Towards the maintenance of an ecologically sustainable Pacific oyster industry

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Tasmanian Oyster Research Council

FRDC Project Number: T93/222

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Non-technical Summary

Under a joint arrangement between the Fisheries Research and Development Corporation (FRDC) and the Tasmanian Oyster Research Council (TORC), a survey was conducted over the three years from 1994 to 1996 to establish techniques for ongoing disease monitoring, to investigate the incidence of disease and to study the incidence and effects of commensal (or parasitic) organisms in farmed Pacific oysters. No diseases were found. A number of commensals were detected although these did not appear to be injurious to the oysters at the levels of incidence observed. A high incidence of mudworm infection was evident in southern parts of Tasmania but not in the north. This warrants further study from the point of view of oyster health and there are possible implications with respect to movement, and movement controls for Pacific oysters.

The absence of disease and the levels of commensals detected in this study are comparable with the results of a similar study by Wilson et al. (1993).

In 1995 and 1996 samples of wild Pacific oysters were also examined and the results were compared with those for farmed Pacific oysters. Some variation in the incidence of commensals between the farmed and the wild oysters was noted. In particular, evidence of mudworm infestation was much higher in wild oysters than in farmed oysters. This could perhaps be explained by differences in age or growth site of the oysters, and in no case was the difference considered to have any health significance. The infestation level for the digestive tubule ciliate Ancistrocoma sp. is very much lower in the wild oyster data set than for farmed oysters in the survey, but the reason for this is not understood.

After the FRDC/TORC survey concluded in 1996 the Tasmanian Oyster Research Council set up a formally structured, ongoing program in conjunction with the Tasmanian Department of Primary Industry. Under this jointly funded program samples of oysters in all growing waters in the State are checked twice yearly for any evidence of change in the disease baselines established during the original survey. Each year, scientific personnel from the Department's Fish Health Unit provide a verbal and written report to industry, with details of the previous year's survey and discussion of relevant issues. These reports to industry are supplemented from time to time by articles in the TORC Newsletter which goes to all oyster growers in the State.

The ongoing program has a joint Industry/Department Management Committee which is charged not only with refinement and development of the monitoring program, but also with the development of formal disease control strategies. Interstate and international certification have been facilitated because the integrity of the FRDC program, and subsequently the Tasmanian Health Program, has been maintained. The program has seen two laboratory technical staff trained in the recognition of shellfish tissue abnormalities and the diagnosis of disease agents and pests, and there has been useful interaction between this project, which is aimed specifically at Pacific oysters, and the detection of abnormalities in other shellfish species.

Thus, the original FRDC/TORC program has served as a catalyst for ongoing disease monitoring, the development of disease control programs, the training of skilled diagnostic personnel and grower awareness of disease issues in the Pacific oyster industry.

Background

Prior to 1994 a two-year pilot study by Wilson et al (1993) had proved that Tasmanian Pacific oysters were free of major notifiable disease agents.

The Industry's attention to environmental quality and product health was recognised at the highest international level. Under a Memorandum of Understanding with the United States Food and Drug Administration Tasmanian oysters, alone in Australia, were granted entry to the United States, live and undepurated. In turn, this recognition provided automatic acceptance in other international markets.

However, like oyster industries elsewhere, Tasmania remained susceptible to economically significant diseases introduced through the movement of shellfish or through the importation of exotic marine organisms in ships' ballast water, particularly from countries where aquaculture practices heightened the risk of parasitic, competitive or pathogenic introductions to Australia.

Ballast water discharge is on the increase because of a continuing trend to bulk cargoes.

Need

Tasmanian oyster culture depends on shellfish movement. Brood stock is obtained from local waters, spat is hatchery-reared then distributed through nurseries to farms throughout the state, and part-grown stock is transferred between farming areas for ongrowing and finishing.

In these circumstances no oyster farm is isolated from others. It was recognised that a previously unidentified disease on one farm or in a hatchery, or the incursion of an exotic disease, could affect the whole Tasmanian industry. A continuing surveillance program was therefore considered essential to monitor oyster health on a statewide basis and to ensure a rapid diagnostic and management response to any unusual mortality.

It was proposed that a suitable program should be developed over three years with FRDC assistance. At the end of that period, Industry was to take over full scientific and financial responsibility for the permanent continuance of the program.

This permanent surveillance program was to cover all sectors of industry from hatchery, to nursery, to farm grow-out. It was intended to include regular on-farm monitoring and historical recording.

It was suggested that FRDC's involvement with the developmental stage would:

a) Assist with establishment of the surveillance program and its eventual transfer to industry.

b) Establish a heightened awareness in all sectors of the risks associated with unrestricted shellfish movement.

c) Clarify risks associated with exotic introductions.

d) Improve the economic performance of industry sectors by providing data for certification of oysters.

e) Establish mechanisms for the early identification of potential threats from local disease agents and from introduced pests, parasites and diseases.

f) Help establish and maintain skills and expertise which would also be of benefit to other cultured shellfish sectors, such as flat oysters, mussels, scallops and abalone; and to the wild harvest and recreational fishing sectors.

Objectives

To protect and significantly improve the high health standards of Tasmania's cultured Pacific oyster industry and thus help it to achieve its full domestic and export potential.

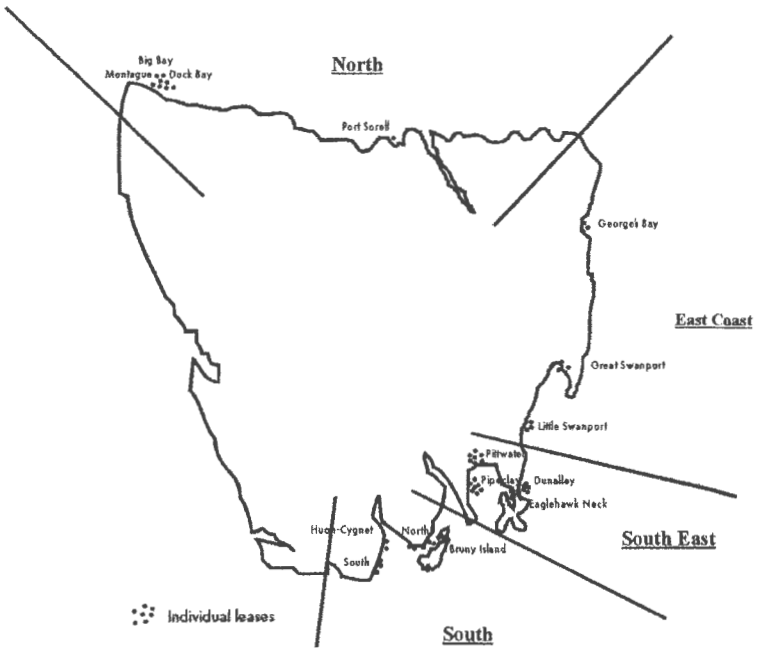
Methods

An annual audit of the health status of farmed stocks of Tasmanian Pacific oysters was conducted for the three years ending December 1994, 1995 and 1996. In 1995 and 1996, wild populations of Pacific oysters were also included for comparison.

The preliminary data base of existing Pacific oyster pests, parasites and diseases established by Wilson (ibid.) was used as a model to indicate which conditions should be included in the investigation. Each oyster was therefore examined for Iridovirus, Herpes virus, Marteiliosis, Haplosporidiosis, Perkinsus infection, Norcardiosis (previously known as Actinomycosis), Rickettsia and Ovacystis, and for parasites resembling Trichodina, Ancistrocoma or Pseudomyicola. Shell blisters and shell burrows indicative of polychaete mudworms were also recorded. Provision was also made for recording any other abnormalities, but in the three years of the study this was rarely used.

An effort was also made to record the condition of oysters submitted. In all cases the oysters were examined for gross pathology and sections were cut for histology. No culturing for bacteria or viruses was undertaken, there being no cell lines available for molluscs. A regional based sampling regime was employed, providing for sampling of stock to be spread over a representative number of bays in each region. Four regions were described, as shown in Figure 1: Northwest, East Coast, South-east and South.

Figure 1: Location of sampling regions



Two age classes of farmed Pacific oysters were distinguished in the survey, one year or less (juvenile) and over one year (adult). Both age groups were sampled where both were a major component of the industry in the bay (some farmers simply on-grow one year plus stock). Specimens from wild oyster populations were of indeterminate age.

The OIE Diagnostic Manual for Aquatic Animal Diseases (1995) indicates that if the population infection level is greater than or equal to 10% a subsample of 30 will provide 95% confidence that an infected animal will be included in the sample. Subsamples from an area can then be pooled to provide a greater degree of statistical assurance for a region as a whole. Accordingly, subsamples of 30 were collected from each growing area.

Table 1 provides full details of the proposed sampling regime.

Table 1: Growing areas, regions and the planned sampling regime

Region	Growing area	Pacific oyster samples
North west	Montagu	30J + 30A
	Big Bay	30A
	Duck Bay	30J
	Port Sorell	30J + 30A
East coast	Hatchery 1	30A broodstock
	Hatchery 2	30A broodstock
	Moulting Bay	30J + 30A
	Great Swanport	30J + 30A
	Little Swanport	30J + 30A
South east	Hatchery 3	30A broodstock
	Dunalley	30J + 30A
	Eaglehawk Neck	30J + 30A
	Pipeclay Lagoon	30J + 30A
	Pittwater	30J + 30A
South	North	30J + 30A
	South	30J + 30A
	Bruny Island	30J + 30A
	Huon-Cygnet	30J + 30A

J = Juvenile A = Adult

Because industry awareness and participation were an important feature of the project, special efforts were made to present growers with the results and their implications throughout the project.

Results/Discussion

The project commenced on 6 January 1994 with the establishment of an Industry / Government Project Management Team and a Scientific and Technical Advisory Committee. An Industry Communiqué detailing how the program was to work was published in News TORC in March 1994 and distributed to all

growers licensed to farm oysters. Farm sampling commenced in March 1994 and the results were forwarded to participating growers as they became available. An Industry Workshop was convened in July and State and Zone Summaries for All Samples to June 1994 were forwarded to Industry in September 1994. Thereafter, survey results were provided to growers annually.

Sampling was co-ordinated by Mr. Colin Sumner who also provided farmers with instructions as to which oysters to sample. This was to ensure that oysters which had only recently been brought to the farm were not sampled. The samples were submitted by farmers direct to the laboratory.

Survey results are summarized in Tables 2, 3 and 5.

YEAR 1

TABLE 2: Number of leases, number of oysters examined and pathological conditions observed – 1994

	North West			East Coast			South East			South		
Period	A	B	C	A	B	C	A	B	C	A	B	C
No. leases	1	3	4	5	4	9	11	2	13	7	3	10
No. oysters tested	90	150	240	150	120	270	390	60	450	236	120	356
Diseases	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Trichodina*	0.0	0.7	0.4	0.7	21.7	10.0	0.8	0.0	0.7	0.9	2.5	1.4
Ancistrocoma*	6.7	8.0	7.5	1.3	10.0	5.2	3.3	8.3	4.0	3.8	10.8	6.2
Pseudomyicola*	3.3	0.0	1.2	4.7	0.8	2.6	1.8	0.0	1.6	1.3	0.0	0.9
Rickettsia	0.0	0.0	0.0	5.3	3.3	4.4	0.0	0.0	0.0	0.4	5.0	2.0
Ovacystis	0.0	0.0	0.0	2.0	0.0	1.1	0.8	3.3	1.1	0.4	0.8	0.5
Shell Blisters	0.0	4.7	2.9	2.0	8.3	4.8	2.6	10.0	3.6	14.0	17.5	15.2
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Period : A= January to June B= July to December C = January to December (weighted averages)
** The abnormalities observed resembled the condition recorded but this diagnosis was not definitive.*

A total of 1316 oysters were examined from a total of 35 distinct leases. This was somewhat in excess of the target for all growing areas. No disease conditions were detected but a range of commensals as reported previously by Wilson et al. were recorded. Comparison of this data with Wilson's findings reveals the following:

SHELL BLISTERS

The overall rate of shell blistering, which includes polychaete burrows as well as true blisters, was 6.9 % compared to an overall rate of 4% recorded by Wilson et al. The latter figure only includes damage caused by true blisters ie it ignores mudworm burrows. The Southern region had considerably higher levels than the other regions.

TRICHODINA sp.

The average level of Trichodina sp. incidence for Pacific oysters recorded by Wilson et al. is 3.5 % compared to 2.8 % found in this survey to date.

ANCISTROCOMA sp.
In the survey period 5.5 % of specimens were found to contain Ancistrocoma sp. in the gut tubules. This compares to an average prevalence of 13.5% in Wilson et al's work.

PSEUDOMYICOLA sp. AND UNIDENTIFIED DEGRADED CRUSTACEANS
Average levels of *Pseudomyicola spinosus* and unidentifiable degraded crustaceans was 1.5 % compared to an average level of 3.2% in Wilson et al.

RICKETTSIA
In the survey period 1.4% of oysters were found to contain rickettsial inclusions in the digestive gland epithelium. This is the same level as found by Wilson et al. All rickettsia. seen were considered to be type A as defined by them.

OVACYSTIS
In the survey period 0.56 % of oysters were found to have ovacystis. This compares with 0.45 % of oysters surveyed by Wilson et al.

YEAR 2

TABLE 3: Number of leases, number of oysters examined and pathological conditions observed – 1995

	North West			East Coast			South East			South		
Period	A	B	C	A	B	C	A	B	C	A	B	C
No. leases	0	0	0	2	1	3	6	3	8	3	4	7
No. oysters tested	0	0	0	60	30	90	178	86	264	150	180	330
Diseases				Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Trichodina*				0.0	0.6	0.0	0.6	0.0	0.4	0.0	0.6	0.3
Ancistrocoma*				8.3	10.0	8.9	6.7	7.0	6.8	13.3	15.0	14.2
Pseudomyicola*				1.7	3.3	2.2	0.0	1.2	0.4	1.3	1.1	1.2
Rickettsia				0.0	0.0	0.0	0.6	0.0	0.4	0.7	2.8	1.8
Ovacystis				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shell Blisters				0.0	0.0	0.0	2.8	1.2	1.9	22.0	14.4	8.8
Shell Burrows				0.0	0.0	0.0	0.0	4.6	1.9	0.0	0.6	9.4
Total Mudworm				0.0	0.0	0.0	2.8	5.8	3.8	22.0	15.0	18.2
Other				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Period : A= January to June B= July to December C = January to December (weighted averages)
** The abnormalities observed resembled the condition recorded but this diagnosis was not definitive.*

No samples were collected from the North West for this period because additional samples had been collected from this area late in 1994. A total of 18 leases, involving 684 oysters from 23 laboratory submissions were examined. One of the samples was of wild oysters present near a lease. No significant diseases were detected. The range of commensal types was the same as for 1994. Comparison of this data with Wilson et al. and the 1994 report shows the following trends:

Shell Blisters
The overall rate of shell blistering was 10.2% of which 5.2% was contributed by mudworm blisters and 5.0 % by mudworm burrows without blister formation. This compares with a total mudworm damage rate of 9.8 % for 1994. The rate of mudworm infection found by Wilson et al. is 4 % and refers to blisters only. As seen in the 1994 findings the degree of infection is considerably higher in the southern region than in other regions.

TRICHODINA sp.
The protozoan Trichodina sp. was found in 0.3 % of the sample. This compares to 0.9 % for 1994 and 3.5% as found by Wilson et al.

ANCISTROCOMA sp.
This year 10.7 % of oysters contained Ancistrocoma sp. in the gut tubules. In 1994 the rate of infection was 5.5%. An infection rate of 13.5% was found by Wilson et al. This year the Southern region appears to have had a higher incidence of Ancistrocoma sp. which was not seen in 1994.

PSEUDOMYICOLA sp.
Average levels of *Pseudomyicola spinosus* and unidentifiable degraded crustaceans were 1.0% in the survey period. This compares to 1.6% in 1994, and 3.2% as seen by Wilson et al.

RICKETTSIA
In 1995 1.0% of oysters contained rickettsial inclusions in the digestive gland compared with 1.4% in 1994. The rickettsia seen were considered to be Type A as defined by Wilson et al. who found an overall rate of 1.4%.

OVACYSTIS
In 1995 no oysters were found to have ovacystis. This compares to 0.45 % as seen by Wilson et al. and 0.56% in 1994.

In the first week of March 1995 165 wild Pacific Oysters were collected from 5 sites on the Tamar River. The purpose of this was to provide baseline information on the health status of wild oysters. In this study the data collected from these oysters is compared with data collected to the end of June 1995 from the main survey. Table 4 summarises this comparison.

Table 4: Conditions observed in wild oysters compared with farmed oysters – 1995

	Farmed oysters	Wild oysters
No. oysters examined	388	165
Diseases	Nil	Nil
Trichodina*	0.3	0.0
Ancystrocoma*	9.5	5.5
Pseudomyicola*	0.8	0.0
Rickettsia	0.5	1.2
Ovacystis	0.0	0.0
Shell blisters and burrows	9.8	9.1
Other	0.0	0.0

* *The abnormalities observed resembled the condition recorded but this diagnosis was not definitive.*

It was notable that samples from four of the five wild oyster collection sites had either a greenish tinge to the flesh, green staining of the inside of shells or both. The greenish flesh tinge did not appear to correspond to elevated numbers of haemocytes which is accepted as one explanation for greenish coloration. With the exception of the oysters sampled from Craigburn, histological examination showed the samples to be in better condition than the gross observations indicated. The green staining of the inside of shells has not been noticed in farmed oysters during the main survey.

Neither the wild oysters nor the farmed specimens submitted in the first half of 1995 were well advanced in the reproductive cycle. Early stages of gametogenesis and late "clean up" stages from the previous spawning season were most common. The range of condition ratings was poor to good for both wild and farmed specimens and no great difference in within group distribution of condition ratings was found.

Farmed oysters had a higher level (9.5%) of Ancystrocoma than wild oysters (5.5%). However, a single sample from the Channel region contributed most of the data for the farmed oyster set. Removal of this sample from the data set points to an underlying lower level in the farmed oysters than in the wild stock. No diseases were detected in wild or farmed oysters and no batch of specimens from either group was considered to be in very poor condition. There was no observed connection between poor condition and any of the pathological conditions.

YEAR 3

TABLE 5: Number of leases, number of samples and conditions observed – 1996

	North West			East Coast			South East			South		
Period	A	B	C	A	B	C	A	B	C	A	B	C
No. leases	2	2	4	1	4	4	2	7	9	2	8	8
No. oysters tested	180	150	330	30	147	179	98	340	438	60	240	300
Diseases	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Trichodina*	1.1	3.3	2.1	0.0	1.4	1.1	0.0	4.7	3.6	0.0	4.3	3.0
Ancistrocoma*	9.4	14.7	11.8	0.0	11.6	10.1	9.8	13.5	12.6	6.7	12.9	11.7
Pseudomyicola*	2.8	0.0	1.5	3.3	3.4	3.4	1.0	0.6	0.7	3.3	0.0	1.0
Rickettsia	1.7	0.7	1.2	0.0	0.7	0.6	1.0	0.6	0.7	0.0	3.8	3.0
Ovacystis	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Shell Blisters	0.0	0.0	0.0			0.0			2.7			4.0
Shell Burrows	1.1	0.0	0.6			4.5			3.4			6.0
Total Mudworm	1.1	0.0	0.6	20.0	1.4	4.5	1.0	7.6	6.1	0.0	11.9	10.0
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Period : A = January to June B = July to December C = January to December (weighted averages)
** The abnormalities observed resembled the condition recorded but this diagnosis was not definitive.*
One lease from the East Coast and two leases from the South were sampled in both period A and period B.

A total of 25 leases, involving 1247 oysters from 44 laboratory submissions were examined. No significant disease conditions were detected. The range of commensals was the same as in 1994 and 1995. Comparison of this data with Wilson et al. and the results from previous years reveals the following:

SHELL BLISTERS

The overall rate of shell blistering was 5.4 % of which 1.9 % was contributed by mudworm blisters and 3.5 % by burrows in the shell without blister formation. These data are lower than for previous years such as 1995 when the overall rate was 10.2% of which 5.2% was contributed by mudworm blisters and 5.0 % by mudworm burrows without blister formation. This compares with a total mudworm damage rate of 9.8% for 1994. The rate of mudworm infection found by Wilson et al. is 4% and refers to blisters only. As seen previously the degree of infection is considerably higher in the south than elsewhere.

TRICHODINA sp.

The protozoan Trichodina sp. was found in 2.7 % of the sample compared to 0.3 % and 0.9 % for 1995 and 1994 respectively and is therefore closer to the original survey level of 3.5 % as found by Wilson et al.

ANCISTROCOMA sp.

In the survey period 11.8 % of oysters contained Ancistrocoma sp. in the gut tubules. This compares to 10.7% in 1995 and 5.5% in 1994. A value of 13.5% infection was found by Wilson et al.

The levels of the commensals are similar in all regions for 1996 except for the prevalence of mudworm blisters which was higher in the South East and higher still in the South.

Two samples, each of 30 wild oysters, were collected from the North East of the State at Bridport and Tomahawk. The latter sample was not obtained until March 1997 but has been included with the earlier data. Further data were obtained from another project in which six sites in the Tamar River and one from Port Sorell were sampled as part of a study on the long term effects of the Iron Baron oil spill. Therefore, all wild oysters sampled in this time period are from the North of the State.

Table 6: Conditions observed in wild oysters compared with farmed oysters - 1996

	Farmed oysters	Wild oysters
No. oysters examined		150
Diseases	Nil	Nil
Trichodina*		0.7
Ancystrocoma*	11.8	1.3
Pseudomyicola*		2.0
Rickettsia		1.3
Ovacystis		1.3
Shell blisters and burrows	5.4	14.7
Other		**

** The abnormalities observed resembled the condition recorded but this diagnosis was not definitive.*

*** One oyster from Sheok Point (Tamar River) had two gut tubules containing unidentified small bodies attached to gut epithelial cells. These appear to be protozoan. They may be small trophozoites of a more complex life form, but so far no other life stages have been identified. One possible amoeba was also present, but it is not known if this was related. Such bodies have been seen before in farmed oysters but rarely. A further oyster from the Tamar had a small ciliate protozoa in one gut tubule of a type which appeared different from Ancistrocoma sp. These have been seen before in farmed oysters.*

The areas from which these wild oysters were obtained do not correspond well with areas in which oysters are farmed. Comparison of the results with the findings in farmed oysters over the same period should therefore be assessed accordingly. In this study data collected from the wild oysters is compared with data from farmed oysters from the main survey in the same year and Table 6 details this comparison.

The level of mudworm infection for wild oysters is far higher than the combined regional data for farmed oysters in 1996 (14.7% v 5.4% for total mudworm and 14.7% v 1.9% for overt blister formation). The difference is even more marked for farmed oysters from the North of the state where < 1% of the total sample had any kind of mudworm infection. In a previous survey of wild oysters from the Tamar River in 1995 the total mudworm level was 9.1%. Farm management practices such as farming off-bottom, and the fact that the wild oysters sampled may have been older than the farmed stock, may explain this.

The other finding of note with regard to commensals is that the infestation level for the digestive tubule ciliate Ancistrocoma sp. is very much lower in the wild oyster data set than for farmed oysters in the survey (1.3% v 11.8% for both the combined regional data and the northern data). In 1995 the figure was 5.5 % for wild oysters surveyed.

General Discussion

Throughout the survey, no disease conditions of significance were observed. The incidence of commensals was variable, with a slight rise in incidence in all areas from 1994 to 1996. In no case was there significant pathology associated with the commensals, and the variability of their incidence was such that no real trends were evident.

In each year, and from each region, the samples of oysters received ranged in condition from good to poor. Where particularly poor batches were received, follow up investigation on farm was undertaken. In every case the poor condition could be explained on the basis of poor management or poor nutrition, and there was no evidence that the poor condition was associated with the presence of commensal organisms.

However, the incidence of shell blisters and burrows, indicative of polychaete mudworms warrants further investigation. Throughout the survey the incidence of shell blisters and burrows was much higher in the Southern region than elsewhere. However, the mean incidence is not representative of a typical lease from the south since the bulk of the positive data was contributed by only 2 leases from that region. .

No significant variations between farmed and wild oysters were detected.

Benefits

The major achievements of this project were the establishment of a methodology for the ongoing monitoring of disease in farmed oysters, and the demonstration of a disease free environment in Tasmanian oysters at the time of the survey.

Further Development

At the end of the FRDC program in 1996 a paper by Dr. Judith Handlinger (Appendix 3) led to the development of a co-operative program between industry and the Fish Health Unit of the Department of Primary Industry, Water and the Environment. This program has been formalized under a Heads of

Agreement between the Tasmanian Oyster Research Council and the Tasmanian Department of Primary Industry, Water and the Environment (Appendix 4) which deals not only with the present, but also with further development of the Pacific oyster health program, including the establishment of industry disease control programs.

This is an ongoing program in which samples of oysters in all growing waters in the State are checked twice yearly for any evidence of change in the disease baselines established during the survey. Sampling routines are more intensive for hatcheries and nurseries, since any disease problem in these establishments would be quickly and widely spread throughout the industry. The program is supported with industry funds through the Tasmanian Oyster Research Council .

Each year, scientific personnel from the Fish Health Unit provide a verbal and written report to industry, with details of the previous year's survey and discussion of relevant issues (Appendix 5). Coupled with the 1998 report, for instance, and reproduced in the Appendix is Dr. Judith Handlinger's report of her overseas study tour. This was undertaken in 1997, coupled with Dr. Handlinger's attendance at the European Association of Fish Pathologists conference. These reports to industry are supplemented from time to time by articles in the Tasmanian Oyster Research Council Newsletter which goes to all oyster growers in the State. TORC considers that ongoing industry interest and involvement is critical to the success of the program

Interstate and international certification have been facilitated because the integrity of the FRDC program, and subsequently the Tasmanian Health Program, has been maintained.

The program has seen Mr. M Lleonart, and subsequently Ms. M Helders, trained in the recognition of shellfish tissue abnormalities and the recognition of disease agents and pests. There has been useful interaction between this project and its trained staff, and the CRC Abalone Mudworm project.

Conclusion

During the period of survey, Tasmanian Pacific oysters were free from Iridovirus, Herpes virus, Marteiliosis, Haplosporidiosis, Perkinsus infection, Norcardiosis (previously known as Actinomycosis), Rickettsia and Ovacystis. They were also free of any significant effects from the levels observed of parasites resembling Trichodina, Ancistrocoma and Pseudomyicola. Significant evidence of polychaete mudworm in the south of Tasmania warrants further investigation.

The project has contributed substantially to the training of laboratory personnel in the recognition of oyster diseases and pests and has given rise to a valuable, ongoing Pacific Oyster Health Program which would not otherwise have developed.

References

Wilson, J; Handlinger, J; and Sumner,C.(1993). The health status of Tasmania's bivalve shellfish. Sea Fisheries Division, Technical Report No. 47. Tasmania.

OIE Diagnostic Manual for Aquatic Animal Diseases (1995) Chapter 1 page 4.

APPENDIX 1:

Intellectual Property

The Corporation and the Tasmanian Oyster Research Council have agreed that the Corporation's share of title to all intellectual property and project income will be 56%.

APPENDIX 2:

Staff : Dr Judith Handlinger, Veterinary Pathologist
Mr. Mark Lleonart, Technical Officer

APPENDIX 3

DIAGNOSTIC AND SURVEILLANCE OPTIONS FOR THE PACIFIC OYSTER INDUSTRY

A discussion paper prepared in July 1996 by Dr J. Handlinger, Department of Primary Industry and Fisheries, Tasmania (DPIF) for the Tasmanian Oyster Research Council (TORC).

INTRODUCTION

The FRDC/TORC "Health Watch" program will be completed at the end of 1996. Specified in the structure of that program is the continuing development of diagnostic and surveillance options for the Pacific oyster industry in Tasmania.

Such development is in keeping with the Department of Primary Industry and Fisheries current direction of developing a more formal basis for diagnostic and surveillance programs across all the aquaculture industries. The Department's preferred framework for this aims to satisfy both the surveillance and diagnostic needs of industry and the obligations of the Department with respect to animal health. This would allow the costs to be shared by DPIF and the industry.

While I have been asked initially to consider the broadest possible options for the industry, after considering the factors involved (outlined below) I have-restricted the discussion to consideration of the one proposal. This is due to the reality of the cost advantage this proposal offers, other options appearing to be significantly more expensive or failing to fulfill the accepted needs of the industry.

FACTORS FOR CONSIDERATION

The following factors need to be taken into consideration when determining diagnostic and surveillance options for the Pacific Oyster industry:

(1) the objectives and expectations of the FRDC/TORC " Health Watch" program

- to establish a permanent surveillance program to cover all sectors of the industry, from hatchery to nursery to farm grow out sector.
- to assist in the transfer of the process to industry
- to establish mechanisms for the early identification of potential threats.
- to establish an expert diagnostic and surveillance capability of benefit also to other cultured shellfish sectors.

APPENDIX 4

HEADS OF AGREEMENT BETWEEN

Tasmanian Department of Primary Industry and Fisheries and Tasmanian Oyster Research Council Ltd.

- The Tasmanian Department of Primary Industry and Fisheries (DPIF) and the Tasmanian Oyster Research Council (TORC) hereby enter an agreement for the on-going conduct of the Pacific Oyster Health Research Assessment ("Oyster Health. Watch") Program for the period. 1 July, 1997 to 30 June, 2000 and the development of the Program as a formal Disease Surveillance Program as specified in the Animal Health Act, 1995 (as per the attached "Diagnostic and Surveillance Options for the Pacific Oyster Industry" discussion paper prepared and presented by Dr. Judith Handlinger, Fish Pathologist, DPIF, Tasmania, and relevant sections of the Animal Health Act, 1995).

- The DPIF is to assume full responsibility for analysis, reporting and collation of results, and general responsibility for the organisation of sample submission.

- The Tasmanian Oyster Research Council will pay an annual contribution of $15,000 to DPIF for industry 's share of the ongoing costs.

    - This levy will be paid quarterly in advance.

    - In December 1998/January I999 the parties will participate in full discussions and negotiations which will cover, among other things, both the scientific content of the Program and the funding arrangements. Similar discussions will ensue in June 2000 to make necessary arrangements for a continuation of the Program. This is to ensure that the service remains responsive to industry needs and that charges are commensurate with the services provided.

- A joint industry/DPIF management group (of no more than four members) will manage the day to day running of the Program with an annual presentation of the Program's findings to industry.

- The Tasmanian Oyster Research Council will appoint the industry representatives on the management group. DPIF representation would be appointed by the Chief Veterinary Officer.

- The Program may be terminated by either party only with six (6) months notice in writing.

APPENDIX 5

Department of Primary Industry and Fisheries
Tasmania

TOWARDS THE MAINTENANCE OF AN ECOLOGICALLY SUSTAINABLE PACIFIC OYSTER INDUSTRY
ANNUAL REPORT - 1998

SUMMARY

Grower: Combined data — Date collected: January to November 1998
Region: All regions — Submissions: 33 — No. leases: 28 — No. oysters: 1891

RESULTS:

Diseases examined for: Iridovirus, Herpesvirus, Marteiliosis, Bonamiosis, Haplosporidiosis, Perkinsus infection, Nocardiosis.

Diseases found: No disease found.

COMMENSALS / PARASITES

	Frequency (%)
Shell burrows	7.3
Shell blisters	8.6
Mudworm	15.9
Trichodina-like	9.7
Ancistrocoma-like	10.3
Pseudomyicola-like	0.7
Rickettsia	0.7
Ovacystis	0.0
Other*	0.1

*(The above are organisms which at the incidences detected are not thought to pose a health threat to the oyster or the consumer). *These refer to the unidentified oyster spherical.*

Shell blisters

The overall rote of shell blistering was 8.6%. This rate is slightly increased over the 1997, 1996 and 1995 figures of 6.2%, 5.4% and 5.2% respectively, but below that recorded in 1994 of 9.8%. Combined blistering and burrows were greatest in the Southern region and least on the East Coast which is similar to that recorded in previous years.

Trichodina sp.

The protozoan Trichodina sp. was found in more than 9% of oysters during 1998, a considerable increase over the previous 4 years: 1.3, 2.7, 0.3 and 0.9% for 1997, 1996, 1995 and 1994 respectively. The levels of Trichodina sp. infestation were not greatly different between the regions.

Ancistrocoma sp.
In the survey period, 10.3% of oysters examined were found to be infested with Ancistrocoma sp. within the digestive tubules. This compares with 10.1, 11.8, 10.7 and 5.5% for the years 1997, 1996, 1995 and 1994 respectively. Again, the levels of infestation were not greatly different between the regions.

Pseudomyicola sp.
Levels of Pseudomyicola sp. and other unidentified degraded crustaceans were 0.7% in the survey period. This compares with 1.1, 1.4, 1.0 and 1.6% for the years 1997, 1996, 1995 and 1994 respectively. The greatest incidence was seen in the southern areas of the state.

Rickettsia sp.
The current survey found 0.7% of oysters with Rickettsia sp. versus 1.5, 1.4, 1.0 and 1.4 in the years 1997, 1996, 1995 and 1994 respectively.

Ovacystis

No oysters were found to be infected with Ovacystis during the current survey period. In the last four years the recorded levels of Ovacystis have generally been <0.1%, although during 1995 the recorded incidence was 0.5%.

Other sp.

An unidentified oyster spherical was seen during 1998. It was only recovered from the East Coast region. The effect on oyster health was not able to be determined although the infection was limited to two oysters from the one farm. The same submission from this farm was scored as being in good condition when the oysters were examined.

CONDITION

The 33 samples were rated as follows:
Fair – 9
Poor-fair - 9
Fair-good - 9
Good - 3
Good-excellent - 1
Not specified - 2

Oysters examined and found to be in poor condition were not considered to be suffering overt disease but to be reflecting seasonal and/or environmental conditions.

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