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Aquaculture Environmental Monitoring
Program 2005**

Summary of Results

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SARDI Aquatic Sciences Publication No. RD06/0009

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Summary of Results

This is a summary of all the results of the Benthic Assessment component of the Marine Tuna Aquaculture Environmental Monitoring Program (TEMP) 2005 for six tuna farming licence areas (Figure 1). All of the monitored licence areas were located in marine waters adjacent to Port Lincoln, South Australia. Five of the licence areas were located in the Boston Island East farming zone and one was located in the Rabbit Island farming zone.

The field sample collections were carried out by the Tuna Boat Owners Association of South Australia Inc. (TBOASA) with a representative from PIRSA Aquaculture onboard the sampling vessel King Hitter in December 2005. The laboratory processing of the samples, data analysis, interpretation and reporting were carried out by the South Australian Research and Development Institute (SARDI) in early 2006. The benthic assessment component uses an analysis that determines the extent to which the samples from the potentially impacted location (compliance site) differ from those from the associated control locations.

The development of DNA assays for selected benthic marine organisms in sediments and the successful application of the Root Disease Testing System (RDTS) for DNA extraction to marine sediments resulted in a system capable of delivering high throughput, quantitative molecular assays for processing of sediment samples. In addition, to deliver the DNA assay system for use as a tool in routine environmental assessment and monitoring, an Environmental Compliance Scorecard (ECS) system was developed to provide a packaged set of statistical and mathematical routines for analysing, integrating and summarising results from the DNA assay system. This DNA assay system together with the ECS system (outcomes of the now completed project “Aquafin CRC - SBT Aquaculture Subprogram: Tuna environment subproject 1: Development of novel methodologies for cost effective assessment of the environmental impact of aquaculture FRDC 2001/102”) was trialled for TEMP in 2005.

The analyses as implemented through the ECS system showed that the results for all six licence areas monitored in the Boston Island East and Rabbit Island farming zones passed all tests. All licence areas had an overall compliance rating above 90%, which lies within the green tier (Table 1 and Figure 2). The green compliance rating means that compliance and control samples were not different, indicating that the current environmental management practices for all licence areas are working well and the operations are within the acceptable limits set for the reporting period of 2005. The detailed Environmental Compliance Scorecard for all licence areas are given in Table 2.

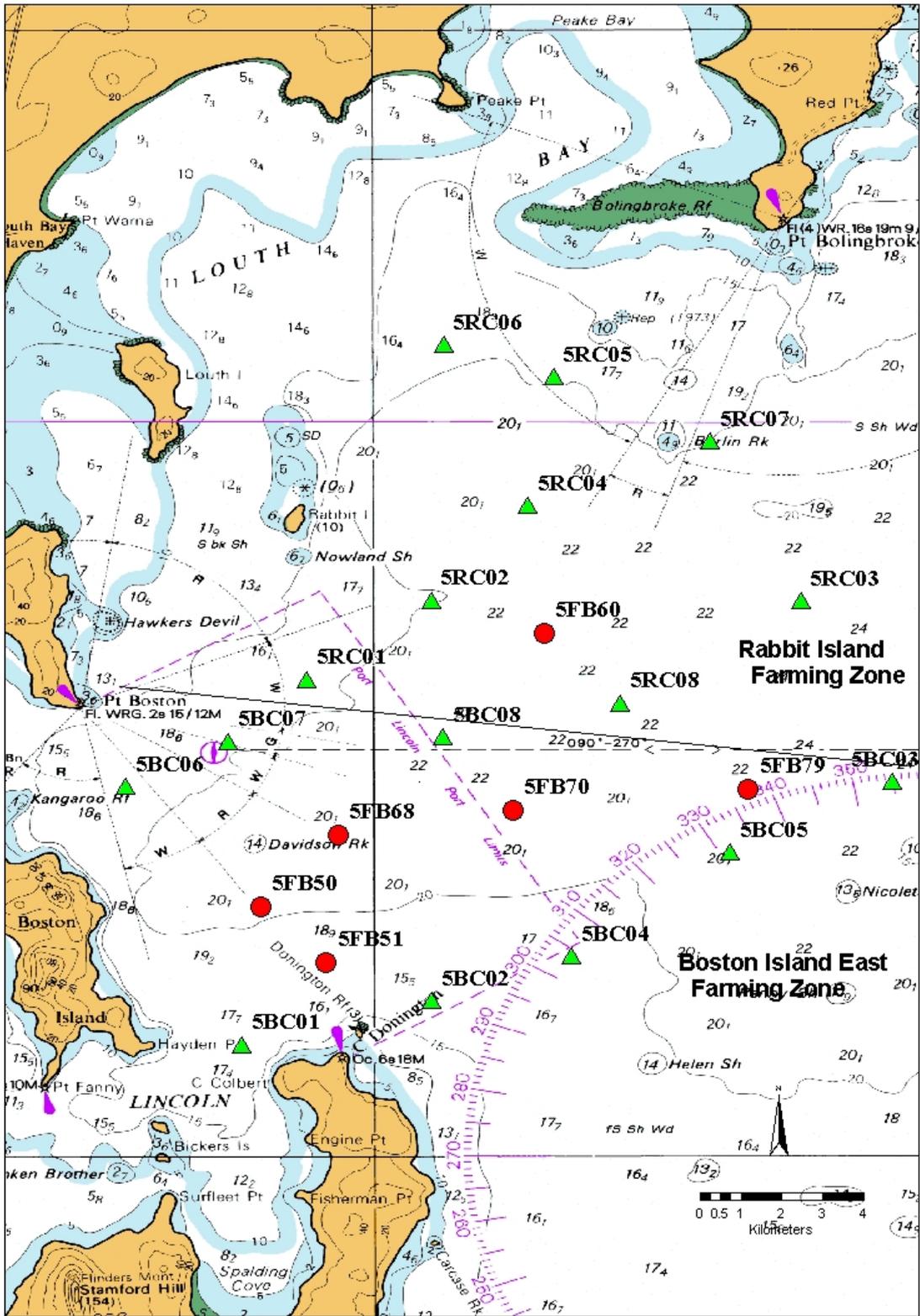


Figure 1 Location of all six compliance sites (●) monitored and associated control sites (▲) in Boston Island East (5BC*) and Rabbit Island (5RC*) farming zones.

Table 1. The compliance rating for all licence areas monitored in the Boston Island East and Rabbit Island tuna farming zones off Port Lincoln, South Australia.

Farming zone	Licence number	SiteID	Compliance rating (%)	Colour indicator
Boston Island East	FB00050	5FB50	96	Green
	FB00051	5FB51	91	Green
	FB00068	5FB68	91	Green
	FB00070	5FB70	94	Green
	FB00079	5FB79	100	Green
Rabbit Island	FB00060	5FB60	91	Green

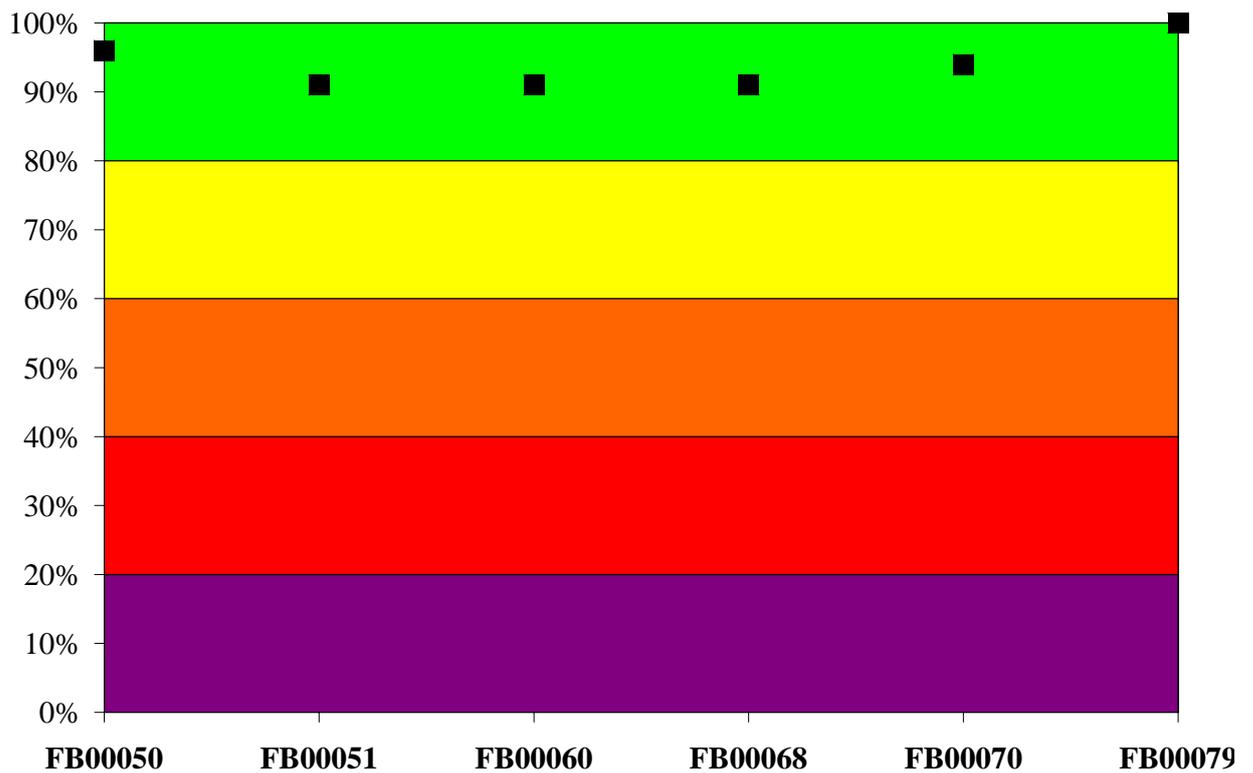


Figure 2 Compliance scores as indicated by black box on plot for all six licence areas monitored in the Boston Island East and Rabbit Island farming zones

Table 2 Detailed Environmental Compliance Scorecard for all six licence areas monitored in Boston Island East and Rabbit Island farming zones.

FB00050

Your compliance score has been calculated as follows:

Test	Result	Test	Level	Rating	Your Score	Best Score
1	0.72	>	0.05	Pass	10.0%	10.0%
2	0.72	>	0.01	Pass	20.0%	20.0%
3	0.85	<	1.50	Pass	10.0%	10.0%
4	0.85	<	3.00	Pass	20.0%	20.0%
5	8.00	/	9.00	0.89	11.8%	13.3%
6	8.00	/	9.00	0.89	23.7%	26.7%

Giving a compliance rating of **96%** **100.0%**

FB00051

Your compliance score has been calculated as follows:

Test	Result	Test	Level	Rating	Your Score	Best Score
1	0.47	>	0.05	Pass	10.0%	10.0%
2	0.47	>	0.01	Pass	20.0%	20.0%
3	1.02	<	1.50	Pass	10.0%	10.0%
4	1.02	<	3.00	Pass	20.0%	20.0%
5	7.00	/	9.00	0.78	10.3%	13.3%
6	7.00	/	9.00	0.78	20.8%	26.7%

Giving a compliance rating of **91%** **100.0%**

FB00060

Your compliance score has been calculated as follows:

Test	Result	Test	Level	Rating	Your Score	Best Score
1	0.58	>	0.05	Pass	10.0%	10.0%
2	0.58	>	0.01	Pass	20.0%	20.0%
3	0.88	<	1.50	Pass	10.0%	10.0%
4	0.88	<	3.00	Pass	20.0%	20.0%
5	7.00	/	9.00	0.78	10.3%	13.3%
6	7.00	/	9.00	0.78	20.8%	26.7%

Giving a compliance rating of **91%** **100.0%**

FB00068

Your compliance score has been calculated as follows:

Test	Result	Test	Level	Rating	Your Score	Best Score
1	0.58	>	0.05	Pass	10.0%	10.0%
2	0.58	>	0.01	Pass	20.0%	20.0%
3	0.94	<	1.50	Pass	10.0%	10.0%
4	0.94	<	3.00	Pass	20.0%	20.0%
5	7.00	/	9.00	0.78	10.3%	13.3%
6	7.00	/	9.00	0.78	20.8%	26.7%
Giving a compliance rating of					91%	100.0%

FB00070

Your compliance score has been calculated as follows:

Test	Result	Test	Level	Rating	Your Score	Best Score
1	0.49	>	0.05	Pass	10.0%	10.0%
2	0.49	>	0.01	Pass	20.0%	20.0%
3	1.01	<	1.50	Pass	10.0%	10.0%
4	1.01	<	3.00	Pass	20.0%	20.0%
5	7.00	/	9.00	0.78	10.3%	13.3%
6	8.00	/	9.00	0.89	23.7%	26.7%
Giving a compliance rating of					94%	100.0%

FB00079

Your compliance score has been calculated as follows:

Test	Result	Test	Level	Rating	Your Score	Best Score
1	0.68	>	0.05	Pass	10.0%	10.0%
2	0.68	>	0.01	Pass	20.0%	20.0%
3	0.87	<	1.50	Pass	10.0%	10.0%
4	0.87	<	3.00	Pass	20.0%	20.0%
5	9.00	/	9.00	1.00	13.3%	13.3%
6	9.00	/	9.00	1.00	26.7%	26.7%
Giving a compliance rating of					100%	100.0%

Explanation of analysis methods

This assessment uses an analysis that determines the extent to which the samples that make up the compliance site differ from samples in the associated control sites for the licence area under assessment. The analysis has two components; the first is based upon a calculation of the Bray-Curtis similarity between all pairs of control samples compared with the similarity between the compliance sample and all control samples. The consistency between the similarity values is calculated and this is used to determine the extent to which the compliance point has an overall similarity to the control samples. Secondly the relative abundances of infaunal taxa in the compliance sample is tested against the upper 95% and 99% CL of the control samples to evaluate the extent to which there has been an increase in the abundance of selected taxa in the compliance samples relative to the control samples.

Explanation of compliance scores

Environmental performance on this farm is consistent with industry best-practice. Monitoring need only be conducted on a bi-annual basis.

Business rules used for the assessment:

A Violet rating is obtained when the compliance score sits between 0% and 20%.

A Red rating is obtained when the compliance score sits between 20% and 40%.

A Orange rating is obtained when the compliance score sits between 40% and 60%.

A Yellow rating is obtained when the compliance score sits between 60% and 80%.

A Green rating is obtained when the compliance score sits between 80% and 100%.

The compliance rating has been calculated using the following rules

Test	Description	Weighting
1	Compliance point is significantly different to controls - $\alpha > 0.05$	10.0%
2	Compliance point is significantly different to controls - $\alpha > 0.01$	20.0%
3	Compliance point is less similar to controls than controls are to one another by a factor of 1.5	10.0%
4	Compliance point is less similar to controls than controls are to one another by a factor of 3	20.0%
5	Number of taxa where abundance does not exceed the upper 95% CL of control	13.3%
6	Number of taxa where abundance does not exceed the upper 99% CL of control	26.7%
Maximum possible compliance rating		100.0%

Explanation of indicator colours	
	A green indicator means that control and compliance samples are not different.
	Current environmental management practices are working well.
	A yellow indicator demonstrates a situation where, although there are some differences between control and compliance points, the magnitude or significance of the difference is relatively low.
	Environmental management practices are not consistent with industry best-practice.
	An orange indicator demonstrates a situation where, although there is a significant difference between control and compliance points, the magnitude or significance of the difference is low.
	Environmental management practices need to be changed to prevent further deterioration of the supporting environment.
	A red indicator demonstrates a situation where there is a significant difference between compliance and control sites and where this difference has a magnitude that warrants immediate remedial action.
	This outcome, is technically in breach of licence conditions and immediate changes should be made to farming practices to prevent further environmental harm.
	A violet indicator demonstrates a situation where there is a substantial difference between compliance and control sites and where this difference has a magnitude that warrants immediate remedial action.
	This outcome is in breach of licence conditions. Farming should cease on this site to prevent further environmental harm.