From Verity Hallinan M.D., 18-20 Cambage Street, Pindimar, N.S.W. 2324

Attention: Director,Industry, Key Sites and Social Projects

Dear Sirs:

I wish to lodge an objection to the Pindimar Abalone Farm Project, MP 10_0006, now on exhibition.

This project is likely to fail because the water in Port Stephens is too hot to grow healthy blacklip abalone. In case of massive mortality, dying and decaying abalone would pollute the port and spread disease.

The manual cited by the proponents as their guide to raising abalone, Heaseman and Saava 2007, states that the highest temperature tolerated by the blacklip abalone during their 3 year growout phase is 23C (table enclosed). According to the satellite data from the National Oceanic and Atmospheric Administration from the US, the average temperature in Port Stephens, at the Corlette location where the farm is sited, is above 24C for 2 months every summer and above 23C for another 2 months (graph enclosed). Moreover,according to the Manly Hydrolics Survey 1994, the temperature is no colder at the bottom of the port than at the surface (graph enclosed). The plan from the proponents EIS (enclosed) shows that water will go straight into the growout sheds from the port with only filtration. In any event, it would not be feasible to chill 50 megalitres of water a day.

If the abalone do manage to survive the summer temperatures, they will certainly be stressed. Stress causes the immune systems of abalone to weaken and makes them susceptible to disease. According to the Victorian Fisheries, temperatures of more than 18C increase abalones' susceptibility to disease (Development of Management Strategies for Herpes-Like Virus Infection in Abalone 2009,page enclosed). This can result in incubation of disease in the farm where a pathogen multiplies to vast numbers that can escape and overwhelm the wild population as happened disastrously in Victoria. Perkinsus has already caused massive mortality in the NSW wild abalone population as has ganglioneuritis in Victorian abalone(summary enclosed)

The malignant effect of high temperature on mortality and disease susceptibility is well documented in the literature (bibliography enclosed). If disease is present in an abalone farm, the risk of escape and spread to the wild population is high(Risk Assessment of Abalone Fishing and Farming Activities,2007,page enclosed) That is why all the Australian abalone farms now in operation are located in the south where the temperature is 5C degrees colder (map enclosed).

Please reject this proposal as this site is certainly not appropriate for this farm as the proponents contend.

Verity Hallinan

These issues highlight the importance of tagging and record-keeping practices for determining which broodstock are most likely to spawn at any given time and for choosing the most opportune dates to induce spawning.

To ensure fast, efficient and reliable year-round reproductive conditioning and spawning, broodstock must be maintained with minimal stress and within a relatively narrow temperature range of 16 ± 2°C. This requires controlled temperature-conditioning facilities and an uninterrupted supply of near-oceanic-quality seawater. Open flow-through systems consume large amounts of seawater that equate to at least the biomass of stock every minute. This is necessary to maintain broodstock within optimum ranges of water quality (including those specified in **Table 1**). In NSW, considerable energy may be required to chill incoming ambient seawater to the prescribed temperature of 16 ± 2°C. Indeed, the temperature of incoming ambient seawater may need to be lowered by as much as 9°C in summer. Incorporation of seawater recirculation in reproductive conditioning systems of the type illustrated in **Figure 18 and Appendix 2** therefore offer considerable cost and energy savings. Water recirculation systems also give the broodstock considerable protection from sudden adverse changes in the quality of the source seawater, particularly at sites susceptible to the effects of storms, floods and associated pollutants and to toxic algal blooms.

Table 1 *Lethal tolerable and optimal rearing conditions*

Environmental / Water quality factor	Lower and upper lethal	Tolerable	Optimal / recommended
Temperature °C			
Fertilisation and Incubation	?	15-21	18
Larval rearing	?	?	18
Settlement Post-larval development	10 and 27	12-25	18-24
Early juvenile	10-and 27	~~12-24~~	15-21
Late juvenile and adult	10 and 25	12-23	14-18
Salinity g/kg	25 and 40	30-38	32-36
pH		7.5-8.5	8.0-8.2
Dissolved oxygen		≥ 95% saturation	100% saturation
Free (unionised) Ammonium mg/L	≥0.05	≤0.004	≤0.001

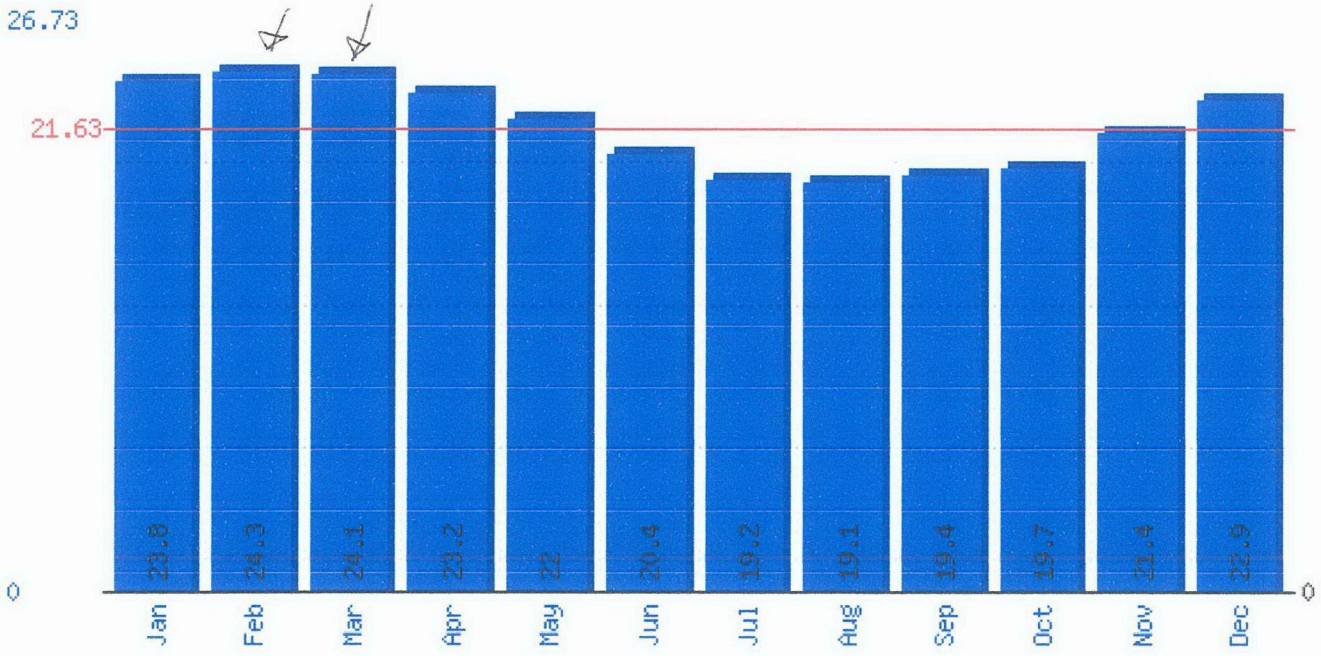
From Heasman and Saava 2007 Manual for Intensive Hatchery Production of Abalone.

National Oceanic and Atmospheric Administration satellite data

The measurements for the sea temperature in Corlette, New South Wales are provided by the daily satellite readings provided by the NOAA. The temperatures given are the surface temperature (SST) which is most relevant to recreational users.

Average April sea temperatures (./corlette-april.htm)

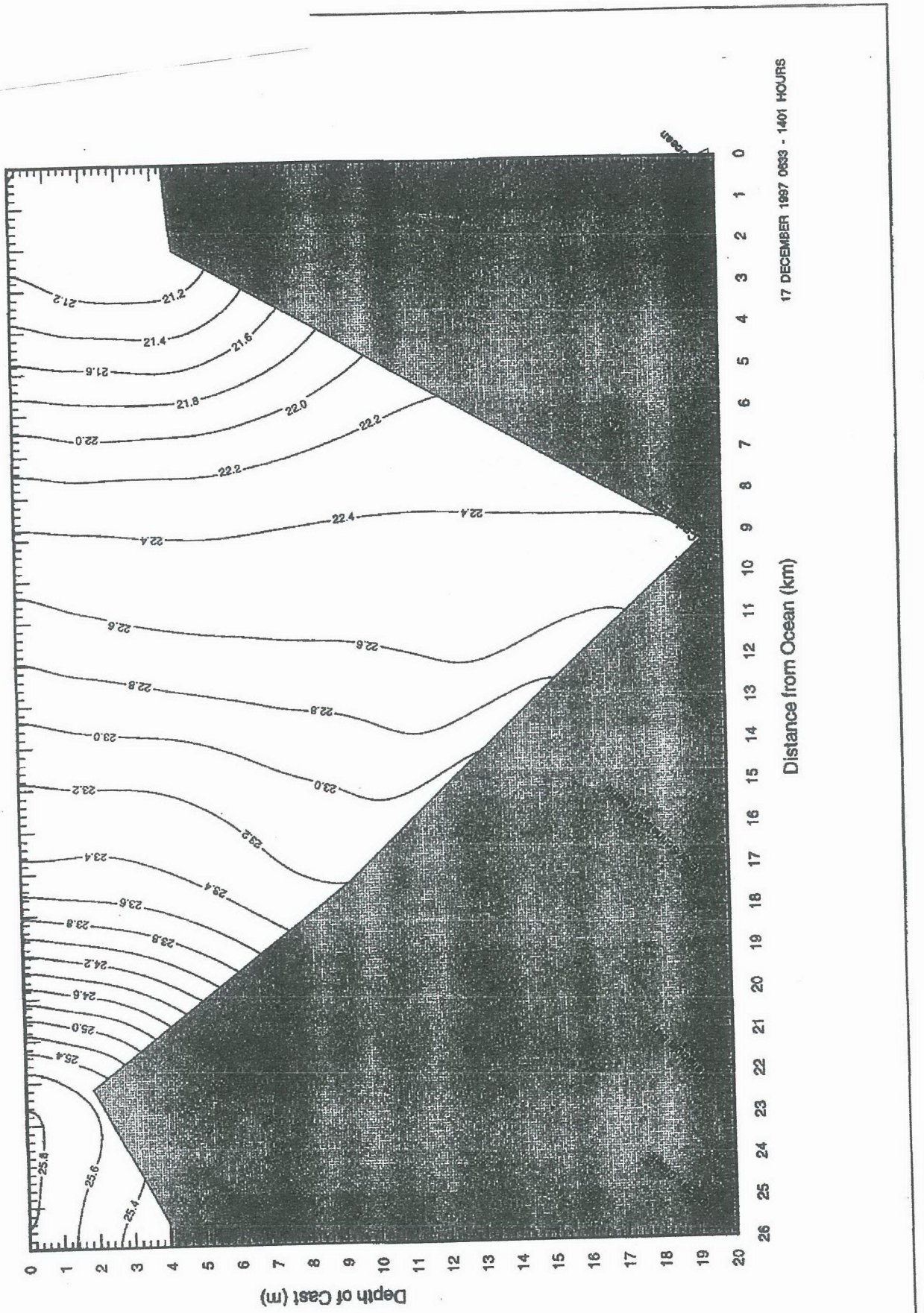
Max: 24.4°C / 75.9°F
Avg: 23.2°C / 73.7°F
Min: 22.1°C / 71.7°F



(./corlette-april.htm)

These average ocean temperatures for Corlette are calculated from several years of archived data.

Locations nearby



e: MHL Report 942 Figure D2

NSW DEPARTMENT OF PUBLIC WORKS AND SERVICES
MANLY HYDRAULICS LABORATORY

PORT STEPHENS - DRY WEATHER LONG CHANNEL TEMPERATURE CONTOURS 17 DECEMBER 1997

MHL Report 913
Figure 5.17
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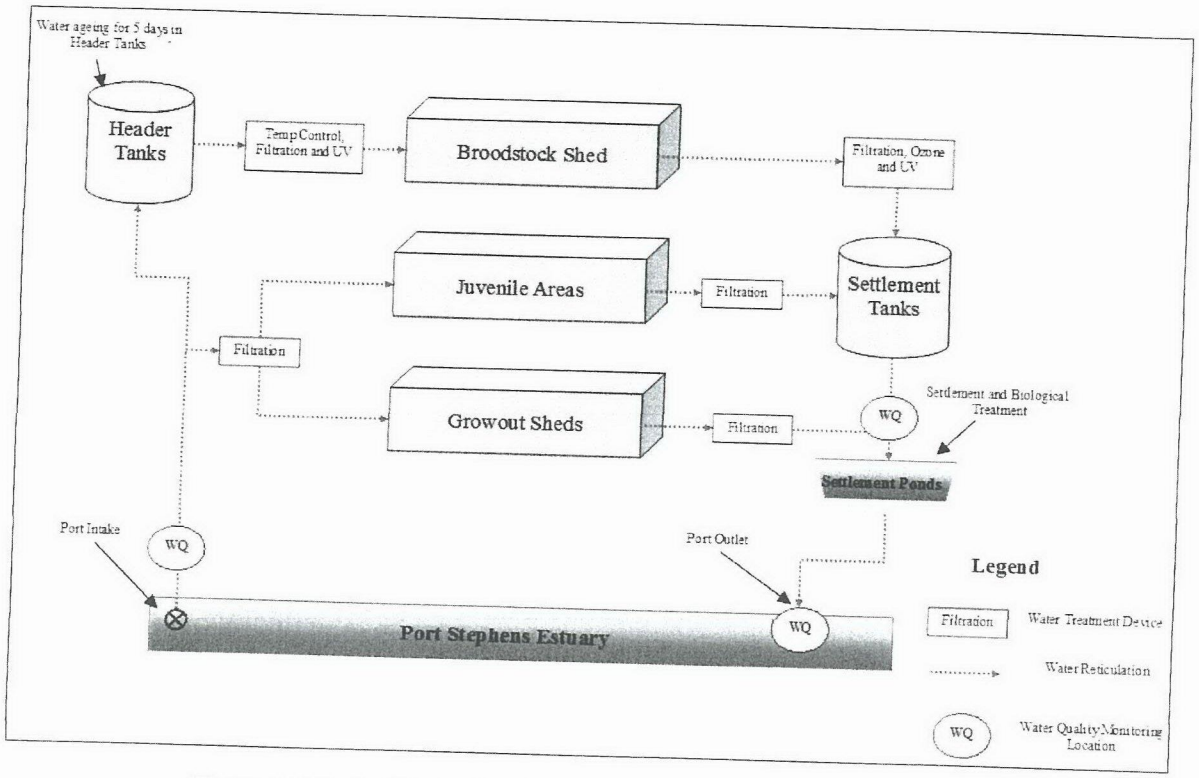


Figure 17: Marine Water Quality Management System- Conceptual View

5.4.3.1 In-Farm Mitigation & Treatment Measures

Marine water will undergo a range of treatment processes within the farm.

As illustrated in **Figure 17**, after intake from the Port there will be some pre-treatment of water before introduction into Abalone tanks and raceways (e.g. ageing, filtering and UV), primarily to minimise the risk of pathogen introduction into the farm. Further details on this system are outlined in **Table 6** in this EA

During and after exposure to Abalone, a number of management, design and treatment measures are proposed to manage water quality before release into the Port. These processes are described below, and conceptually illustrated in **Figure 17**.

ALL FARM FACILITIES

- **Strict feeding protocols:** as discussed in **Section 3.7.6.3**, Abalone feeding practices will be managed and monitored carefully to minimise waste. Abalone fed on commercially available feed have an extremely high food conversion ratio (i.e. approximately 1.3:1, meaning that 1.3kg of feed is required to produce 1kg of Abalone). Accordingly, Abalone will utilise feed so efficiently that minimal excreted waste will be produced. The ingredients of the feed (e.g. milk, wheat,

NSW are relatively small compared with the other states.

In recent years, an abalone aquaculture industry has developed in several Australian states, notably Victoria, Tasmania and South Australia (Table 2). Other states have small, developing industries that have not yet reached commercially reportable quantities.

Table 1: Key features of commercial abalone fisheries production by state in 2004-05 (ABARE 2006).

State	Species	No. Diver Licence Holders	Total catch (tonnes)	Value ($million)
NSW	Blacklip	48	186	7.83
Victoria	Blacklip, Greenlip	71	1,491	60.2
Tasmania	Blacklip	123	2,709	105.4
South Australia	Blacklip, Greenlip	35	902	33.8
Western Australia	Greenlip, Brownlip and Roe's	28	304	12.65
TOTAL		**270**	**5,592**	**219.88**

Table 2: Production of farmed abalone by state (ABARE 2006).

State	2002-03		2003-04		2004-05	
	Tonnes	Value ($M)	Tonnes	Value ($M)	Tonnes	Value ($M)
Victoria	27	1.2	102	3.6	124	4.5
Tasmania	nd[1]	0.6	nd	1.6	nd	3.4
South Australia	59	3.1	105	3.1	177	5.3

The commercial harvesting and aquaculture sectors are supported by a vibrant abalone processing sector that prepares the abalone for sale to domestic or export markets. Processors also add value to the product through canning, or the production of other products (e.g. abalone sauce). Around 90% of abalone is sold to Asian markets. In 2004-05, a total of 4,004 tonnes of abalone were exported with a value of $263 million (ABARE 2006). This included 2,032 tonnes of fresh, chilled or frozen abalone and 1,972 tonnes of canned abalone (ABARE 2006).

As the mollusc aquaculture industry has grown in volume and importance world-wide, the incidence of disease in farming systems has also increased (Elston 1984). There are a number of factors behind this observation, including that the animals are subject to closer scrutiny when held in aquaculture farms and so diseases can be more readily identified and described. The recent outbreak of abalone viral ganglioneuritis in abalone in south-western Victoria has highlighted that Australia is not immune to such disease incursions into developing aquaculture industries.

The abalone viral ganglioneuritis outbreak in Victoria

Summary

In late 2005 and early 2006 mass mortality events occurred in abalone at several aquaculture farms in south-west and central Victoria. By May 2006, mortalities were being reported from wild abalone in the area (Hardy-Smith 2006). A previously unknown herpes-like virus was implicated as the cause. Table 3 summarises the key events in the outbreak of abalone viral ganglioneuritis in Victoria.

Mortalities were first observed in two on-shore abalone farms (Farms 1 and 2) and one sea cage farm (Farm 3). The alarm was raised in early January 2006 and samples of moribund animals were submitted for diagnostic testing. The disease was diagnosed relatively quickly and was identified using standard histology and transmission electron microscopy (TEM) techniques. The virus appears to be confined to the nervous system and causes inflammation of the nerves. For this reason the disease was initially given the name "ganglioneuritis" and was made a notifiable disease under the *Livestock Disease Act* 1994. In 2007, the Consultative

Committee on Exotic Animal Disease (CCEAD) decided that abalone herpes-like virus and the disease it causes should now be known as "abalone viral ganglioneuritis".

Once the virus was identified as the likely cause of the mortalities, voluntary restrictions were placed on movement of animals from the affected farms to other farms. Clinically healthy animals were sent to processing plants, with the approval of the Chief Veterinary Officer (CVO). On the farms that had mortalities from the virus, stock was culled and facilities were decontaminated. After a period of time sentinel abalone were then placed into the facilities and monitored. In November 2006, both of the land- based farms (Farm 1 and Farm 2) applied to DPI for (and were granted) permission to re-stock with abalone.

Infected abalone were first observed in the wild in the vicinity of Farm 2 (located west of Port Fairy) on 7 May 2006. By the end of May it was reported that sites east and west of the initial site were infected. On 9 June 2006, a Control Area was declared for 60-days around Port Fairy. The aim was to minimise the risk of human activity transferring the disease to unaffected abalone populations elsewhere in the state. The declared Control Area was later replaced by a Fisheries Order. An Incident Control Team was established and a structured surveillance program commenced to monitor wild abalone populations within and adjacent to the Control Area, as well as at processing plants.

Professional divers were encouraged to submit suspected cases for diagnosis. To ensure that industry and community were kept informed of the outbreak, a communication program involving regular meetings with industry and regular dissemination of updates was established. Figure 1 shows the coastal bays between Warrnambool and Port Fairy that were surveyed in the search for diseased animals. Figure 2 shows the results of that monitoring up to January 2007. Based on mortality and presence of lesions, abalone viral ganglioneuritis was no longer detectable in areas where it had previously been present, notably in the closed area (marked in red in Figure 2). However, since tests that detect the virus if it is latent or sub-clinical are not available it is not known whether the virus is still present. In February 2007, abalone viral ganglioneuritis was also detected and confirmed in Portland Harbour west of this area.

Table 3: Herpes-virus outbreak in Victoria - summary of key events (Source: Hardy-Smith 2006, Abalone Virus - Scientific Forum, 21st September 2006, Melbourne, and other sources)

Month/Year	Event
October / November / December 2005	Translocation of abalone from both wild and farmed sources to and between four Victorian aquaculture farms. Some mortalities were observed in translocated stock during this period.
December 19th 2005	aquaculture farms. Some mortalities were observed in translocated stock during this period.
December 21st 2005	High mortalities noted in seacage system (Farm 3).
December 26-29 2005	High mortalities in two broodstock tanks at Farm 2. All broodstock and abalone in two other tanks culled or harvested. No further signs of the disease.
Mid January 2006	Inflammation of the nerves (abalone viral ganglioneuritis) identified by histopathological examination and herpes like virus identified within the nerve cells of abalone dying at Farm 1. Lesion and virus has never been seen before in abalone in Australia.
March 17th 2006	Unusual mortalities noted at Farm 2. Mortalities rapidly escalated and spread to other tanks.
April 24th 2006	Sick and dead abalone submitted from Farm 4. Abalone viral ganglioneuritis identified in four abalone.
May 15th 2006	Farm 2 totally de-stocked of abalone.
May 18th 2006	Abalone viral ganglioneuritis identified in some of abalone collected from the wild near Farm 2 (west of Port Fairy).
June 9th 2006	Control Area declared for Western Zones 3.06 and 3.07 (surrounding Farm 2). All diving (and other proclaimed activities) prohibited in these areas, except under authority.
June 15th 2006	Farm 1 totally destocked of abalone.
July 26th 2006	Abalone viral ganglioneuritis confirmed in wild abalone collected from Western Zone 3.05 The Crags.
Early August 2006	Mortalities reported from wild abalone 5 km west and 12 km east of initial reported site Abalone at the initial reported site showed no clinical signs of the disease.
September 21st 2006	Abalone Virus - Scientific Forum (Melbourne).
November 2006	Farm 1 and Farm 2 granted permission by DPI to re-stock with abalone.
November 2006	Abalone viral ganglioneuritis confirmed from abalone on reef near Warrnambool, 23 km east of the initial reported site.
February 2007	Disease confirmed from abalone on reef known as "Devils Kitchen", located to the west of Portland, 60 km west of the initial reported site.
May 2007	Disease confirmed from beach at Murrels located on the western side of Cape Nelson. No evidence to suggest disease has progressed further east than the Warrnambool Breakwall or further west than South Bridgwater/Bully Cove.

were retrovirus-like in size and morphology (Nakatsugawa *et al*. 1999).

Currently there are no known methods of prevention or control. Management focuses on avoiding the risk of introducing this pathogen to other culture facilities or natural stocks. Only animals certified to be free of infection should be considered for transplantation from areas where the disease occurs. In addition, imported animals must be held in quarantine and assayed for cryptic or subclinical infections prior to release into the new environment (Bower 2001).

Current knowledge on the Victorian abalone viral ganglioneuritis

Abalone viral ganglioneuritis causes damage to the nerve tissues of abalone (the ganglion) and results in death in most cases. It is known to affect greenlip, blacklip and hybrid abalone and it has been observed that young stock are more seriously affected than adult stock. The incubation period of the virus is between 2-14 days with significant mortalities occurring after 10-14 days. The virus is noticed most often where there are dense populations of abalone, but the animals may be pre-disposed to becoming infected if other stress factors are present, including:

- High stocking densities
- High water temperatures >17.5-18°C which are at the upper limit of optimal for abalone culture
- Spawning activity
- Concurrent disease (e.g. *Vibrio* sp.).

Clinical signs

Infected abalone are lethargic and may have enlarged mouth-parts and a curled foot. The presence of enlarged mouthparts in isolation is not sufficient to diagnose abalone viral ganglioneuritis and is not shown by all infected abalone. In some cases, the radula (a band of sharp hooked teeth) may protrude from the mouth. When clinically affected by the virus, the abalone are weak and are easily removed or fall off the substrate. In tanks on aquaculture farms, where the abalone can be more closely monitored than animals in the wild, mortalities of 5% to 90% have occurred.

Initial identification

Abalone viral ganglioneuritis was initially observed in infected abalone using light microscopy (Hardy-Smith 2006). Samples of infected tissues were subsequently submitted to the Australian Animal Health Laboratory (AAHL) where Electron Microscopy was used to examine the specimens. Viral particles were visualised in pleuropedal ganglion and, morphologically, these particles resembled viruses from the family Herpesviridae (Hardy- Smith 2006).

Transmission of the virus

Trials at AAHL have shown that the virus is transmitted horizontally through the water column and does not require direct contact for transmission (Hardy-Smith 2006). The virus is highly pathogenic, killing all healthy experimental animals within six days of exposure to the virus (by injection and co- habitation). The virus remains virulent and pathologic after being frozen at -80°C. An experiment in which healthy animals were placed in water spiked with various dilutions of virus inoculum indicated that the virus remained infectious even after a 1 in 100 dilution. There is a marked decrease in virulance with dilution.

Knowledge gaps

In September 2006, a series of workshops were held with international and Australian experts on aquatic animal diseases (Table 6) and other stakeholders in the abalone industry. These workshops were organised by the Victorian Department of Primary Industries and the commercial abalone harvesting sector in a process separate to this project. As an outcome of the workshops, the following key knowledge gaps on abalone viral ganglioneuritis were identified:

- **Origin**: It is not known whether the virus is exotic or endemic to Australian waters, but the panel strongly suspected that it is endemic as no probable linkages with an exotic source had been identified.
- **Range**: If the virus is endemic, it is not known if the outbreak is localised (as a result of translocating infected animals) or if the virus is widespread, but reached a critical dose when concentrated on the farm. Diagnostic techniques (e.g. PCR) must be developed and validated before the distribution of the virus in Australian waters can be determined.
- **Mode of action**: Very little is known about how this virus infects abalone, what the infectious dose is, how long it survives outside of the host (and in the water column) and if healthy abalone can carry the virus without showing

Table A3.1d. Risk rankings for the impact of the environment on the industry (Component Tree 8). Key: C – Consequence level, L – Likelihood level, RV – Risk Value, RR – Risk Ranking. Additional comments on the summaries from the workshop were provided by the Abalone Aquaculture Industry. Wherever possible the exact comments were included, however additional words and phrases have been included to improve readability and understanding.

Issue		C	L	RV	RR	Justification for ranking/Comments
Impacts of the Environment on the Industry						
Climate	Temperature	3	5	15	High	*Will alterations in the climates temperature significantly impact on the success of the industry?* ▪ The water temperature in South Australia (where farms are currently located) is close to the abalones upper temperature tolerance. If water temperatures were to increase significantly there is a potential for the whole industry to be wiped out. Mass mortalities have occurred due to higher than average temperatures in some years. ▪ There are some management strategies in place eg. changes in tank design and there is also potential to move to other areas.
					High	**Industry comments:** ▪ We agree that temperature increases are a huge risk to the industry
	Rainfall					*Will alterations in rainfall significantly impact on the success of the industry?* ▪ There is generally low rainfall in South Australia and the tanks are covered. This issue is not relevant and therefore has been removed from the component tree.
	Sea level change	3	1	3	Low	*How would sea level change impact on the industry and what are the risks associated with this?* ▪ Sea level change is not a huge threat at the moment but it is possible in the next five years. It is generally a long-term issue and while possible, is not likely to be an issue in the next five years.
Human Induced Change	Water Quality	3	4	12	Moderate	*What are the risks associated with human induced changes associated with water quality (eg. oil spills)?* ▪ The land-based abalone aquaculture is reliant upon good water quality. Algal blooms may clog filters which may be human induced and have the potential to momentarily stop production. ▪ Human induced changes in water quality (eg. as a result of an oil spill) may have severe consequences for abalone farms.
	Habitat Modification					*How would habitat modification impact on the operation of the facilities?* ▪ The abalone are not cultured in their natural environment and therefore this issue has been removed from the component tree.

6.1.5. Staircase abalone

Staircase abalone lives under boulders or crevices in areas with slight to moderate water movement (Shepherd, 1973; Joll, 1996). It occurs on rough water or sheltered coasts to a depth of about 50 m, although it is mostly a shallow water species. It inhabits West Island and Tipara Reef, South Australia (Wells and Bryce, 1987) and is also found in low densities in Western Australia as far north as Cervantes/Jurien area (S. Slack-Smith, pers. comm., 2000).

6.1.6. Donkey-ear abalone

This is a tropical species that is most commonly found under rocks and in crevices (Joll, 1996). It inhabits tropical reefs in Queensland, Northern Territory, and northwest West Australia to as far south as Exmouth Gulf (S. Slack-Smith, pers. comm., 2000), and is widely distributed over the Indo-western Pacific area (Singhagraiwan and Sasaki, 1991). Donkey ear abalone is an intertidal species and can be observed grazing on top of coral boulders at night (R. Counihan, pers. comm., 1999).

6.2. Temperature

Mozqueira (1996) outlines the importance of temperature for temperate abalone. Water temperatures below 7°C will cause temperate abalone to stop feeding and become dormant. Feeding, respiration and growth rates will increase as the water temperature increases until reaching levels that cause stress. He concluded that temperatures greater than 24°C will cause stress in temperate abalone which will decrease their survival rate. Research indicates major differences in the water temperature requirements of Australian abalone species (Table 11).

Abalone Species	Temperature Range for Growth [min-max]	Preferred Temperature	Reference
Greenlip	12°-22°C	18°C	Hone and Fleming, 1998
		18.3°C*	Edwards, 1996
Roe's	14°-26°C		Lawrence, 1995
Blacklip	10°-22°C	16°-18°C	Hone and Fleming, 1998
		17.0°C*	Edwards, 1996
Donkey ear	20°-32°C	28°C	Hone and Fleming, 1998

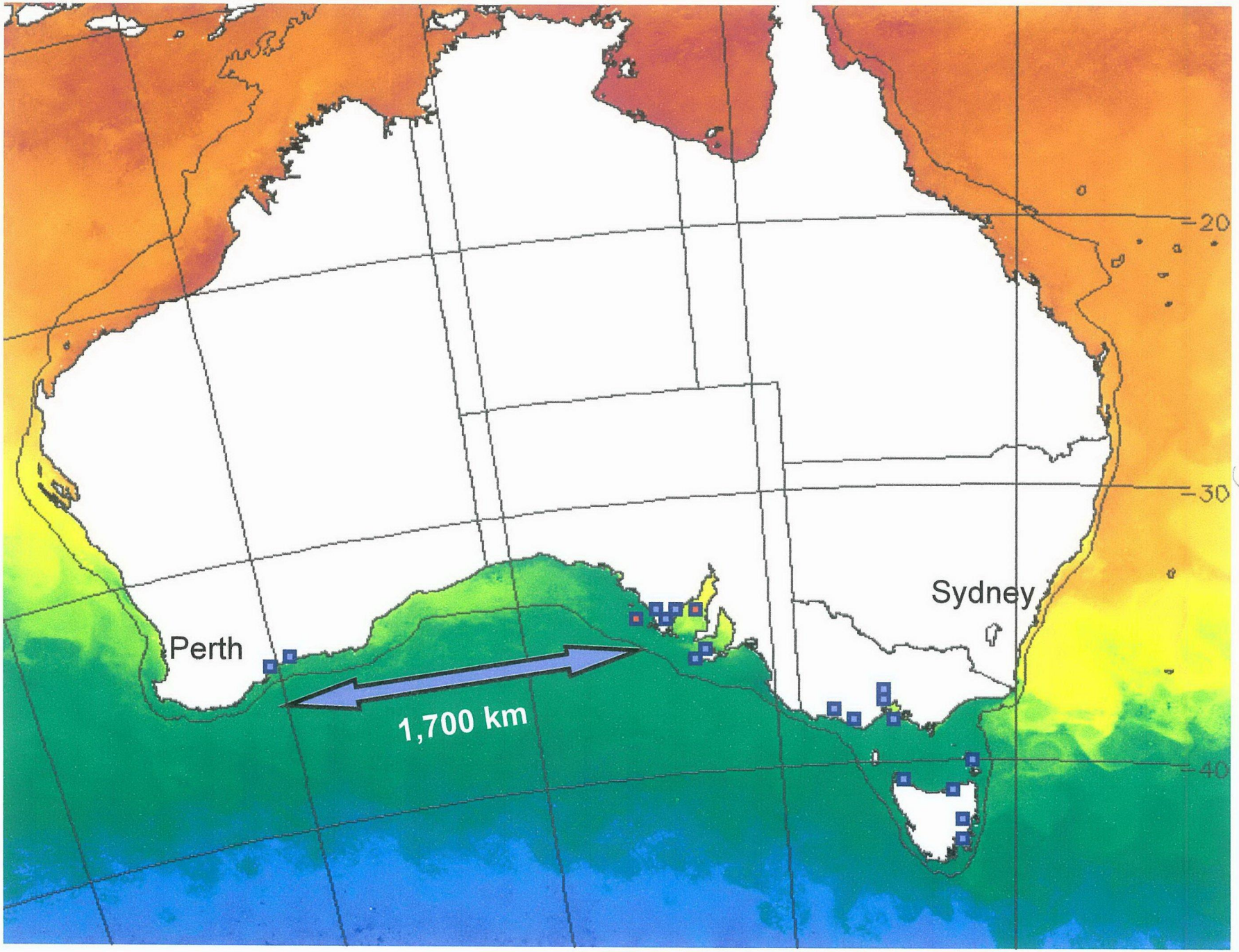
N.B: * These values are the optimum temperatures which were calculated using the CTM, the preferred temperatures reported in Edwards (1996) experiment and the model equations outlined by Jobling (1981).

Table 11 Responses of four species of abalone to water temperature.

Although the optimal temperatures for some of the Western Australian species are not known, the natural temperature ranges are likely to be a useful indicator to lethal temperature limits.

6.2.1. Greenlip abalone

Edwards (1996) found that the CTM50 [critical thermal maximum temperature when 50% of the abalone lost attachment as temperature was increased by 1°C hour^{-1}] for Greenlip abalone (30-100 mm) was at 27.0°C. The CTM ranged from 25.0°C when the first abalone began to lose attachment to 30.0°C when the last abalone lost attachment.



Abalone farms

Bibilography

Heasman and Saava, Manual For Intensive Hatchery Production of Abalone, NSW Department of Fisheries, 2007

Global Sea Temperatures, National Oceanic and Atmospheric Administration, 2014

Port Stephens/Myall Lakes Estuary Processess Study, Manly Hydrolics Laboratory, January 1999

Theil et al, Environmental Risk Assessment of Land Based Abalone Aquaculture in South Australia

Development of Management Strategies for Herpes-Like Virus Infection in Abalone,FDRC Project NO. 2006/43, Dept. of Primary Industries Victoria, Fisheries, 2009

Vandepeer,M., Abalone Aquaculture Subprogram,SARDI Aquatic Sciences Publication no.RD02/0035-2

Risk Assessment of Abalone Fishing and Farming Activities, Department of Primary Industries and Water, Tasmania, 2007

Freeman,K, Aquaculture and Related Biological Attributes of Abalone Species in Australia - A Review, Fisheries Western Australia, 2001