing into NZ any live or dead abalone, or any shell, coral or beach material collected from the infected area
- If a traveller says yes to the above, border control staff should inspect all fishing, swimming, surfing and diving gear to ensure the gear is clean (and free of any algae debris) and fully dried;
- If a traveller has been on any aquaculture facility, border control staff should inspect shoes and any other relevant clothing to ensure they are clean and dry.
- Border control staff confiscating any live or dead abalone product or any shells, rocks or other beach material that have been collected along the Victoria coastline.

### *Lessons for New Zealand*

To-date there has been no reported incursion of the ganglioneuritis virus infecting any of New Zealand's abalone species. Lessons New Zealand can learn from the situation that has occurred in Victoria include the need for:

- Strict border controls on all potential vectors coming into New Zealand.
- Strict biosecurity protocols that should be followed for all marine organism translocations and,
- Strict biosecurity protocols that are adhered to at all times, on all land-based aquaculture facilities.
- Codes of Practice to be developed for paua farm biosecurity, and aquatic animal translocation.

The biosecurity protocols for translocating marine organisms should encompass the movement of all animals. This includes moving marine organisms from the wild to land-based or marine aquaculture facilities or vice versa, or from one location in the wild to another. All batches of animals to be translocated should be known to be pest and disease free, and **this knowledge should be a result of suitable pest and disease testing procedures being undertaken**. Animals should be tested prior to translocation and at any point where risk of infection is suspected. All translocated animals should be quarantined either prior to movement or once they reach their final destination. Animals should remain quarantined until they are known to be pest and disease free.

Translocating animals from a land-based farm for release into New Zealand's marine environment requires a special permit from the Ministry of Fisheries. An assessment of pest and disease risks is required to be submitted with each permit application and this includes a report of pest and disease tests undertaken by a qualified pathologist. The Ministry of Fisheries has developed a set of guidelines outlining information required to be submitted with applications for special permits.

## **References**

<sup>β</sup> <http://www.vada.com.au/Virus/CodeMap.htm>

<sup>¥</sup> Prince J (2007) A review of the outbreak of a Herpes-like virus in the abalone stocks of western zone Victoria and the lessons to be learnt. Biospherics P/L POB 168, South Fremantle, WA 6162.

\* Handler J (2007) Report to Western Abalone Divers Association of Victoria on the ganglioneuritis outbreak. Senior Veterinary Pathologist, Aquatic Animal Health DPIW, Tasmania

<sup>ψ</sup> <http://www.dpi.vic.gov.au/dpi/nrenfaq.nsf/childdocs/-D45F5C300E5D2ED54A2567D700236463-C5360C2028FA31E2CA2572330021C4BE?open>

<sup>£</sup> Report on a disease resembling abalone viral mortality in Victoria, Australia, 21/9/06: Mike Hine, Senior Veterinary consultant, MaF, New Zealand.

<sup>§</sup> <http://www.dpiw.tas.gov.au/inter.nsf/Attachments/SCAN-6ZW2B3?ope>

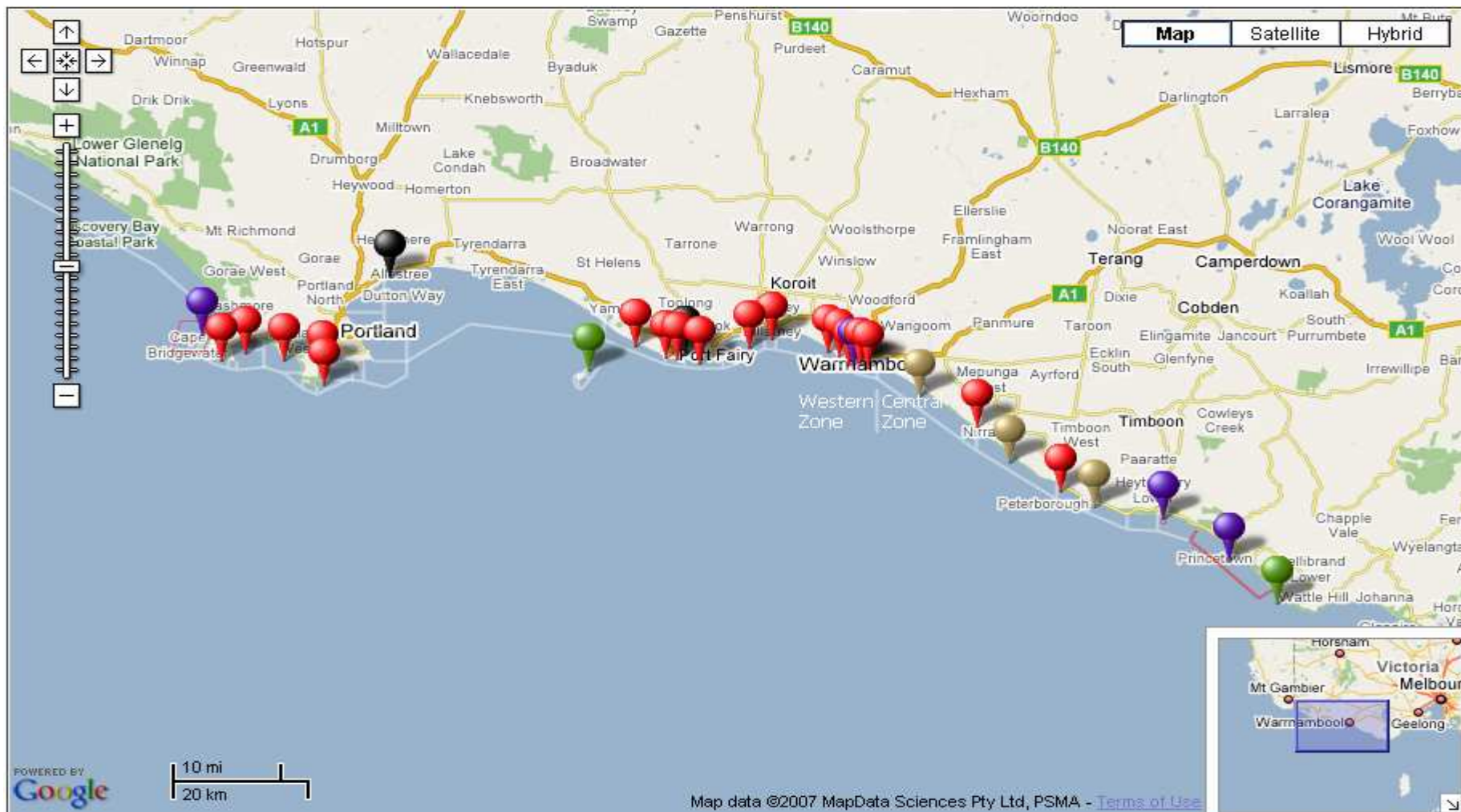


Figure 2 Area of Victoria coast in which wild abalone populations are or have been infected by ganglioneuritis virus

## Ganlioneuritis Spread

This map in figure 2 attempts to show the reef codes affected by the spread of Abalone Viral Ganglioneuritis.

The map is not complete and only confirmed outbreaks have been listed.

Active monitoring of the virus was suspended on the 8th. March 2007, and since then there has been anecdotal evidence, to suggest the whole Western Zone coastline is affected

### Key -



- Abalone Aquaculture ventures.



- Reef codes affected by the Ganglioneuritis Virus.



- Marine Parks & Sanctuaries.



- Reef codes with no Ganglioneuritis Virus to date.



- Voluntarily quarantined reefcodes.



- Reefcode boundaries (indicative only).

## Appendix One

### What can you do?

- » **Keep a close watch** for signs of the disease and report any signs even if you are not sure.
- » **Do not move abalone** between locations, including shells and offal. Take your whole catch home (it is illegal to shuck abalone at sea) and dispose of the waste and shell with your household rubbish. It is illegal to use abalone viscera (guts) as fishing bait.
- » **Keep your fishing gear, dive gear and boat clean and disinfected.** By thoroughly cleaning surfaces and removing organic material that may harbour the virus you can prevent the spread of many aquatic diseases and marine pests.
  - » **Wash gear thoroughly** – wash wetsuits with a wetsuit wash preparation and freshwater, or with a mild soap or shampoo. Tanks, buoyancy vests, regulators and masks that have not come in contact with abalone can be washed down with soap-free freshwater. Equipment that has come into contact with abalone (catch bags, gloves, knives and measuring devices) should be soaked in soapy freshwater for 30 minutes and then rinsed. All equipment should be allowed to dry (preferably in the sun) before re-use.

Wash boats thoroughly with freshwater and detergent, away from the shore. Use of specialised detergents produces good results but any detergent will do. If you can't wash your boat at home use a car wash or service station with washdown facilities.



- » **Wash people** – all people that have contact with abalone should wash their hands with soap and water. Spray waterproof clothing with soapy freshwater and rinse, leave in the sun to dry. Wash all other clothing in laundry detergent.



### CONTACT DETAILS

Disease Watch Hotline  
Ph 1800 675 888 (24-hours)  
Recreational Sea Fishing Line  
Ph (03) 6233 7042  
Web [www.fishingtas.gov.au](http://www.fishingtas.gov.au)

## Help protect Tasmania from Abalone Viral Ganglioneuritis



Department of  
Primary Industries and Water



## What is Abalone Viral Ganglioneuritis?

- » *Abalone Viral Ganglioneuritis is a viral disease affecting the nervous system of abalone resulting in weakness and death.*
- » *The outbreak in Victoria is the first reported case of this disease in Australia however a similar disease has caused mortalities in abalone overseas.*
- » *There are no human health implications from handling or eating infected abalone.*
- » *Abalone Viral Ganglioneuritis only affects abalone species.*
- » *This disease could have a severe impact on abalone stocks if it spreads to Tasmania.*

Images provided courtesy of the Department of Primary Industries, Victoria and the Tasmanian Aquaculture and Fisheries Institute.

### What are the signs?

- » You may see patches of weak and / or dead abalone.
- » In some abalone you may see:
  - » Protrusion of the mouth part; and /or
  - » Edges of the foot curling inwards, leading to exposure of clean shiny shells.



healthy greenlip abalone



greenlip abalone showing the symptoms of the disease

### If you see any sick abalone:

- » Contact the Department of Primary Industries and Water Disease Watch Hotline 1800 675 888 (24-hours freecall)
- » You may be asked to collect some whole abalone in a sealed plastic bag or container and record the exact location the samples were collected.
- » Refrigerate but do not freeze any samples.
- » Stop diving and don't move to another dive-site – this could spread the disease. Return to land and carry out the cleaning procedures outlined in this brochure.



### How is it spread?

- » The virus is easily killed by disinfection and only survives a short time in the water column.
- » The most likely means of disease spread is direct contact between infected abalone or abalone product (offal, mucus or shells) and healthy abalone.
- » It may also be carried on fishing equipment or people who have come into contact with infected abalone.

### What is Tasmania doing about the disease?

- » Abalone Viral Ganglioneuritis has not been found in any Tasmanian abalone.
- » A comprehensive biosecurity response strategy is being developed.
- » The northern Bass Strait islands have been closed to all recreational and commercial abalone fishing as a precautionary measure to prevent the disease spreading to Tasmania's abalone stocks.



*No abalone may be taken from State waters adjacent to the northern Bass Strait islands bounded in the north by the line of Latitude 39°12' South, in the east by the line of longitude 147°35' East, in the south by the line of latitude 39°33' South and in the west by the line of longitude 146° East.*

