RUELLO & ASSOCIATES FISHERIES CONSULTANTS

CONSULTANTS TO THE AQUACULTURE AND SEAFOOD INDUSTRY

NSW OYSTER INDUSTRY

R & D STRATEGIC PLAN

Prepared for

NSW Fisheries

and the

Fisheries Research & Development Corporation

by

Ruello & Associates

February 1996
Revised 2 May 1996

4 Sherwin St, Henley, New South Wales 2111, Australia. **Telephone (02) 817 4652** Fax (02) 879 6501

Foreword and Disclaimer

This report has been prepared for NSW Fisheries and the Fisheries Research & Development Corporation.

It is based on information gathered by the author from published reports and unpublished documents and by means of interviews with a number of persons believed to be reputable and reliable.

I believe the report to be accurate but it contains estimates and evaluation of future events and I accept no liability for the information herein, hence readers should make their own enquiries to satisfy themselves on all matters.

Nick V Ruello

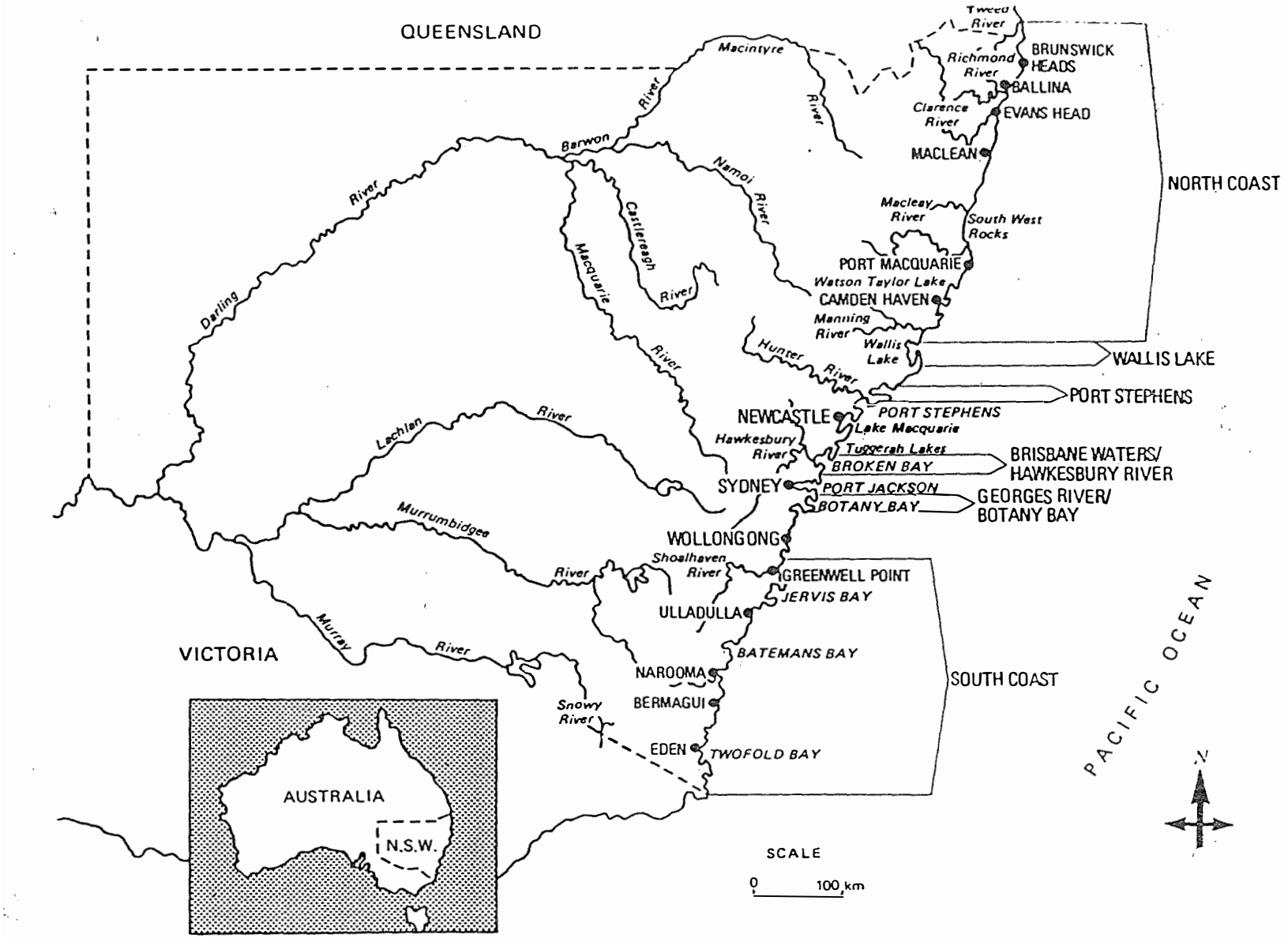
Acronyms

AOMCL	Australian Oyster Marketing Cooperative Limited
ASSMAC	Acid Sulphate Soils Management Advisory Committee
CRC	Cooperative Research Centre
DEET	Department of Employment Education & Training
EPA	Environment Protection Authority
FRDC	Fisheries Research & Development Corporation
NFA	National Farmers Association
NHMRC	National Health & Medical Research Council
NSSP	National Shellfish Sanitation Program
OFA	Oyster Farmers Association
OLMA	Office of Labour Market Adjustment (of DEET)
ORAC	Oyster Research Advisory Committee
QA	Quality Assurance
QAP	Quality Assurance Program(s)
RAS	Rural Adjustment Scheme
R & D	Research & Development
SQAP	Shellfish Quality Assurance Program Committee
SWOT	Strengths, Weaknesses, Opportunities and Threats
TCM	Total Catchment Management

Contents

		Page
EXECUTIVE SUMMARY		i
1.	INTRODUCTION	1
2.	METHODOLOGY	3
3.	NSW INDUSTRY OVERVIEW	4
4	R & D ON SYDNEY ROCK OYSTER	8
	4.1 Past R & D Projects	9
	4.2 Current R & D Projects	17
5.	INDUSTRY ISSUES	
	5.1 Industry unity	21
	5.2 The Pacific Oyster	23
	5.3 Triploid oysters and hatchery technology	23
	5.4 Interaction with NSW Fisheries	25
	5.5 Inactive leases and hobby farms	27
	5.6 Oyster diseases	29
	5.7 Water quality and estuary management	30
	5.8 Depuration of oysters	33
	5.9 Product quality	35
	5.10 Marketing and Promotion	36
	5.11 Industry economics	38
	5.12 Cultivation Practices	40
	5.13 Training, seminars and workshops	41
6.	INDUSTRY (SWOT) ANALYSIS	
	6.1 SWOT Analysis	42
	6.2 Industry capacity for expansion	44
7.	INDUSTRY GOALS and RESEARCH WANTS	
	7.1 Goals and vision	46
	7.2 Research requests and priority	48
8.	THE R & D PLAN	50
	8.1 The key R & D projects	53
9.	DISCUSSION	
	9.1 R & D Resources and mechanisms	57
	9.2 Extension and technology transfer	60
	9.3 Evaluation and accountability of R & D	63
10.	REFERENCES	66
	APPENDIX 1. Questionnaire to oyster farmers	67

Figure 1 Physical Location of Oyster Farms in New South Wales



EXECUTIVE SUMMARY

The NSW oyster industry production in 1994/5 was 83545 bags (average 108 dozen) of Sydney Rock oyster (SRO) and 1713 bags of the Pacific oyster (PO) valued at $28 million at the farm gate. This is approximately 60% of the production of SRO in the record year of 1976/7.

This decline is the result of:

- public health problems and oyster diseases with the SRO,
- the increasing encroachment of PO in Port Stephens from 1984
- and related control measures
- inadequate attention to promotion and marketing and increasing competition from PO from interstate and New Zealand

The industry today is characterised by many small independent farms : more than 45% producing less than 50 bags SRO in 1994/5, and there are a significant number of idle leases. PO is only allowed to be cultivated in Port Stephens but output has increased steadily in the past few years.

The farmers economic returns could however double within 10 years with:

- the strong demand for the highly rated SRO a species native to N S W
- the capacity for rationalisation of farms and expansion of supply
- the increasing change to the more desirable single seed oysters
- the marketing of quality assured oysters, generating higher returns.

A strategic R & D plan covering six key project areas has been produced to help transform the NSW oyster industry into a united, forward looking industry, producing a range of quality assured oysters and other products, marketing in a more collaborative and profitable manner.

The R & D portfolio mix recommended to NSW Fisheries and the FRDC for the next five years is:

1. Industry Analyses Projects
   Economic survey, estuary capacity study and a review of PO control
2. QA programs and a Code of Practice
   including a review of depuration methods
3. Industry Development Projects
   Strategic development plan, Local (Estuary) plans & Crisis plan
4. Marketing projects. Domestic and export plans and industry workshop
5. Hatchery Technology, to provide a variety of genetically selected spat
6. Cultivation Technology:
   comparison of growing methods and alternatives to timber

Total distribution of FRDC funds in the proposed program is $1.395 million over the next five years (approximately 5 x $280000).

The plan requires a greater than average distribution of funds by FRDC in the first three years, and an increase in expenditure by NSW Fisheries and the industry from levels of recent years. We see this increased expenditure as a sound investment in the future of an attractive industry.

The portfolio mix has been selected to provide for immediate needs to consolidate current business activities and improve profitability with existing farming methods and resources. The projects on QA and the industry development strategy lay the groundwork for expansion of production and domestic markets, and successful entry into world trade.

The development of hatchery technology is investment in the future growth of the industry through genetically selected oysters and diversification with other shellfish.

The proposed R & D portfolio moves away from the past emphasis on biology, oyster diseases and production, and focuses on business profitability and the future.

Many oyster farmers are critical of much past research describing it as not relevant to their needs and some even useless. We believe this to be largely unjustified. R & D on the SRO industry has generally been of high calibre mostly relevant and mostly delivered on time but communication, extension of research and technology transfer by many R & D providers has been inadequate or weak.

This situation can be improved by the research community:

- clearly informing industry of the nature of their organisation, ie its functions, goals, funding sources and targets and any constraints regarding industry related research
- aiding communication by not assuming farmers are familiar with past research and by avoiding technical jargon and acronyms;
- providing concise practical reports that spell out the economic implications of their research and development.

The personnel and mechanisms available to help industry with R & D issues and other problems are many and varied but financial resources and time are limited. We therefore propose that major or widespread problems and R & D issues are addressed with public resources and funds (with industry input) while local minor issues are dealt with primarily at the local level and with industry personnel and funds.

Response plans and protocols, and a register of R & D providers and other resources, should be prepared by each estuary management committee in readiness for tackling unfavourable incidents or ongoing problems quickly.

The NSW industry has expended much energy debating about PO and other problems. It should put aside the past and now invest heavily in its own future: in R & D, in emergency funds, in promotion and marketing.

1. INTRODUCTION

The NSW oyster industry is one of the states oldest and most valuable fishery, with a farm gate value of more than $27 million in 1994/5. It has an impressive history covering more than a hundred years of farming the native Sydney rock oyster ***Saccostrea commercialis*** but has experienced a decline since its record year of 1976/7 (Chapter 2). Nevertheless the NSW industry produced more than 60% of the country's oyster output in 1994/5.

The NSW industry is notable in many ways: it is found in all estuaries in NSW, it is based on two species of cupped oysters: the Sydney Rock Oyster and ***Crassostrea gigas*** the Pacific oyster (PO), first introduced from Japan, and farmed only in Port Stephens in NSW. The Sydney rock oyster is widely regarded as one of the finest oysters in the world and the SRO industry is characterised by the common practice of growing the oyster in more than one estuary during its life and the various linkages between about forty growing estuaries.

The other major oyster producing states are Tasmania and South Australia with approximately 25 and 15 % of the national output respectively, almost exclusively PO. Although the NSW industry is large it is dwarfed by those in Japan and Korea, the two largest producers with an industry about twenty times larger.

The NSW industry has had to cope with considerable change and disruption, as a result of public health problems in the Georges River in 1978 and a proliferation of PO in Port Stephens (figure 1) in the 1980's, as outlined in the following chapter.

The industry was reviewed by a departmental Task Force established by the Minister for Agriculture and Rural Affairs in 1989. (Task Force Report 1990) and this report included a small section on research, primarily recommending that the industry develop options for collecting and allocating research funds.

Research on the SRO has a long history, with the first study on mud worm problems 106 years ago and the first report on winter mortality disease in 1926. NSW Fisheries established a Brackish Water Fish Culture Research Station at Port Stephens in 1972 and oysters have been a central part of the work there since.

The present review of Research & Development in the NSW oyster industry and the development of an R & D strategy for the next five years has been commissioned by NSW Fisheries to assist the Fisheries Research & Development Corporation FRDC) evaluate funding priorities for R & D projects.

The FRDC has recently been calling for such studies in order to ensure that the limited research funds available are directed to areas that provide the highest net benefits.

The study was undertaken in January and early February 1996.

The terms of reference follow:

The study is to :

1. Outline pending, current and past research of the Sydney Rock Oyster (SRO) relevant to the industry and its future including a summary table of the studies indicating objectives, duration and results of the research.

2. Undertake a SWOT study (strengths, weaknesses, opportunities and threats) of the industry to enable identification of key areas of R & D needed to bring improved viability to the industry.

3. Determine areas of R & D investment that give a strategic response mechanism to incident, short term and long term future of the industry on a local and statewide basis.

4. Prioritise issues for R & D.

5. Make recommendations for evaluating R & D investment.

6. Make recommendations for technology transfer, accountability and performance evaluation mechanisms of R & D.

Acknowledgments

Many people around the country assisted with information and advice. My thanks are extended to them, especially the farmers who returned a questionnaire.

N V Ruello

2. METHODOLOGY

This study commenced and finished with a desk review of the industry; earlier studies and reports on the NSW oyster industry were then used as a starting point to prepare a list of issues for exploration with all relevant parties. Consultation with the oyster industry and other parties was undertaken by means of:

Meetings with groups of farmers, individual farmers and former farmers. These were undertaken with farmers from 11 estuaries between the Hastings River in the north to Merimbula in southern NSW.

Farmers were contacted with the assistance of the two industry groups to cover the geographical range of the industry, the major cultivation methods and as wide a range of opinions as possible. The number of personal meetings was limited because of the time and budget constraints.

Meetings or telephone discussions with research and administrative personnel in the NSW Fisheries and the NSW Health department.
Meetings or telephone discussions with research staff at :
NSW Fisheries, Cronulla, Wollongbar and Port Stephens research station
Universities with a record in oyster research
Other public and private sector R & D providers
Meetings or telephone discussions with
Chairman and members of the Oyster Research Advisory Committee
Chairperson and members of the Shellfish Quality Assurance Program
Oyster processors, restaurateurs, seafood wholesalers, retailers and consumers; supermarket seafood buyers

Meetings with
President and Vice President of the Oyster Farmers Association (OFA)
Director of the NSW Farmers Association (NSW FA)

In addition a letter and questionnaire was mailed to all oyster farming members of the NSW FA and the OFA seeking their input into the development of this paper. This was undertaken in order to get as broad a coverage of the industry as possible given the time and budget available for the study. The questionnaire was kept short and simple in order to maximise the return rate.

A total of 85 farmers responded to this invitation to participate, with the most common respondents being medium sized businesses, producing between 50 and 250 bags in 1994/5. Large enterprises, producing more than 250 bags, were over-represented in the survey and small scale farmers were under-represented in the sample. A copy of the questionnaire is appended.

In all, more than 100 farmers participated in this consultation process, with some farmers participating with an anonymous reply to the questionnaire as well as personal discussion.

3. NSW OYSTER INDUSTRY - OVERVIEW

The NSW industry is dominated by the widespread culture of Sydney Rock Oyster *Saccostrea commercialis,* with a small volume of Pacific Oyster *Crassostrea gigas* grown in Port Stephens. The total production in 1994/5 was 83,545 and 1713 bags respectively earning the farmers $27. 5 million and $0.5 million respectively .

The SRO industry is complex because this species is cultured in almost all estuaries along the coast and production ranges from the traditional stick culture carried out entirely in the one estuary by a small family firm to an integrated company operation involving a combination of growing methods (sticks, trays, cylinders etc) utilising more than one estuary and its own transport and marketing infrastructure.

One of the distinctive features of the SRO industry is the movement of SRO from one estuary to another. The culture of PO in NSW is restricted to Port Stephens, by Fisheries regulations.

Table 1 shows the SRO production figures from 10 leading estuaries for the last three years and for 1976/77 when the SRO production was at a record high. PO production (from Port Stephens) has risen steadily for those three years from 537 bags in 1992/3 to 1570 (1993/4) and 1713 bags in 1994/5.

Table 1 Sydney Rock Oyster Production (bags).*

Estuary	1976/7	1992/3	1993/4	1994/5
Hastings R.	3162	3152	3639	3220
Manning R.	3323	3696	3571	3133
Wallis Lake.	19777	25621	24782	26031
Pt Stephens	43130	10915	8206	5305
Brisbane Water	3002	6173	5332	5047
Hawkesbury R.	16253	6405	7810	6975
Georges R.+Botany B	32687	8873	9129	10359
Crookhaven R.	2063	2454	1822	1439
Clyde R.	5156	4791	5658	6437
Merimbula L.	1402	1825	2235	1510

Estuaries are listed according to geographical position from north to south
1 bag = approximately 108 dozen average 1994/5 * Data NSW Fisheries

Production levels vary from year to year in each estuary as a result of a variety of biological factors and farming practices as well as the impact of oyster diseases such as Winter Mortality and Qx and infestation by the mudworm *Polydora*.. The downward trend in production has come about as a result of the supply factors described above as well as marketing and other economic difficulties experienced by the industry and described in Chapter 5.

The most dramatic changes have been at Port Stephens where production has steadily declined particularly in the late 80's with the proliferation of PO (and the collapse of several major businesses), and at the Georges River.

Port Stephens has long been the nursery area for much of the State and the spread of PO has reduced its importance as an oyster growing area as well as a principal supplier of SRO spat.

Georges River has recorded a large downturn in production, after several major public health problems related to the consumption of oysters from this estuary, and the impact of winter mortality and Qx disease problems. In 1994/5 the Georges River industry suffered another setback because of the impact of Qx disease west of Tom Ugly's Bridge, but overall production was maintained because of better results in Botany Bay.

The industry farms 4772 hectares held under 3583 leases operated by some 980 leaseholders (NSW Fisheries data). There are believed to be about 700 separate oyster farm businesses in NSW, many inactive leases and a significant number of hobby farmers according to many of the farmers participating in this study.

Table 2 highlights the large number of farmers producing less than 50 bags of oysters (46%)and the very small numbers producing more than 500 bags annually. There are only two percent of farmers (total 11) producing more than 1000 bagsbut 30% with less than 25 bags.

Table 2 Sydney Rock Oyster production levels by business size*

PRODUCTION:	< 50 bags	51-150	151-500	> 501
% of farmers	46	28	18	8
No. of farmers	217	132	85	40
Total Bags	4363	11496	21744	45963
% of prod'n	5	14	26	55

* Note these data do not include "nil returns", hence the percentage of small farmers is larger than indicated by the numbers in the table above.

Many farmers still undertake some degree of the traditional stick cultivation whereby spat (larval) oysters are allowed to settle onto timber sticks and grow on this stick until harvested some 2-4 years later but the vast majority of oysters are grown out on plastic mesh trays nailed on racks.

In the past decade there has been a change to single seed oysters caught on plastic slats and then on-grown in trays, baskets, cylinders, envelopes or a combination of these containers.

The industry is characterised by the diversity of its cultivation techniques as well as its marketing methods and business entities. Table 3 (next page) demonstrates the SRO production in 1994/5 according to production technique.

Table 3. 1994/95 SRO Sales by Production Technique (in bags)*

Production Technique	Plate Grade	Bistro Grade	Bottle Grade	Totals
Dredge	349	-	151	500
Floating Basket	17	-	-	17
Floating Stick	55	6	42	100
Mangroves	1	-	-	1
Other	1	-	1	2
Rack	1283	1168	359	2810
Rack-Stick	4234	1722	1457	7414
Rack-Tray	36667	17512	14414	70592
Rack- Tumblers	30	-	17	47
Raft	1253	327	121	1700
Rocks	30	69	68	167
Shell Beds	5	1	186	192
Totals	45924	20805	16815	83545

* One bag of plate =100 dozen@$390 per bag, bistro =110 doz@ $280, bottle =130 doz@230. Data NSW Fisheries

Table 4 demonstrates the dominance of the domestic trade in Sydney and interstate for the SRO; direct exports are negligible although a small volume is also exported occasionally by seafood processors. Local sales represent only 14% of the market for plate grade oysters and a quarter of the trade in the smaller bistro grade. The bottle grade oyster is predominantly sold interstate (mostly to Queensland) and in Sydney.

Table 4 1994/95 SRO Sales by Markets (bags)

Markets	Plate Grade	Bistro Grade	Bottle Grade	Totals
Export	53	90	-	143
Interstate	12961	5575	6649	25185
Local	6356	4951	3132	14439
NSW (Non Sydney)	4149	2842	1271	8262
Sydney	22407	7347	5764	35517
Totals	45924	20805	16815	83545

Data NSW Fisheries

Almost all sales by farmers are of unopened oysters and raw oysters on the half shell and there is very little other processing or value adding activity with SRO or the PO.

The industry is heavily regulated by NSW Fisheries and the Health Department. The NSW Health Department is responsible for the inspection and licensing of oyster depuration plants. The State is divided into various zones to control the movement of oysters from one estuary to another as

part of the PO control program and in order to quarantine Qx to the northern rivers area and the Georges River.

Fisheries regulations prohibit the growing of PO outside of Port Stephens and have provision for the collection of a number of levies to fund research, a compulsory Quality Assurance Program and market promotion.

Pacific Oyster Cultivation

Pacific oyster spat appeared in large number in Port Stephens in 1985 but the species was then considered a noxious species. Restrictions on growing and marketing PO were lifted in 1991 (Nell 1993).

Today the PO is cultivated in Port Stephens almost exclusively from single seed and then grown out in baskets or trays reaching a marketable size within 2-3 years. The main markets are interstate predominantly Queensland.

The NSW PO is not differentiated in the marketplace and consequently it is not well known or recognised by name in retail store or restaurants.

Several farmers in the Crookhaven River have been harvesting the large PO growing wild along rock walls as a means of increasing income and to keep the PO in check and there is a number of farmers in this estuary hoping to be able to grow triploid PO here sometime in the future.

The PO does not suffer from Winter Mortality and Qx as does the SRO (but both species suffer from mud worm infestation) and as indicated earlier the PO industry is still growing in Port Stephens and is being watched by farmers elsewhere in the state.

4. R & D ON SYDNEY ROCK OYSTERS

NSW Fisheries and its predecessors have undertaken research on SRO for more than 100 years since Whitelegge's 1890 "Report on the worm disease affecting the oysters on the coast of NSW" and dominate the literature on SRO. The focus has been on biological matters, other issues such as economics and marketing have not received much attention, despite the declining fortunes of the industry in the past 19 years.

Public health issues came to the fore in the 1980's and the University of NSW, CSIRO, NSW Fisheries and the Health Department have contributed to this area. A common foundation to almost all of the research in the past 25 years is the financial support of the FRDC (and its predecessors).

In all, FRDC has contributed more than $3.2 million to 25 research projects on the NSW industry and the SRO, including the present study (Table 5). In the past five years there has been a noticeable widening of the subject area and variety of R & D providers.

Table 5 FRDC Supported R &D Projects.

FRDC No	Organisation	End date	Short title
71/009	NSW Fisheries	Jun 76	High density culture & husbandry
72/018	NSW Fisheries	Jun 75	Pathology service
76/014	NSW Fisheries	Jun 77	Deepwater oyster culture
80/035	NSW Fisheries	Jun 81	Food poisoning , SRO depuration
80/006	CSIRO Food Res	Jun 82	Depuration of SRO
80/036	Univ of NSW	Jun 81	Depuration of SRO
81/002	NSW Fisheries	Jun 86	Mortality of SRO , NSW & Qld
81/020	Univ of Queensland	Jun 89	Qx disease
82/008	CSIRO Food Res	Jun 84	Pathogenic vibrios
84/067	NSW Fisheries	Jun 87	Mariculture nutrition
84/069	NSW Fisheries	Jun 85	Economic study of NSW industry
85/021	Univ of NSW	Jun 88	Genetic improvement of SRO
86/066	NSW Fisheries	Jun 89	PO in NSW
87/036	NSW Fisheries	Jun 90	Nursery culture SRO & PO
88/104	NSW Fisheries	Dec 91	Settlement and recruitment
89/063	NSW Fisheries	Oct 92	Triploid oysters
90/061	NSW Fisheries	Dec 93	Yeast and bacteria as. food
91/075	Univ of NSW	Jun 94	Depuration, Vibrio vulnificus
92/125.2	Seafood Technology	May 95	Grading and counting machine
93/151	NSW Fisheries	Dec 96	Commercialisation of triploids
93/153	Univ of Queensland	Jun 96	Winter mortality and Qx
94/132	Moreton Bay P Farm	Jun 96	Oysters in aquaculture effluent
94/156	Univ of Queensland	Jun 96	Qx in central NSW
95/124	Aust Water Tech.	Jun 96	Rapid technology for detection
95/175	NSW Fisheries	Mar 96	R & D strategic plan NSW

An even greater sum has a been contributed by FRDC to general research on oysters, shellfish marketing and economic issues of some value to the NSW oyster industry. The PO growers have also benefited from research on PO in NSW and interstate.

The following review commences with NSW Fisheries and the appointment of an Oyster Biologist by NSW Fisheries in December 1964. Wherever full information was available on the project leader, objectives, duration and results these have been presented in tabular form.

4.1 Completed R & D Projects

4.11 NSW Fisheries (and Agriculture)

Oyster Cultivation and Disease Problems

Mr P H Wolf, the Department's Oyster Biologist worked on this industry particularly its winter mortality problems and the life cycle, ecology and pathology of *Mikrocytos roughleyi*, the organism responsible for Winter Mortality, for 20 years until his retirement. Some of this work was funded through a three year FRDC grant 72/018 on Oyster Pathology Service and a five year grant 81/002 on the Mortality of the SRO in northern NSW and southern Queensland.

During this time he also undertook histological studies on the pearl oyster and the blacklipped oyster, and in conjunction with his biometrician colleague A. Collins examined the temperature and salinity regime for major oyster bearing estuaries in NSW.

These studies were concluded with a variety of scientific and technical reports and industry was advised of progress and various farm management techniques for reducing the potential impact of winter mortality via presentations at the Open Days at the Port Stephens station and by means of short articles in Australian Fisheries magazine and the departments magazine The Fisherman.

With the opening of the Port Stephens station in 1972 and the employment of new staff, research was undertaken on the mud worm (*Polydora websteri*) problems by Ms M Skeel who reported on various control techniques at the Open Days and in Australian Fisheries magazine and the scientific press.

Pond and Subtidal Culture

Dr B Wisely and Mr J E Holliday undertook trials on pond culture and experimental feeding of SRO with a variety of artificial diets in the 1970's and in the early 80's Dr J A Nell continued some of this research.
A large number of papers on this work were published in the scientific and popular press and results presented at Port Stephens open days. In all the scientists have written more than 140 papers for the scientific press and a similar number of magazine / newsletter articles.

FRDC 71/009 B. Wisely
High density oyster culture and oyster husbandry
Duration: five years

Objectives: Determine techniques and economics of cultivating oysters under pond conditions. Develop reliable techniques to produce seed oysters under controlled hatchery conditions. Conductbreeding experiments to develop a fast growing disease-resistant strain of oyster.
Results: The pond cultivation did not prove successful, management of algal blooms proved difficult at that time and high mortality from mud worm brought an end to this work. Hatchery successwas limited by inadequate facilities for laboratory algal production [later overcome] and efforts diverted to study of the feeding biology of wild larvae.

FRDC 76/014 Wisely, Holliday and colleagues
Deep water oyster culture
Duration: one year

Objectives: Develop and evaluate commercially feasible methods for growing oysters in deep water in estuarine and inshore coastal waters; develop and evaluate best trays, flotation units, moorings for deepwater, grow out trials of growth and mortality, economics of deep water culture.
Results: Deep water culture with rafts and pontoon trays indicated better growth rates and meat condition than that noted in the traditional intertidal rack and post at selected estuaries. This work produced numerous publications and led to the development of subtidal oyster culture. Raft culture is now common in five rivers and pontoon culture is used in Wallis Lake and the Manning River.

FRDC 84/067 J Nell
Mariculture Nutrition
Duration: three years

Objectives : Develop microencapsulated diets for use in oyster hatchery operations.
Results: A range of artificial food ingredients were evaluated and a microencapsulated diet of better than average performance was developed but abandoned because it was not good enough for commercial use

---

FRDC (86/066). J Nell
Pacific oysters in NSW
Duration: 3 years

Objectives :a comparative study of the biology of the SRO and the introduced species in order to find differences which could be used in controlling the exotic species.
Results: Pacific oysters were found to grow twice as fast as the SRO and PO but juveniles were readily killed by heat unless shaded and can be controlled by air drying at ambient temperature for two weeks, a procedure quickly adopted by industry.

FRDC 87/036 J Holliday
Nursery Culture of the Sydney rock oyster and the pacific oyster
Duration : three years.

Objectives: Develop alternative hatchery settling techniques to scallop shell chips for Sydney rock and pacific oyster

Results : Slurry coated PVC slats were the best collectors for SRO larvae. Sectionalised trays developed by modifying the traditional timber growing tray and PVC cylinders developed by a Hawkesbury R farmer proved to be successful nursery units for the culture of juvenile SRO. Optimum stocking densities for the sectionalised trays and the PVC cylinders were determined

FRDC 88/104. **S McOrrie**
Oyster (Saccostrea commercialis and Crassostrea gigas) settlement and recruitments study
Duration : three years

Objectives: What determines effectiveness of areas with consistently good spat settlements of SRO and PO in Port Stephens.
Results: Documented the spatfall pattern for the PO and SRO (and barnacles) around 24 leases in Port Stephens. Results indicated that there is potential to increase the amount of spat available to the oyster industry and this paper provided a useful checklist of spatfall.

FRDC 90/061 J Nell
Isolation, growth and evaluation of marine yeasts and bacteria as live foods for aquaculture
Duration : three years

Objectives : To carry out nutritional trials to assess the quality and suitability of selected micro-organisms as food for bivalve larvae, rotifers and for feeding /fattening of adult bivalves in particular oysters.
Results: Many pigmented yeasts with good fatty acid profiles were isolated and several gave good growth rates (80% of growth shown by controls fed on an algal diet) when used at 80% substitution for alive algae.

Depuration and Storage

A serious public health problem with SRO in the Georges River in 1978 led to the opening up of a new line of research on depuration and the storage of oysters by NSW Fisheries (and the Health Department and the University of NSW.

FRDC 80/035 Staff not listed
Food poisoning associated with consumption of the Sydney rock oyster
Duration: 1 year

Objectives: Construct a pilot depuration plant. Carry out associated virological and physiological studies to determine optimum purification procedures.
Results: This project was apparently undertaken in conjunction with project 80/006 carried out by CSIRO

R & D work on depuration and refrigerated storage undertaken in conjunction with Mr P Bird of the Health Department in 1990 led to the establishment of depuration procedures for SRO, guidelines for depurating SRO and Pacific oyster and an assessment of the storage life (time - temperature data) on both oyster species.

Reports on depuration and refrigerated storage were presented at the Australasian Pacific Oyster Seminar at Port Stephens in May 1991 and also published in various magazines and journals.

Economics Studies

FRDC 84/069 Economists from the Marketing Division of the Agriculture Department
An economic study of the New South Wales oyster growing industry
Duration: one year

Objectives: Determine financial status of oyster growers and their dependence on oysters for their income; productivity market potential and economic trends, level of investment and indebtedness; sensitivity of industry to changes eg prices and costs.
Results: Reported that farmers in the central coast of NSW had positive returns to capital and management while farmers in the south had negative returns; also noted that labour costs represented approximately half of the costs of growing oysters

Cyril Catt an economist with the Agriculture and Fisheries department also undertook an economic analysis and modelling project in 1990. Catt (1992) developed a simulation model to help compare the profitability of different methods of oyster production and small vs large businesses. This project was abruptly terminated with the separation of Fisheries from the Agriculture Department and the models were never adequately tested.

Pollution Studies

N Mackay and colleagues from Sydney surveyed heavy metals level in the SRO in 19 major producing estuaries in 1973 and found that there were little or no health risks to consumers. They also noted that oysters from the Georges River had relatively high levels of zinc, cadmium and copper and that the levels increased with increasing distance from the sea.

Nell and Holliday (1986) examined the effects of potassium and copper on the settling rate of the SRO larvae in the hatchery, at a time of concern about the effects of antifouling paints -- and noted that these metals too could stimulate the settlement of hatchery larvae

In 1989-90 Nell and Chvojka examined the effect of bis- tributyltinoxide (TBTO) [the active component of many of the old antifouling paints] and copper on the growth of oysters. The findings of this research and that of others was used by NSW farmers to convince the NSW government to institute a ban on the use of this substance. Research paper (Nell and Chvojka 1992) published.

Development of triploid oysters

In 1989 J Nell opened up a new line of research to evaluate the economic prospects of cultivating genetically selected single seed triploid oysters to extend the growing and marketing season of the SRO.

FRDC (89/163). J Nell
Title Evaluation of Triploid SRO on Commercial Leases in Port Stephens
Duration : three years.

Objective: determine if triploid SRO hold their meat condition better than diploid SRO during winter, and thus have an extended marketable period.
Results: triploids grew 30-40% faster than the diploids and held their meat condition for longer period than the diploid oysters and thereby have an extended marketing season. (A parallel project on PO undertaken by University of Tasmania with the same FRDC funding). This work has been extended to other estuaries in the current FRDC assisted project 93/151.

University of Technology Sydney

University of Technology Sydney. Dr K Brown and colleagues
Wallis Lake Oyster Management Plan. 1994. Funded by Mid Coast Regional Employment Education and Training OLMA (Office Labour Market Adjustment) Committee.
Duration: one year

Objective: To prepare a model oyster management plan for the Wallis Lake.
Results: A detailed management plan, with recommendations for government and industry, was prepared in consultation with the general community, the oyster industry, other water users in the district as well as NSW Fisheries, other State and local government organisations.

University of NSW

The Centre for Marine Sciences has had two graduate students work on SRO, one with funding assistance from FRDC.

FRDC 85/021 University of NSW P Dixon (M Griffiths)
"Growth, cytogenetics and larval rearing of Saccostrea commercialis"
Duration: three years. (Nine years till submission of thesis)

Objectives: Improve growth rate of SRO. Supplements work at Port Stephens research station.
Results: Mr Griffiths was unable to rear larvae using standard techniques but completed some work on aspects of growth and cytogenetics; reported in his MSc thesis submitted in 1994.

Elizabeth Ferdinandus Ph D 1994
Project: "Taxonomy and population structure of the Sydney Rock Oyster Saccostrea commercialis".
Duration : three years

Objective: To investigate the genetic relationship between Australian and some Indonesian rock oysters, to work out the status of the SRO
Results: Ms Ferdinandus reported that the SRO formed a separate group from those oysters identified as *Saccostrea cucullata* and the Western rock oyster and that there was no evidence of hybridisation in nature between the SRO and the PO.

University of NSW, Dept of Food Science & Technology

The Department has researched aspects of the microbiology, quality and public health safety of the SRO since the late 1960's. Early work examined the incidence of faecal pollution and mercury contamination of the Georges River system; assessed rapid methods for the detection of faecal pollution; and examined the seasonal incidence of *V. parahaemolyticus* in oysters and the marine environment and the laboratory detection of this organism.

Following the public health outbreak in 1978 G Fleet and colleagues conducted extensive laboratory and commercial trials to develop the basic data on which the UV light depuration technology currently in use is based. These studies, funded by industry, the University and an FRDC grant produced a large number of papers for the scientific press and articles for Australian Fisheries and the Port Stephens Open Days. Souness (1979) also showed that purified SRO had a longer shelf life than unpurified stock.

FRDC 80/036 Univ NSW, Dept Food Science Tech A J Rowse
Depuration of Sydney rock oyster
Duration : 1 year

Objectives: Investigate bacteriological depuration of oysters. Assess the effectiveness of the seawater to be used for depuration by UV light and ozone units. Establish their limits and optimise their use in terms of costs and bacterial destruction.
Results : Rowse's contributed to the development of the technology outlined above and reported on the effects of temperature and salinity on the elimination of *Salmonella charity* and *E. coli* from SRO.

Staff and graduate students at Food School have undertaken a wide range of studies on or with oysters throughout the 1980's and 90' including sensory tests of SRO and PO and further work on depuration and *Vibrio vulnificus*. More than 30 theses and research papers have been completed on contamination issues, purification technology and improved methodology.

A. Longley (1982) found that SRO was more acceptable than PO in regards to appearance, flavour, texture and overall acceptability and depuration was not found to have a detectable effect on oyster acceptability. Flavour was found to be the major determinate of oyster acceptability.

Another study of note is a recent FRDC funded one.

FRDC91/075. Prof K Buckle.
Depuration of the Sydney rock oyster with particular reference to *Vibrio vulnificus*.
Duration : Three years

Objectives: Optimise identification and enumeration of *V vulnificus* and other contaminants of major oyster growing areas in NSW. Assess the incidence of these contaminants in the growing areas. Determine the rate and extent of accumulation in and removal of V v from SRO in laboratory and commercial depuration.
Results: Buckle and coworkers have demonstrated that ozone treatment can reduce V v numbers to undetectable levels in the tank water with 48 hours depuration and that depuration without ozone produces a much smaller reduction of V v numbers.

Research is continuing at the Food School on the future role of ozone depuration and *V. vulnificus* in particular.

University of Queensland

The Parasitology Department has undertaken research on marine parasites and disease in shellfish and fish for the past 15 years with assistance from FRDC. A consultancy service was provided to the fishing and oyster industry in the 80's (immediately below) and two projects are currently funded by FRDC (Section 4.2)

FRDC 81/020. R Lester
Investigations into QX disease in oysters and other problems associated with marine parasites.
Duration: Eight years

Objectives: To provide a continuing source of expertise on marine parasites and disease to minimise their effect on the industry.
Results: Re SRO in Moreton Bay: found that new infections occurred only in summer. Oysters from where the disease was endemic had no more resistance to infections than oysters from outside the Qx area. Fish suspected as intermediate host further work postponed until better method for detection of parasite was available.

CSIRO

The Division of Food Research (N Ryde) undertook studies on the depuration and pathogenic vibrios and a taste test of SRO and PO in the 80's, with FRDC assistance, in conjunction with the NSW Health Department and NSW Fisheries respectively.

FRDC 80/06. CSIRO Food Division W Murrell & G Davey, NSW Health Dept
Viral and bacterial contamination and decontamination of oysters.
Duration: two years

Objectives: Bacteriologically, virologically & physico-chemically monitor oysters water & sediments from selected growing areas for a year. Study oyster depuration processes. Assess safety measures & microbiological standards, improve purification processes.
Results: This study found that purified oysters occasionally fail to comply with the prescribed NHMRC standards and that purification has little impact on the incidence of V *parahaemolyticus*. Added to the information bank on depuration.

FRDC 82/008. CSIRO Food Research M Eyles, W Murrell & G Davey
The occurrence and significance of pathogenic vibrios in oysters
Duration: Two years.

Objectives: Obtain information enabling the oyster industry to minimise the risk of an outbreak of oyster borne illness cause by *V parahaemolyticus* and *V cholerae*. Examine the ecology of these vibrios and their behaviour in SRO.
Results: Suggested that *V parahaemolyticus* is almost always present in SRO purchased by consumers during most of the warmer months of the year and therefore have to be handled with caution against temperature abuse.

R Mc Bride, J Nell (NSW Fisheries) and K. Easton from CSIRO also undertook a sensory comparison of SRO and PO grow in Port Stephens in 1986-7 with some funding from FRDC. They found that both species were highly acceptable. In the single presentation condition SRO was liked slightly but significantly more than the PO; however this difference was not observed when presented side by side, nor were there any detectable differences between species after cooking.

4.2 Current R & D on Sydney Rock Oyster

4.21 NSW Fisheries

NSW Fisheries funded
Mass Selection of Sydney rock Oysters for Faster Growth
CommencementDate: January 1990
Duration: Review planned for December 1987
Objective: The objective of this project is to use the faster growing strains of oysters and winter hatchery production to reduce the growingtime by at least oneyear.
Results to date : Four selection lines of oysters have been grown in Port Stephens and the Georges River. The Port Stephens second generation selection line (one generation of selection) have recorded an average improvement in weight of 4.1% over the controls; a second comparison (with the third generation) is to be undertaken in November 1996. The Georges River work has been disrupted due to the problems with Qx disease in 1995.

NSW Fisheries and CRC funding
Establishment of Tetraploid SRO breedinglines
CommencementJuly 1994 terminate June2001
Objective : To establish a tetraploid copy of each of the four diploid Port Stephens breeding lines.
Results: Tetraploid larvae produced chemically, in January 1996, by blocking polar bodies 1 and 2 in eggs from diploid and sperm from diploids were slow to develop and mortalities were high. A total numberof 18000larvae were put out to set and ongrowing.

FRDC 93/151 JNell
Commercialisation of Triploid SRO
Duration: three years One year extension applied for

Objective: To evaluate the commercial benefits of triploid oysters, particularly growth and survival in the face of winter mortality, with both single seed and stick oysters. This is a continuation of an earlier FRDC project (89/163), being undertaken with 12 farmers in nine estuaries.
Results to date : An experiment has been started at Port Stephens to see if runt diploid or triploids from hatchery spat have commercial value. Another experiment is underway at Merimbula to see if single seed diploid and triploid are more susceptible to winter mortality than stick oysters

4.22 Other R & D Providers

FRDC 94/132 Moreton Bay Prawn Farm. Qld. G. Harrison
The use of oysters as natural filters of aquaculture effluent
Duration: two years

Objectives: To quantify the biofiltration capacity of the SRO and their effects on the water quality of aquaculture pond effluent. To determine the relative growth rates and condition of the SRO grown in pond effluent channels and traditional oyster leases.
Results to date: Given satisfactory conditions of salinity and temperature SRO can and will fatten very quickly in pond effluent but in conditions of low salinities and/or high siltation levels the oysters do not perform well. Work continuing on growth performance in relation to bacteria, suspended solids and total nutrients in the water.

CRC Aquaculture

The CRC has two research projects underway on SRO :

Project Leader Dr Judith Handlinger. DPI & F Tasmania
Project A2.1 Improved early survival of Molluscs
Objective: To improve the early survival of larvae and early juvenile molluscs, with particular reference to oysters by determining the cause of mass mortalities and diseases, and by developing methods of control and prevention.
Results: M Heasman (NSW Fisheries) at Port Stephens is examining the causes of the intermittent mortalities of young SRO at the Port Stephens hatchery. Early results suggest that this may be due to ***V. alginolyticus*** as a result of handling and grading of the young oysters.

Project D.1 Genetic diversity in Pacific and Sydney rock oysters
Project Leader: Dr Bob Ward. CSIRO Fisheries Hobart
Objective: To examine inbreeding effects in oysters by comparing levels of genetic diversity in hatchery stocks with those in wild populations. To use these genetic markers in the development and monitoring of breeding programs aimed at improving the domestication qualities of PO in Australia.
Results : No significant loss of genetic variation detected to date in SRO; will be looking at another generation in 1996.

Seafood Technology Pty Ltd

FRDC 92/125.2 Seafood Technology Pty Ltd. MWhite
Development of an automated oyster grading and countingline.
Duration : three years.

Objectives: To develop and manufacture a fully automated grading system to accompany existing sorting accounting lines in the oyster industry. To develop prototype of a complete two channel automated grading line, incorporating infeed system, washing system, delivery system, size grading, weight grading, automated bulk packing, conveyor elevator line and or electronics control system.
Results: A prototype machine has nowbeenbuilt and shipped to Hobart for field trials at a farm. It has been built to grade 2 to 3 oysters per secondsby length and weight with an upper and lower limit thus capable of giving three size grades of oysters (>30 mmonly).

Australian Water Technologies

FRDC 95/124 Australian Water Technologies-EnSight. Dr G Grohman
Rapid technology for the detection of food poisoning organisms in commercial shellfish.
Duration: oneyear

Objectives : To develop relevant screening tests using modern molecular biology techniques such as the polymerase chain reaction to detect common pathogens transmitted by commercial oysters and shellfish. the screen would include E coli, V vulnificus, Reovirus and Adenovirus.
Results: This team has developed rapid methods for screening pathogens such as viruses and algae from water at low concentrations and adapting these methods to oysters. Norwalk virus for example can be detected in numbersas small as 10 organisms.

University of Queensland

FRDC 93/153. University Qld, Dept Parasitology. Prof R Lester
Application of DNA based tests to elucidate the epizootiology of the winter mortality organism and the Qx disease organism.
Duration: 3 years

Objectives: Perfect the prototypes for DNA based diagnostic tests for Qx disease and winter mortality and to apply the tests in the field to clarify the life cycles and epidemiology of these two parasites.
Results: Coworker Dr Adlard has perfected a reliable PCR based test for Winter Mortality and recently used the test to show that oysters from Merimbula were infected with the parasite in May. The probe for Qx is still under development and expected to be ready for routine use by July 1966.

FRDC 94/156. Univ Qld Dept Parasitology. Dr R Adlard
QX disease Marteilia sydneyi of the Sydney Rock Oyster Saccostrea commercialis on the central coast of NSW.
Duration: 2 years, extended to a third

Objectives: To establish the distribution of the QX organism in estuaries on the central coast. To establish the period of risk from initial infection with QX in the Georges River . To determine if this varies in different parts of the river. To determine whether young oysters imported for growout from other rivers are already infected with QX disease.
Results. Reported that Qx disease on the central coast is currently restricted to Georges River Information provided to industry which led to: 1. farmers not buying stock elsewhere for growout in Georges R because of unacceptable risk 2. NSW Fisheries maintained a ban on movement of live oysters from Georges R to other areas. A number of scientific publications and extension of results to farmers via personal presentation and industry newsletters.

Tasmanian Department of Primary Industry and Fisheries

FRDC 92/054 Tasmanian Department of Primary Industry and Fisheries S. Stanley
Predictive modelling of carrying capacity of oyster farming areas in Tasmania
Duration: two and a half years

Objectives: Carry out assessments of oyster production in relation to primary productivity and nutrient cycles in 8 coastal areas; to develop predictive models of the carrying capacity of these areas; to utilise t hese models in the formation of a general model which can be applied with specific minor modification to existing and potential intensive shellfish farms. To apply this general model in the day to day shellfish farm management.
Results : A model has been developed and tested and the work currently being written up. Results demonstrate that models can be used for prediction work but the utility of the model depends on the quality and quantity of the hydrodynamics, primary production and feeding rates information available

Sydney University

Ms M Anderson was granted an Australian Postgraduate Research Award for a study on "Recruitment, development and comparison of assemblages associated with commercial oyster leases" from February 1993 to January 1996.

This work shows that settlement of oysters was enhanced by the presence of a film of plants or animals on the settling surface and that the time and numbers of oysters affects subsequent settlement of animals. She has published four papers on this work and is scheduled to finish her PhD thesis by the end of 1996.

4.3 Discussion

There has been a substantial body of work completed and published on the SRO and NSW oyster industry over the last 106 years; mostly in the scientific press but with shorter-parallel publications in the trade magazines in the past decade. The focus has clearly been on scientific research and there has only been a very small effort devoted to Development, and this in the past decade alone.

There is also a large body of research available on other oyster species, principally the PO, with some contributions from Australia, in the past decade.

Almost all of the FRDC assisted work has been completed on time (with only one notably late completion) and the objectives mostly fulfilled. The calibre of work judging from the acceptance in refereed journals appears to be commendable and better than average.

Industry assessment of this R & D ranges from very good to useless, but too often not complimentary, as discussed further in Chapter 9. It should be noted however that until about a year ago industry involvement in research funding and direction was essentially negligible. Hence R & D programs and objectives were developed by the research organisations in collaboration with funding bodies and there was little industry involvement at the planning stages..

5. INDUSTRY ISSUES

The various issues arising from focus group meetings with farmers, in questionnaires and interviews with various parties are discussed below. There is of course some overlap in the issues and not all fit neatly into one subject heading. Key areas for R & D are identified in this chapter but are described fully in section 8.

5.1 Industry Unity

Disagreements over the management of the proliferation of Pacific oysters in Port Stephens in the 1980's and the public health problems in Georges River and the consequent introduction of compulsory depuration are generally considered responsible for the fragmentation and rifts seen in the NSW oyster industry in the past ten years.

These incidents, essentially of biological origin, have led to the alignment of the majority of farmers into two industry groups: the Oyster Farmers Association and the National Farmers Association (NSW Branch, NFA). This situation evolved as farmers who were originally members of the Shellfish Association of Australia and/or the United Oyster Growers Council, joined the NFA in 1995. Within the two major groups themselves there is still disagreement about the management of PO.

Many farmers recognise the extra costs and damage to their industry's status that this lack of unity has brought about and they have identified this as a major problem facing their industry (Table 6, next page) and nominated industry unity as a major goal for the next five years.

There is no doubt that this division has damaged the public image and reputation of this industry, added unnecessary costs to industry and government and impeded the development of the SRO and the emerging PO industry in a variety of ways. Cost-effective marketing and Quality Assurance can only come with genuine cooperation and after general agreement on product grading, standards and uniform terminology.

One farmer commented " with a united industry everything else can be tackled, we need a leader ". Another noted that the lack of a single united voice had been responsible for the oyster industry losing out in its "fight with other users of the waterways".

It would appear that this rift has directed attention from other critical issues facing the industry and has also weakened its capacity for obtaining assistance from various Commonwealth, State and Local government agencies.

Table 6 Problems facing the individual business and industry.

The numbers in each column represent the frequency of response. Note some farmers offered nil or multiple answers to some questions hence comparisons have to be handled with caution.

Problems	Q5. Business problem today	Q6. Industry problem today	Q7. Industry Longterm problem
Diseases Winter Mortality	6	-	1
QX	4	1	2
Mortality	4	-	-
Government costs	4	2	-
Poor depuration systems	1	1	1
Economic costs / timber	1	3	3
Funds short / cash flow / insufficient for change in growing methods	6	-	-
Profit low, price trend	3	1	3
Skilled labour shortage	1	-	1
Environ. Pollution, Water Qual	3	6	17
Acid sulfate soil	2	-	-
Siltation / dredging	3	-	1
Spatfall Overcatch	4	-	-
Spat Insufficient	2	-	-
No hatchery spat	1	-	-
P O overcatch	12	11	7
Development pressures	-	-	3
Industry disunited , factions	-	9	2
No industry planning / goals	-	1	2
QAP Inadequate / none / Too slow	1	5	3
Lack promotion & PR	1	5	5
Marketing, absent , inadequate, poor	2	8	8
Poor product Q, small oysters	2	3	1
Competition from other oysters	2	7	4
Inability to change technology	-	3	-
Stock shortages / costs	2	1	1
NSW Fisheries	4	6	4
Bureaucracy over-regulation	4	5	-
Overcultivation, derelict leases	1	-	2
Restrictions on oyster movement	4	-	-

A more positive, active (not reactive) and united approach to industry issues are imperative if the NSW oyster industry is to fully regain prestige, community and government support, and achieve its potential.

Industry itself should be responsible for bringing about better interaction amongst farmers, with the active encouragement of relevant Government agencies. With a positive outlook and constructive debate much can be achieved.

5.2 The Pacific Oyster

The Pacific oyster is now farmed in Port Stephens and harvested from wild stock in the Crookhaven River and both of these products compete on the domestic market with the SRO and the PO from interstate and overseas.

Many traditional SRO farmers regard the PO as a major personal and industry problem (Table 6) principally because of its "overcatch" in Port Stephens and seek its eradication from NSW. The competition in the marketplace from Pacific oysters (from Tasmania and South Australia mainly) has also been an annoyance to some NSW farmers, who once had no competition from other fresh oyster products.

The eradication of PO from Port Stephens is currently almost impossible. The NSW oyster industry has to face this fact, and despite the continuing impact of PO (described below), move forward in the marketplace in parallel with the local and interstate PO. The distraction and energy dissipated over management of PO has led to a diminution of attention to other critical issues, such as product quality and marketing.

PO grown in Australia and New Zealand now have a firm foothold in the Australian market and are evidently very satisfying for many consumers and profitable for many businesses. The production of PO from Tasmania and South Australia is growing rapidly and it appears that PO farming will soon be permitted in Corner Inlet in Victoria.

Demand for PO is growing here, and the NSW oyster industry would be foolish to ignore the potential that this species offers in the domestic and export trade and its suitability for the manufacture of value added product.

5.3 Triploid Oysters and Hatchery Technology

We believe that the increasing competition from Pacific oysters cultured outside NSW makes the development of hatchery technology and the production of genetically selected triploid oysters (SRO and PO) essential for the long term well being of the NSW industry. Triploid oysters will be grown interstate and overseas and NSW cannot afford to remain behind its competitors.

The critics of research on triploidy and the development of hatchery technology should recognise this and be prepared to accommodate or embrace this new technology in the not too distant future, with SRO and/or PO. The availability of (sterile) triploid PO will also eventually provide an additional control mechanism for the current problem of PO and SRO overcatch, and it can eliminate the problem of loss of condition due to spawning in depuration tanks.

In economic terms the more uniform cupped shape, potential faster growth rate, and consequent reduction in growing times, risk and costs with a genetically selected triploid SRO are startling. Wild spat is unquestionably cheaper at this time but it can never have the reliability that is required for continued business and industry development. The viability of several oyster industries located on south coast estuaries is reliant on the vagaries of natural spatfalls elsewhere in the State.

The agriculture and livestock industries have progressed over the last 50 years with genetic selection of stock and aquaculture will also improve with genetic selection for faster growth, disease resistance and improved economic returns. This is happening with shellfish and other species throughout the world. Commercial shellfish hatcheries are inevitable in NSW too.

Industry Diversification

The development and commercialisation of hatchery technology in NSW will also allow for diversification into other shellfish such as flat oyster, scallops, pipis, clams abalone, mussels etc. NSW has such a broad range of estuarine habitats from north to south and has potential for a variety of aquaculture enterprises.

Some estuaries in NSW could thus be able to produce three species of oysters. Genetic selection can also help to minimise the economic problems due to diseases and lead to new "designer" products with more attractive meat and shell colours eg whiter meat and golden shell. Such extension of product range can deliver a great marketing advantage to the NSW industry.

Such diversification can lend economies of scale in production and marketing to existing farmers and provide security in case of failure of one species/crop for any reason.

The economic and other benefits of diversification have already been recognised by many farmers who wish to have the opportunity to develop their business around a diverse product portfolio. This diversification would also assist the NSW oyster industry in matching its interstate competition. Tasmania for example has a well established oyster and mussel industry and has already produced small volumes of hatchery bred abalone and scallops.

Another benefit that comes from the development of a hatchery is the opportunity for better training and technology transfer to industry.

Therefore we see the commercialisation of genetically selected triploid oysters (PO and SRO) and the development of hatchery technology for oysters (and other shellfish) as a key area for R & D.

5.4 Interaction and Consultation with NSW Fisheries

NSW Fisheries is the government agency responsible for management and licensing of aquaculture in the State and the management of the Shellfish Quality Assurance Programs. It has also been the main provider of research for the oyster industry and has invested in a substantial research facility at Port Stephens that has focussed on oysters since its opening.

Relations between the oyster industry and various sectors of the department have varied over time but have generally been good. Debate or disagreement over PO has been responsible for most of the unsatisfactory interaction between oyster farmers and fisheries enforcement officers or research officers. Interestingly, both the pro-Pacific and antagonists blame Fisheries staff for favouring the other side.

Some farmers have commented on the unreasonable, inconsistent or overzealous approach of the department and/or certain enforcement officers over the issuance and execution of Section 20 Notices to clean up PO on their leases. Farmers have also pointed to delays from Fisheries in correspondence and the tardy delivery of services while they are forced to comply with time deadlines on notices.

For farmers in financial difficulties a request to clean up PO at critical times in their farming or marketing of SRO can be disastrous. If they divert their attention from their scheduled work they can lose their marketing opportunity and their income; if they do not act on the Section 20 Notice they face penalties and perhaps risk losing their aquaculture permit.

This problem and the damage to departmental relations will probably be reduced with the new oyster farming training programs (New Works Opportunity Program of Department of Employment Education and Training) initiated by NSW Fisheries and the NSW Fishing Industry Council, with their lease rehabilitation and clean up training exercises. The more formal induction training programs undertaken by fisheries enforcement officers in recent years will probably also lead to better interaction between farmers and enforcement officers.

The problem with derelict leases and PO is examined further below.

Table 6 demonstrated the feelings of some farmers that there is too much bureaucracy and many government charges hampering their industry. Such feelings are not confined to oyster farmers, however we cannot do more in this study than to note that the User Pays principle is now well established in government circles and that the levies for research and the shellfish quality assurance programs are clearly for the betterment of the industry.

Industry has also been critical of the slow pace in industry policy development and reform and of the consultation between the various sections of the department and industry groups. Fisheries staff acknowledge that consultation has sometimes been done a little late and in haste and point to staff shortages as explanation. At the same time industry should recognise that consultation does not necessarily mean that all industry suggestions have to be automatically adopted.

Departmental reviews, reorganisations and the loss of staff coupled with the development and proclamation of the new Fisheries Act have been held responsible for slow progress with development of policy and management plans for the oyster industry.

The research staff at NSW Fisheries generally enjoy a good relationship with farmers, particularly now that the controversy over PO has waned. Relationship between researchers and farmers can however improve if both parties have a better understanding of the different working conditions, motivations, rewards and constraints each have in their chosen profession. This communication task is examined further in Chapter 9.

There is clearly room for improvement in consultation and for prompter service from NSW Fisheries offices but this should be addressed by NSW Fisheries and industry together; efforts should be made so that consultation is timely and exercised in good faith by both industry and government.

Derelict Leases

Some farmers believe that PO on derelict and idle leases are a major source of the problem with PO and add to their costs of control of PO and exacerbate their cash flow problems. The Rural Adjustment Scheme (RAS) has apparently not proven useful for oyster farmers facing short term financial difficulties.

The reported experience of oyster farmers is that one has to be almost bankrupt before the RAS can assist. This is not often the case but many experience financial difficulties in carrying out their usual farming and marketing work and then requiring additional labour for the control of PO.

The control of PO is unquestionably a major concern of many farmers and it was cited as a major problem facing the industry today and in the foreseeable future. Several farmers point to their "Catch 22" problem of not being able to surrender unwanted leases until they have been cleared of PO; but this is difficult in the absence of funds.

We recommend:
NSW Fisheries' examines the current control policy on PO in order to review its effectiveness.

5.5 Inactive Leases and Hobby Farms

As indicated earlier more than 140 farmers produced less than 25 bags of market oysters in 1994/5 and there are apparently many idle leases. This low productivity may be a blessing or a burden for the industry, but this uncertainty prevails because the productive capacity and financial status of many leases/farmers are unknown.

Productive but inactive leases may represent potential opportunity for industry expansion while unproductive leases are probably best surrendered in order that the industry's true status is clear.

Some farmers are reluctant to surrender inactive leases because they fear that other farmers will take them up and restock them and hence adversely affect the productivity of leases nearby. Others with cash flow problems point to the difficulty of finding or diverting resources (time or hired labour) to clean up unwanted or marginal leases when they have to carry on with their usual tasks to survive.

The existence of inactive or derelict leases diminishes NSW Fisheries' and the industry's stature as good resource managers. Given the pressures and criticism coming from other water users it is in the industry's interest to surrender any unused/unwanted leases and the departments responsibility to have a good understanding of the utilisation of leases.

The department and industry need reliable information on lease utilisation and estuary carrying capacity if they are to cope with industry or local development or expansion plans. The mail survey of farmers indicates that the majority plan to increase production by more than 100% over the next five years.

However some farmers are fearful that several estuaries are already overcultivated while other estuaries are seen to be capable of producing more oysters. But the capacity of the estuaries remains unknown in the absence of a comprehensive survey of leases in all of the major producing estuaries.

The large numbers of inactive, marginal and derelict leases coupled with the closure on issuing new leases in most estuaries means that new entrants or farmers wishing to expand production may be held back unnecessarily. Industry cannot safely plan for the future in this climate of uncertainty.

Any rationalisation of leases and the industry in recent years has come about by virtue of the introduction of new levies and charges and not any active restructuring program of NSW Fisheries, despite a recommendation for such action by the 1990 Task Force on the Oyster Industry.

The human and other resources servicing the oyster industry in recent years have been inadequate and have drawn unfavourable comment from farmers

NSW Fisheries currently has simple mapping facilities for managing its lease records and needs far better tools for managing its oyster lease maps and timely transfers. It should obtain a modern geographical information system to facilitate routine work as well as planning, research and developmental tasks and especially those involved in the SQAP.

We recommend:

An assessment of lease utilisation and the carrying capacity of the key estuaries is necessary if an industry strategic development plan, local (estuary) management plans are to be soundly based. We see this project as having a high R & D priority.

NSW Fisheries should accelerate policy development on the question of unused and idle leases in the light of industry development needs and community concerns about the best utilisation of the aquatic resources.

NSW Fisheries should invest in a modern Geographical Information System to enable it to undertake its work effectively and efficiently.

5.6 Oyster Diseases

NSW oyster farmers have long been adversely affected economically by Winter Mortality, a disease problem attributed to a microscopic organism called *Mikrocytos roughleyi*.. Most farmers are able to keep this problem in check by moving stock from one estuary to another or to another area within a particular estuarine system, but new farmers or those with limited financial or other resources are still sometimes severely affected by stock losses.

Qx disease is a more recent problem for SRO growers, responsible for almost decimating the Georges River production (west of Tom Ugly's Bridge) in 1994/5. The organism held responsible for Qx, *Marteilia sydneyi* is currently being investigated by scientists at the University of Queensland.

While many farmers asked for research on disease problems a comparison of the responses to Questions 5, 6, and 7 in the questionnaire, related to disease R & D, indicates that they recognise that disease problems affect few businesses only and are not current or long term problems for the industry as a whole (Table 6, page 22).

This is an important issue as farmers and researchers who recognise that research resources are limited are questioning the cost/benefits of such research, particularly to alleviate disease problems in estuaries which are regarded as suffering from poor water quality or environmental stress. Some farmers reported that the large volume of research on winter mortality has not produced any information new to the industry.

Worm disease has been an area of research for the past 100 years and research on winter mortality has a history of 70 years and continued almost uninterrupted for the past 30 years.

We do not see R & D on oyster diseases as a key area for further (new) investment. We believe that much of the problem with current diseases can be avoided with better management by farmers and that a more strategic approach is the production and cultivation of disease free spat.

However we recommend that the Fish Health Diagnostics service provided by NSW Fisheries at the Wollongbar station and other oyster industry support provided by the Port Stephens station be maintained, as discussed further in Chapter 8.

Some farmers, mostly new entrants to the industry, indicate that there is a continuing need for dissemination of user-friendly information on managing the common disease or pest problems. The Ag-Facts style sheets produced by Fisheries some years ago were well regarded and we would recommend their revision and release.

5.7 Water Quality and Estuary Management

The oyster industry operates in almost all estuaries in NSW most of which generally have good quality water, ie clean enough to grow oysters safely, except after heavy rain and runoff.

There is however the risk of sewerage overflows from various drains, unpredictable pollution from a variety of human activities and the possibility of acidic runoff after rains due to the presence of acid sulphate soils around some of the northern rivers in NSW, leading to potential public health risk or injury to the oysters.

Pollution and declining water quality are now widely recognised as major risks to the oyster industry and were identified as the greatest long term problem faced by the industry (Table 6). The imposition of compulsory depuration in the early 1990's is a result of public health problems in 1978 and again in 1989/90 linked to sewerage pollution.

The establishment of the Quality Assurance Program (QAP) in the Georges River in 1990 and the establishment of the Shellfish Quality Assurance Program Committee (SQAPC) in 1995 is Government's and industry's continued response to this public health issue.

This statutory advisory committee was established under the Fisheries Management Act 1994 to manage and foster the development of QAP programs around the state, through a system of local QAP programs and committees, and to educate farmers and the community in public health and environmental issues.

It has a special levy and trust fund to undertake this work managed by a committee of six and staffed by a full time coordinator. This new committee had only had one meeting at the time of writing and it is yet to formulate plans and priorities.

Given the large number of committees interested in estuarine quality issues one of the SQAP Committee's first task will probably be the identification of the persons in the oyster industry involved in the various estuary QAP programs, Estuary Management Committees and Total Catchment Management (TCM) Committees to ascertain what each of these committees are doing and what relevant information and data they hold.

With the limited resources and magnitude of the task facing the SQAPC it is essential that it does not duplicate any work already available or being undertaken by others. Although some farmers resent the imposition of levies for QAP the need is widely acknowledged by industry. We would suggest however that the current levy funds may prove to be too low, given the apparently lax approach to depuration (described below, section 5.8), to bring about the necessary improvements quickly enough.

This Committee and the regional QAP committees are funded by industry levies and manned by farmers who do not have much time to spare to sit on such committees, therefore it is imperative that all farmers assist these committees in any way they can in order to minimise costs and maximise the return on their own contributed levies.

Areas of interest already identified by the committee are

- heavy metals, including cadmium, entering the estuary, via superphosphates used in agriculture or from other sources
- toxic algae
- pesticides
- depuration technology and practice.

This committee thus recognises that the QAP must extend beyond microbiological or sewerage problems and take in the full range of risks to oyster quality and public health. It is essential that the QA programs take account of all the risks to the market success of oysters right through transport and delivery of the product.

In addition to the above there is an Acid Sulphate Soils Management Advisory Council (ASSMAC) which is a whole of government initiative to coordinate state actions aimed at combating problems arising from acid sulphate soils. It involves a range of government agencies, the Environment Protection Authority CSIRO, NSW Farmers Association, the NSW Seafood Industry Council and the four rural R & D corporations which are supporting programs investigating acid sulphate risk areas and impacts of acid waters on fish habitats.

ASSMAC would therefore appear to be a valuable resource for sectors of the oyster industry with acid sulphate soils in their catchment area.

Other estuary management problems identified by oyster farmers include siltation and river flow reduction at the mouth of the Manning River and restrictions on dredging in parts of Wallis Lake. While these two problems are local issues of great importance to farmers they are not really amenable to solution by general R & D programs and are best tackled through the Estuary Management Committee or TCM infrastructure with the full support of the NSW Fisheries and the industry associations.

Two other areas of interest related to clean waters problem are the Clean Waters Classification and Depuration.

Clean Waters Classification

Many NSW oyster farmers are concerned about the effectiveness of the mandatory depuration procedures and are seeking the adoption of the clean waters classification system used in the USA.

The Food and Drug Administration of the USA has required the classification of shellfish growing waters by state agencies according to the levels of faecal (sewage) contamination of the waters.

- Those waters which are consistently or highly polluted are permanently Closed to shellfish harvesting
- areas with light or intermittent pollution are classified as Conditional or Restricted and shellfish from these waters must be relayed or purified before sale.
- other waters free of pollution are classified as Approved waters and the shellfish from here can be sold without any treatment.

Under the terms of the National Shellfish Sanitation Program (NSSP) domestic or foreign intended sellers of shellfish in the USA must demonstrate that they harvested shellfish from Approved or Conditional waters.

France, New Zealand and Tasmania have adopted the waters classification system to gain access to American markets and some farmers propose that this should be adopted in NSW in lieu of depuration, for domestic sales and for access to markets in the USA and Europe.

Given the concern about the safety of oysters in Australia the abandonment of depuration in favour of a clean waters classification system in NSW would seem to be premature at this time. The merits of clean waters system and depuration would best be assessed after the SQAPC has had some time to analyse the current status of the industry and the waterways.

The merits of a waters classification system should be reviewed by industry and government within two years in order to allow willing and financially capable NSW farmers the opportunity to compete on export markets in the USA and the European Community on the same terms as their colleagues interstate. The financial costs of meeting the USA NSSP requirements are not insignificant and will need to be considered by interested farmers.

5.8 Depuration of Oysters

Current state health legislation provides that oysters must be purified under prescribed conditions of temperature and salinity for at least 36 hours and that the purification plant must be inspected and licensed by the NSW Health department.

One leading farmer described the current depuration procedures as a "joke" because of the apparently not uncommon misuse or the complete avoidance of depuration procedures while another asks " why purify when it doesn't kill viruses at all ? "

The arguments against current depuration requirements are:

- it is ineffective and provides a false sense of security
- it is too costly
- the current prescribed procedure of 36 hours is too long; and there is a great risk that oysters will spawn and lose condition and value
- the prescribed operating temperature of >18°C is too high for southern oyster farms in winter
- consequently some farmers are flouting the law, endangering the consumer and the industry and gaining unfair economic advantage over those "doing the right thing".

Other farmers see depuration as insurance or some sort of guarantee but this would appear to be false security at this time when some depuration plants are reportedly not in use, not been inspected as required by regulation and others are not used in the prescribed manner.

Most farmers see depuration and public health as great problem areas and have therefore placed a high priority on research that will lead to a more effective, quicker and cheaper depuration technology. NSW Fisheries researchers have some evidence suggesting that oysters can efficiently filter out algae from the water almost as effectively at 15°C as at 18°C and we recommend that this preliminary work be completed.

Vibrio vulnificus, a bacteria that has attracted a vast amount of attention in recent years because it has been implicated in the deaths of at least three Australians, has been identified as a high priority area of R & D by several farmers.

The benefits of further Australian research on the virulence of *V. vulnificus* and the elucidation of control mechanism for vibrio have not been clearly identified by the proponents of this line of research. History demonstrates that research in such fields is demanding, time consuming and costly and that the chances of developing a solution useful to oyster farmers in the three year duration of such research programs are slim.

P Bird, NSW Health Department, has suggested (personal communication) that new technology developed by Dr G Rodrick of the USA and colleagues in Ireland, utilising UV light with ozone, appears likely to provide a safer depuration methodology for little added cost for NSW farmers.

There is however a need to

- **commission a desk review, by an independent microbiologist, of the effectiveness of the prescribed depuration procedures in the light of recent experience and research in Australia and overseas**
- **examine the oyster filtration and depuration at temperatures lower than the prescribed limit.**

We believe that the two projects outlined above should have high priority and that new research on depuration and/or *Vibrio vulnificus* be deferred pending the outcome of these two studies. However provision has been made in the R & D plan (Chapter 8) for further work in the area of depuration/vibrios, and/or the Clean Waters Classification according to the outcomes of the two recommended programs above.

We **also recommend that the SQAPC investigate the Commonwealth Quality programs as a source of funds to speed up and enhance industry training in Quality Assurance** for oyster farmers and processors and help restore consumer and trade confidence in the SRO industry.

5.9 Product Quality

The NSW oyster industry has no uniform product size grading, or widely accepted specifications or terminology on sizes. Consequently product is sold by farmers mostly by the bag under a variety of names such as supreme, plate, bistro, cocktail etc with no well known or defined parameters and as many as seven (size) grades of oysters may be sold by the one company.

Furthermore there is very little agreement on the handling and shelf life of unopened or open oyster in the trade, and refrigerated transport is the exception rather than the rule. While the industry is conversant with QA as it relates to water quality and product safety the shell appearance, meat content and colour and other product characteristics - which are critical to market success - have generally been ignored.

One of the problems facing many farmers is price competition from small poorly graded oysters which are sold purely on price and which have the effect of undermining established prices across all size grades. There are however a few farmers, one marketing group and several companies with their own commendable product grading and marketing systems.

The absence of agreed industry standards has undermined consumer and trade confidence in NSW oysters (SRO and PO), facilitated the market penetration of PO from interstate and New Zealand and contributed to the competition and economic pressures felt by some farmers.

The industry recognises that there is a need for:

- a uniform grading system and terminology
- the development of educational material for the trade
- development of a code of practice for the handling of oysters

for the domestic trade and for development of export markets.

We recommend :

- **development of a code of practice for the handling, wholesale and retail sale of oysters, including product description and grading**
- **development of educational material for seafood merchants and restaurateurs.**

The existing National Health and Medical Research Council's (NHMRC) 1989 Code on oysters and mussels is now outdated and not a user-friendly publication for oyster processors or retailers.

A more appropriate booklet is required to assist in delivering quality assurance along the entire marketing chain from the grower through to the consumer. QA at the producer end alone is not sufficient. This proposed material will thus continues on from the farmers QAP and help provide assurance from when the oysters leave the control of farmers.

5.10 Marketing and Promotion

The lack of marketing skills and plans and insufficient attention to promotion and marketing are recognised throughout the NSW industry, and therefore R & D on marketing and promotion was seen as a priority area by many respondents to our questionnaire.

NSW oysters are almost all sold unbranded and the only notable product differentiation relates to the naming of the geographical origins such as Wallis Lake or Hawkesbury River oyster on bags of unopened oysters. Most farmers do not have continuous supply, any strategic marketing alliance or a well established marketing plan and hence are price takers when their product is ready for sale.

A Sydney company Australian Marketing Cooperative Ltd (AOMCL) was established in late 1992 to market uniformly graded oysters with a well developed quality assurance program under the brand name Pearler. This company got under way well but soon came into financial difficulties, reportedly as a result of undercapitalisation, inexperienced management and a flawed marketing plan, and closed within two years.

The early success of AOMCL with size grading and attention to product quality has encouraged a group of farmers on the south coast to market together in a cooperative (collective) fashion. This group does its own work without additional paid staff, has established a five size class grading system for unopened SRO and has been able to gain a net increase in prices through delivering a more consistent supply and quality with more reliable service.

While these attempts at better marketing are admirable they all appear to have been undertaken with little attention to consumers perceptions or needs. In short the NSW oyster industry is ***selling*** oysters (as distinct from *marketing*) in competition with high quality well graded, branded Australian and overseas product, in an information vacuum.

In Tasmania the oyster producer's marketing company TASEA has been established for several years and has made noticeable improvements in the handling, grading and marketing of oysters for the benefits of its members. While this marketing company originally met with some indifference from oyster processors and seafood merchants on the mainland it has gained widespread respect and support and a premium price for its member's products because it has been able to reliably deliver a consistently high grade and uniform product.

The NSW oyster industry like much of the fishing and aquaculture industry elsewhere in Australia has not invested in promotion, but equally important it has failed to address consumer concerns about the safety of oysters. This is somewhat surprising given that a marketing study

undertaken by final year students from the Sydney Technical College highlighted the need for such promotion (Sydney Technical College 1988).

There is a need for ongoing promotional exercises and for a proactive PR program including the development of a Crisis Management Plan in the event of another major public health problem related to the consumption of oysters. This plan should cover the professional management of public relations relating to public health or other issues of importance to the industry as well as the farmers responses to a particular type of problem.

Industry levies for promotion are essential, and should be implemented in about two years once QAP and product quality are improved. We recognise that many operators in this industry are short of funds but this industry has to recognise that it cannot afford not to spend on promotion. Expenditure on promotion is vital; as a general rule of thumb many food businesses invest several percent of turnover on promotion.

Export markets are seen as the panacea to the economic difficulties faced by some farmers. A common perception amongst SRO growers is that the development of substantial markets overseas will increase overall demand and help to raise domestic prices.

This simple picture is faulty because a diminution of supply of SRO on local markets will not automatically lead to a substantial increase in price if similar quality PO are available. Furthermore few farmers have the right product quality, adequate facilities and financial resources to tackle export markets directly. Attention to product quality by the SRO industry is therefore desirable before entering the export trade.

We recommend

- research on domestic trade and consumer perceptions on SRO and PO, current marketing arrangements, prospective demand for raw and value added products,
- and the development of an industry marketing plan.
- the development of industry Crisis Management Plan
- An assessment of export potential, in about four years time

when the industry completes its QAP projects and product quality assurance is widespread.

5.11 Industry Economics

The economic performance of the NSW oyster industry was examined by officers of the NSW Agriculture Department in 1981-1984 who reported that only the farmers in the central coast of NSW had positive rates of return to capital and management and on the high costs of labour in farming operations (Marshall and Espinas 1987, Espinas Marshall and Rish 1988).

Catt (1992) later developed computer spreadsheet models on the profitability of different methods of oyster farming but this project was abruptly terminated and the models have not been adequately tested.

The present study, albeit a much shorter one than the earlier two by the Agriculture economists, confirms that many oyster farmers are still returning low profits, but the reasons for the current situation are somewhat different.

Many farmers reported the cost of control of PO as a burden and they have recently had to absorb the extra costs brought on by research and QAP levies (about $300-500 for a medium sized farm) as well as increases in workers compensation insurance, and one company finds payroll tax to be a problem.

The rising costs of timber sticks, rails and posts on oyster leases, and their removal and replacement costs, has been described by farmers as frightening and consequently alternative plastic rods and/or coverings are being used by a few farmers. Research on plastic and other materials as alternatives to timber has therefore been proposed as an area of needed technological research for the industry, and warrants support.

Another area of production costs that industry itself should consider is the standardisation of tray types and sizes in order to gain some economy of scale with a standardised plastic variety. Several companies are making trays and plastic mesh but costs would be reduced with some standardisation wherever possible.

One of the most significant changes in the industry has been the apparent increase in sales of very small and rather poor quality oysters. This has reportedly come about because of the increasing financial pressures experienced by some farmers, as described above, as well as the traditional practice of selling off oysters in order to minimise losses from Winter Mortality. The end result is a worsening of the industry's economic performance because these cheap products reduce the returns of all products and businesses.

Despite the seemingly low returns on investment in much of the oyster industry in NSW there are many farmers making a healthy profit from their enterprises and there is a steady stream of willing new entrants to the industry. Nevertheless there is a need for a comprehensive study of the

economics of the NSW oyster industry in order to provide the basic information needed by government agencies and industry for sound planning.

Economic modelling studies can later be used to assess relative merits of various approaches to farming and can in fact be used to assess the likely cost benefits of R & D before the event as recently undertaken in Virginia USA (Bosch and Shabman 1990).

At this time there is no reliable up to date reliable information available on the number of oyster farming business, profitability of small vs large holdings and the performance of single seed culture vs traditional stick culture, nor the economic impact of the industry on the state's economy. In short, the basic information on the State's most valuable fishing/aquaculture industry is very poor.

We recommend:

- an economic survey and economic impact study of the industry as a key priority for R & D

- that research on alternatives to timber be undertaken.

Skilled Labour

There is a divergence of viewpoint as to labour availability for oyster farming with some respondents suggesting that there is a shortage of skilled labour while others reported that labour was readily available and not a problem. This polarity of opinion probably reflects the respondents definition of skilled labour.

It appears that truly skilled or experienced people are leaving the industry as they age and given the uncertain and discontinuous nature of employment in many oyster businesses there are seasonal shortages of skilled labour.

There is however unanimity that skilled labour is a high cost component, and that there is a need for more mechanisation hence the interest in oyster grading and weighing machines and other labour saving devices. A new locally manufactured weighing-grading /counting machine, developed with FRDC funding, is currently in Hobart awaiting tests on farm.

The skilled labour shortage may be alleviated somewhat at the completion of the current oyster farming training programs initiated by NSW Fisheries and the NSW Fishing Industry Training Council.

5.12 Cultivation Practices

The industry has traditionally been based on growing oysters on sticks but many new approaches are being taken with the change to single seed oysters, the impact of increased PO overcatch, and the increasing boating activity and subsequent wave damage on leases in some estuaries. Oysters are currently being grown in a variety of timber framed plastic bottom trays from the ordinary to "tricky compartmentalised" trays.

There are also quite a number of steel framed, and plastic trays borrowed from the bread industry on trial around the state. New entrants to the industry have little reliable information on the cost benefits of the different cultivation practices, and need help to avoid the cost of a major change in cultivation practice later .

There is a need to compare the biological and economical performance of the various grow out methods and containers in use today in order to maximise productivity from the existing leases. The research of ten years ago along similar lines, by NSW Fisheries, is essentially outdated and needs revision to provide reliable information for today's producers.

We recommend a scientific comparison of the most promising grow out containers and methods on selected leases, as a key priority R & D project.

5.13 Training, Seminars and Workshops

Although a small number of farmers indicated a wish for Workshops, Training and Seminars there were no specific suggestions on subject area other than workshops on managing winter mortality, Qx and mud worms and these came from new entrants to the industry.

As discussed in detail in section 9.1 we propose that field days be held to assist in development of a unified industry, for continuing education and as an aid for new farmers.

Our discussions with industry indicate that there is a need for training in marketing and business management and there is also clearly a need for training in quality assurance. The last subject is a matter of great importance at this time, but the first two should not be dismissed or disregarded by industry. The two industry associations should consider marketing and business management training seminars as areas for continuing education and industry self help.

Many farmers are involved in some type of QA program but few have a sound understanding of QA concepts and practices despite having attended seminars, intended as training exercises, at some time in the past.

There is a need for development of special training material to assist the many de facto trainers such as local QAP leaders in the field and others called in to assist farmers. Good training is not an accidental outcome. It requires adequate training material and people with the expertise to transfer knowledge and develop practical skills in adults. Competent researchers and technical specialists are not necessarily good trainers.

We recommend :

Special training material be developed to assist in training of QAP personnel and that training programs are implemented for these personnel, as a high priority.

An industry workshop be held in about 2-3 years time as a forum for exchange of view on R & D projects completed and pending, and as a mechanism to promote industry unity.

6. INDUSTRY SWOT ANALYSIS

This chapter summarises the industry's strengths, weaknesses opportunities and threats (SWOT) and the obstacles and limitations to industry expansion, and the ability of R & D to address these limitations.

6.1 SWOT

Strengths

- Many estuaries widely spread along coast, provides diverse base and security in case of disease or environmental problems in one area
- Many small and inactive farms means there is room for industry rationalisation, economies of scale and increased profitability
- Large number of farmers means there is a moderately large base of research and development funds
- Port Stephens research station has good resources for oyster work and offers strong support
- Large amount of research activity, reports and information on oysters world wide
- Innovative industry responsible for various technological improvements.
- NSW industry is well positioned for market expansion in Sydney, Queensland Victoria and for export trade.
- Optimism still prevails despite many adversities and setbacks
- SRO is essentially unique to NSW, has a long shelf life and an image of superior flavour quality amongst some oyster consumers

Weaknesses

- Many widespread estuaries, adds to production, marketing, research and administrative costs.
- Industry has, no single voice. Reduces capability and adds to industry and government costs (increasingly passed back to industry).
- Many small independent, inefficient enterprises with inadequate business skills; more reactive than proactive.
- Many businesses undercapitalised and cash short, this makes adoption of new technology or rationalisation of activities difficult.
- No effective QAP in most estuaries
- Some depuration plants not being used effectively hence false security for industry, government and consumers
- Grading, packaging and other product controls are generally poor and not standardised or uniform
- Product range is very limited and there is almost no branding or promotion.
- Minimal coordination of supply, market intelligence or other marketing activities hence most farmers are price takers.

Opportunities

- Growing demand for seafood including oysters, domestic as well as overseas, particularly in supermarket and restaurant sectors.
- Ethnic niche market, particularly Asian market, still untapped in Australia
- Value added oyster products still to be explored
  -- hence various domestic and export market development opportunities
- The growing interest in environmental issues means that water quality is likely to improve in the long term.
- The Sydney Olympics Year 2000 provides a once in a lifetime opportunity to relaunch the NSW industry and SRO on foreign and local consumers
- Culture of genetically selected triploid oysters can assist in reducing overcatch and disease problems
- Hatchery breeding of genetically selected shellfish provides opportunity for diversification, marketing strength and savings from economies of scale.

Threats

- Winter Mortality and Qx disease
- Mudworm
- Pacific oyster, in several areas
- Food poisoning outbreak / public health / marketing problems
- Growing oyster production and competition from interstate and overseas
- Strong pressure from other water users and environmentalists
- Poor water quality within some estuaries:
  Siltation, acid sulphates soils and poor water flow in several estuaries
- Rising costs of sticks and timber
- Customer base changing with population, many young people don't like oysters and there is a growing incidence of vegetarianism

6.2 Industry Capacity for Expansion

Industry growth is currently constrained by:

1. The large number of idle and derelict leases in many highly productive areas; the closures on some productive areas.

2. Low profitability and undercapitalisation of many farmers, and the resultant lack of confidence/support from most financial institutions

3. The up front costs and 2-3 year delay in cash income from a change in farming method (eg to single seed) impede the adoption of such innovation

4. Recurring biological/management problems such as diseases and pests and biological events such as uncontrollable spatfall.

5. Vagaries of weather, heat waves /cold spells

6. Poor marketing and insufficient promotional activities

Can These Limitations be Addressed by **R & D ?**

The capacity of R & D to address the limitations outlined above is summarised below. This assessment is based on a consideration of the issues covered in Chapter 5.

- Current leasing situation should be resolved with proposed research on estuary capacity and review of PO.
- Financial problem is not directly aided by R & D but R & D has been proposed to provide information for better decision making and boost confidence.
- This financial problem can only be indirectly ameliorated with proposed R & D.
- Disease problems may be partly relieved with further R & D. The spatfall problem can be diminished with R & D on hatchery technology to provide spat (sterile or normal).
- These oyster kills cannot be directly addressed with R & D, but is better addressed with Continuing Education and Training.
- R & D can assist in bringing about a substantial change in market success. Promotion needs can be identified by research but industry will need to increase its investment in promotion in order to capitalise on proposed R & D and subsequent changes.

In short, the constraints are not insurmountable.

Expansion will also depend somewhat on industry's reaction to NSW Fisheries' and FRDC's response to this study, particularly subsequent financial support. A clearly positive response will help to stimulate this weakened industry.

Expansionary Forces in the SRO industry

The main forces driving expansion are :

- Many energetic resourceful operators, small and large, who can see the potential for increased profits through adoption of new technologies and products and sound business management

- Strong demand for premium quality assured oysters, particularly for the unique SRO

The NSW oyster industry hopes to double output over the next five years, but the history of aquaculture indicates that farmers projections are rarely achieved. Our assessment, albeit based on limited primary data, is that the industry is a resilient one with great potential for expansion.

Given government support, a speedy rationalisation of leases by NSW Fisheries and industry (by surrender of marginal leases and a rezoning-leasing of productive areas), and good will from all parties, we believe that the industry has the capacity to double production from current levels within 10 years.

With lower unit costs and an increase in returns per oyster from improved growing and marketing practices the future economic return from the NSW industry is indeed attractive.

7. INDUSTRY GOALS and RESEARCH WANTS

7.1 Industry goals and vision

The vision of most NSW oyster farmers is simply to have a "united viable industry". This statement reflects the low profitability of many farmers and the modest expectations of most, who do not have any specific target level for profitability.

The industry goal or vision most nominated by farmers relate to this economic viability of their industry as seen in Table 6 below produced from the replies to Question. 8 on the mailed questionnaire.

Table 6. Response to question on industry goal or vision for next 5 years

Industry goal or vision	Frequency of response*
Better depuration	1
Cleaner water	4
Better QAP	5
United/Professional industry	12
Increase / stabilise profitability	8
Improve productivity	2
Improved growth rates	1
Diversify industry	1
Triploids /Hatchery	4
Control pacific oyster	2
Eradicate pacific oyster	3
Better Marketing, better prices, strategy development	17
Develop export markets	14
Better product Quality / grading	8
Less Govt interference / costs	4

* Some farmers offered nil or multiple answers to this question hence comparisons have to be handled with caution,

The adoption of better prices and marketing practices and a promotion and marketing strategy were the most frequent remarks and this was in line with R & D requests (following section). The next most common was export markets development (nominated by some 20% of respondents) and again this was reflected in the R & D wishes.

Related to the marketing goals were the recognition of the need for better attention to grading and uniform grades and the desire for better product (shell shape and meat content) going to market. Many farmers are concerned at the poor quality control common in the industry and the absence of uniform standards.

Other farmers nominated the development and quicker adoption of QAP programs around the state, the goal of cleaner waters and better depuration methods.

A unified and more professional industry was the third most frequently nominated goal for the next five years.

7.2 Research Requests and Priority

Approximately half of the respondents nominated their research needs in just one or two words and hence they are described below in the abbreviated manner they were received.

More than half of the respondents expressed a wish for more Marketing and Promotion studies and the development of new markets, with the priority ranging from low to high, and a number two priority being the most common. Research and Development of export markets was nominated separately by 10% of respondents. The development of uniform grading and product standards regarding shell shape and meat content was noted by almost 10% of respondents (Table 8).

The next most nominated research area was Diseases and Pests with an aggregate nomination by 37 respondents, including 10 for Qx and 5 for Winter Mortality. The priority rating for this area ranged from low to high but medium was the most common. As noted earlier, several other farmers suggested that there was no need for further research on diseases and mortality as it was regarded as a local problem and most farmers now knew how to manage these.

Breeding & Genetics and Triploids & Hatchery development scored 36 nominations in total reflecting the wish of farmers wanting genetically selected oysters and other shellfish. As indicated earlier there were a number of comments made that there was no need for research on triploids or the development of hatchery technology as there was ample wild spat available.

The wish for a safer oyster was evident in Table 8 in areas relating to environmental and public health issues. The development and improvement of the QAP was nominated by 25 respondents and there were 16 suggestions for research on a quicker and better depuration procedure than that currently prescribed by state regulations; more than half of these giving it a number one priority. One of these recommendation on public health was for the development of better testing procedures for pathogens.

Twenty two recommendations were received for "Economics and costs", most seeking economic analysis and information on their industry but one was for a review on plastics and other materials available that would prevent barnacle settlement, and another asking for general antifouling research.

Table 8. Farmers research requests and priority scores

R & D topic	Priority 1	2	3	4	5	Total
Diseases/pests	5	3	7	3	4	22
QX	3	4	2	0	1	10
Winter Mortality	1	2	1	1	0	5
Growing methods	3	1	6	2	1	13
Breeding & genetics	4	3	3	4	5	19
Triploid, hatchery techn	3	7	3	4	0	17
Diversification.	0	0	0	2	0	2
PO control/ eradication	3	3	3	1	1	11
Code of Practice	0	1	0	0	0	1
Better Depuration	9	3	1	3	0	16
Waters Classification	3	2	2	0	0	7
QAP	9	7	2	1	6	25
Public Health issues	5	2	1	5	1	14
Pollution Water Qual	5	1	2	1	0	9
Estuary Management	4	3	4	0	1	12
Governmentinteraction	1	0	1	2	2	6
Marketing & promotion	9	14	12	8	6	49
Crisis management plan	0	0	0	1	0	1
Productquality, grading	1	1	4	0	1	7
Marketing coops	1	1	0	0	0	2
Export MDevelopment	1	1	2	2	2	8
Value Adding	0	0	0	0	1	1
Industry Issues	2	1	2	2	1	8
Economics, costs	3	5	5	5	4	22
Timber Alternatives	0	2	2	0	1	5
Technology , machinery	1	0	1	2	0	4
Replacing tarring	0	0	0	3	0	3
Grading machine	1	1	1	2	3	8
Training, seminar, wshop	1	1	0	8	7	17

There were a total of 13 suggestions for R & D to compare growing methods and including one recommendation on finding an effective way of accelerating growth, and one for fattening oysters at will.

There were 12 recommendations for research on estuary management including several suggestions for an audit of the estuaries and their carrying capacity and a suggestion for an audit of toxic algae in growing areas. Seven respondents asked for the development of clean waters classification, so that there would not be a necessity for depuration, and all of these rated it a medium to high priority.

The recommendations for workshops, seminars and training were general but specific recommendation were made on management of winter mortality and mud worm and a suggestion for "more socialising". A specific request for technology /machinery and equipment was for the development of "bulk handling equipment for single seed".

8. THE STRATEGIC R & D PLAN

The industry vision nominated by farmers and their association leaders can be summarised as

Vision: :	A united, sustainable, profitable industry

The Mission Statement developed from the vision and goals nominated by farmers is :

Mission Statement :	To produce premium quality oysters and other shellfish for domestic and overseas consumers in an ecologically sustainable and profitable manner.

The goals, strategies and desired outcomes for the industry, determined after consideration of farmers verbal and written comments, input from other parties, and our SWOT analysis are detailed below:

Goals	Strategies	Desired outcome and time frame estimates
1. Delivery of safe oysters	Development of an effective QAprogram (QAP) in all estuaries	Production of an effective and efficient QAP that will assure customers of product safety and value and restore industry & consumer confidence. *Time 3 years*
2. A more united and profitable, growing, industry	Production of an industry strategic development plan and estuary management plans to foster industry unity and growth	Industry working together developing in a planned manner based on sound biological and economic data and not just on intuition, reacting to crises. *Time 3-5 years*
3. Creative collaborative marketing of oysters	Using market intelligence to guide active promotion and marketing	Increased market penetration, prices and profitability with current products as a result of more market information and collaboration. *Time: 3 years*
4. Reliable supply of genetically selected oysters & shellfish	Development of hatchery technology for future expansion	A wider choice of oysters and other shellfish for farming, more secure future through diversification of products *Time 3-5 years*

The proposed R & D plan consists of six key project areas:

- Industry Analyses
- QA Programs
- Industry Development Plans
- Marketing
- Hatchery Technology
- Cultivation Technology

Table 9 on the following page outlines these key projects and subprograms along with prospective R & D providers and indicative budget (for FRDC and other parties). In short, the six projects:

- assess current industry status
- determine industry capacity to expand
- ascertain what customers and consumers want
- develop industry's capability for producing and marketing a range of quality assured products in a profitable, sustainable manner.

They are selected to assist in transforming a disunited industry producing a narrow product range of variable quality in an unplanned and low profit manner into a:

united, forward looking industry producing a range of quality assured oysters and other products, marketing in a more collaborative and profitable manner

The portfolio mix has been selected to provide for immediate needs to consolidate current business activities and improve profitability with existing farming methods and resources. The projects on QAP and industry development strategy lay the groundwork for sustainable expansion of production and domestic markets, and entry into world trade.

The development of hatchery technology is investment in the future growth of the industry through genetically selected oysters and diversification with other shellfish.

The proposed R & D portfolio moves away from the past emphasis on production, biology and diseases and focuses on business profitability and the critical success factors for competing in the modern marketplace.

The portfolio and budget has been based on FRDC distributing an average of $280000 per year over the next five years (based on current industry contributions of $70000 pa), with larger allocations in year one and three in recognition of the special need to "kick start" this industry, with a series of high priority studies simultaneously and in sequence in the first 2-3 years.

We see the three industry analyses projects as foundation stones or prerequisites for the Industry development projects; the information gathered in key Project 1 will allow for better outcomes from the key Project 3.

Table 9. Summary of Proposed R & D projects for the five years from 1996/7 to 2000/01. (Cost estimate in the right side of each column, underlined, is the recommended funding from the non FRDC source.

Project	Cost $'000 estimates Year 1	Year 2	Year 3	Year 4	Year 5	R & D providers #	Non FRDC funding sources
1.1Lease mgmt review	FRDC 20	FRDC	FRDC	FRDC	FRDC	Legalplanning Consultants	
1.2 Estuary capacity	50 50					NSW F or Consultants	NSW Fish
1.3 Review PO	20					NSW Fish	NSW Fish
2.1 & 2.2 QA Programs	100	50 100	100	100	100	SQAPC staff Consultants	SQAP trust account
2.3 QA Training	20					SQAPC and staff	SQAP trust /Qual prog
2.4 Review depuration	10					Consultant	
2.5 Oyster Filtration Depuration	30 30	30 30	80 80	80 80	80 80	NSW Fish Univ.	NSW Fish Univ
2.6 Code of practice		40				Consultant or SQAP	
3.1 Disease Management	50 50	50 50	50 50			Univ, NSWF	Univ, NSWF
3.2 Estuary mgmt plans		40	40	40	20	NSW F	NSW F Industry
3.3 Crisis mgmt plan		30				Consultants	Industry
4.1 Market Dev Domestic		20 20				Consultants	DPI&E, Industry
4.2 Export M Dev				20 20		Consultants	DPI & E Industry
4.3 Industry Workshop			30			Industry	Industry sponsors
5. Genetics technology	100 100	100 100	100 100	50 50	50 50	NSW Fish	NSW Fish
6.1 Cultivation methods			50 50	50 50	50 50	NSW Fish & Industry	NSW Fish
6.2 Timber Alternatives				50 ?	50 ?	Materials consultants	Plastics industry
Current Work							
FRDC 93/151 Triploids	60*					NSW Fish Dr Nell	NSW Fish
Diagnostics	yes	yes	yes	yes	yes	NSW Fish	NSW Fish
Oyster staff	yes	yes	yes	yes	yes	NSW Fish	NSW Fish
FRDC Total $000	320	290	310	250	230		

* NSW component. A similar amount is expended on this work with PO in Tas

These are just some of the potential providers, there are others available; NSW Fisheries is nominated as provider because of its infrastructure (field staff and vessels etc) and experience in the particular subject.

High priority projects are scheduled to start in year one while the medium priority projects start in year three, but marketing and the industry development projects are part of a series of high priority projects which start with the " foundation stone" industry analyses projects in year one.

The plan also requires an increase in NSW Fisheries' (Consolidated Revenue) expenditure on the industry, above that of recent years, again in recognition of the merits and attractive prospects of this important decentralised industry and the Department's need for greater resources to manage this industry in a more effective and speedy manner.

Industry too has to contribute more resources, time and money, for the plan to work. This commitment is required to demonstrate to FRDC, NSW Fisheries and the community at large that the NSW oyster industry has faith in its own future and is prepared to actively participate in change. If farmers remain divided and continue to just react to issues as they arise the industry's value and position in the marketplace will continue to decline.

The key (first and second priority) R & D areas summarised above are discussed here. Other areas of research, proposed by various parties, are regarded as low priority at this time and are outlined at the conclusion of this section.

8.1 The Key R & D Projects

1. Industry Analyses

1.1 Economics and marketing channels

Objective : Assess the economic performance and document the marketing channels of industry . (via mail survey and personal interviews)

ie capital investment, operating costs, production levels, products, market outlets and prices for 20 major estuary

1.2. Lease Utilisation and Estuary Carrying Capacity

Objective : Survey 20 major producing estuaries to physically assess current lease conditions and utilisation and capacity for rationalisation and expansion. (via physical inspection and desktop survey)

1.3. Review of PO control

Objective: Review the effectiveness and efficiency of the existing control measures.

2. QA Project

2.1. Develop an effective QA model program & training material.
Objective: Prepare an effective model for use in planning local QAP and preparation of training materials to facilitate effective training.

2.2 Develop and implement local QA programs
Objective: Establish standards and procedures for safe growing, harvesting handling and transport of oysters

2.3 Train local QAP personnel
Objective: To have knowledgeable personnel managing QA at local and state level.

2.4 Desktop review of existing depuration methods and current research overseas with particular reference to *Vibrio vulnificus*
Objective : Ascertain best practice for depuration and assess the value of new technology in Australia and overseas, especially USA-Irish research.

2.5 Compare filtration capability of SRO and PO at 15°C and 19°C
(Continue on from NSW Fisheries preliminary research)
Objective To examine industry's claim that oysters can depurate efficiently at 15°C, ie lower than prescribed temperature.
Funds are earmarked for further research on depuration, and/or clean waters classification (in years 3 to 5) to be determined according to the outcome of Project 2.4 and 2.5.

2.6 Development of product handling Code of Practice
Objective : Introduce uniform product grading and description, safe handling and processing practices for farmers, fish merchants and restaurateurs; disseminate printed material.
Additional funds may be procurable from the Department of Primary Industries & Energy to hold special training seminars for fish merchants and restaurateurs.

3. Industry Development Plans

3.1 NSW Oyster Industry Strategic Development
Objective : To produce a strategic management plan to guide the industry development for the next five years.
This study is best conducted after basic data on industry status and capacity has been gathered and examined by the three industry analyses projects.
3.2 Local Estuary Oyster Management Plans
Objective : To produce plans to guide development for each estuary for the next five years.

3.3 Crisis Management Plan

Objective : to produce a public relations and industry action plan for managing problems adversely impacting on the industry eg public health problems implicating oysters.

4. Marketing

4.1 Domestic marketing plan

Objective : Assess domestic consumer and trade attitude to oysters, produce plan for increasing industry collaboration, enhancing market intelligence, raising domestic demand & prices.

This project is best conducted after the industry analyses are completed.

4.2 Export market development

Objective: Identify the most attractive overseas opportunities for NSW oysters and develop market entry strategy.

This project is best conducted after the QA Programs have helped improve product quality and export markets can realistically be assessed and targeted.

4.3 Industry Workshop

Objective s: To present results of industry strategy and marketing projects for industry discussion, allow for review of industry progress and further plans. To assist in industry unification process. (This workshop should be directed by industry but could be managed by another party).

5 Hatchery Technology

Objective : To develop technology for the reliable and profitable production of genetically selected oysters and other shellfish. Continuation of the triploid technology commercialisation work at Port Stephens.

6. Cultivation Technology

6.1 Comparison of cultivation methods

Objective: Compare costs and benefits of various growing practices eg compartmentalised trays, cylinders; distance between racks/cylinders etc.

6.2 Evaluation of alternatives to timber

Objectives: Undertake desktop review and field trials on a selection of materials and containers which can be used effectively as economic alternatives to timber on oyster farms.

It may be possible to enlist the support of the plastics industry and/or material specialists on this project.

All of the six key R & D projects fall into the FRDC Program 3. Industry Development classification, under the subheadings of Aquaculture Development, Market Development or Quality.

The key priority R & D areas have been discussed above, and designated as high or medium priority projects. Other areas of research and development proposed in this study or to FRDC by various parties, and outlined below, are regarded as a low priority in regard to the NSW oyster industry at this time of writing.

1. National shellfisheries workshop

2. Application of an in-vitro tissue culture assay for the determination of paralytic shellfish poison and comparison to the standard mouse bioassay and HPLC assay

3. *Vibrio vulnificus* and oyster safety

4. Translocation of pathogenic diseases by inter-estuarine movement of Pacific and rock oysters.

5. Training in marketing and business management.

9. DISCUSSION

9.1 R & D Resources And Mechanisms

Australia has limited resources for Research and Development and this problem is probably compounded by their widespread geographical location. The R & D resources available for addressing long term and incidental immediate or emergency) issues range from those of CSIRO with its many divisions including Fisheries, Food and Engineering. the various sections of many Commonwealth Department as well as universities and colleges almost everywhere in coastal cities.

There are also State departments such as NSW Fisheries, local government organisations such as regional development bodies, the two oyster industry representative bodies (OFA and National Farmers) and a diversity of consultants eager to assist.

Recently the Cooperative Research Centre for Aquaculture (CRC) was established to promote and provide cooperative research across Australia and this will hopefully reduce the not uncommon tendency to reinvent the wheel all around the country. The Aquaculture CRC is currently funding two projects with work on SRO and PO, and advises that it can respond with assistance quickly where there is a need for resources from a number of institutions across the country.

The NSW oyster industry is quite familiar with NSW Fisheries resources because of its long association and has indeed relied too much on NSW Fisheries and other public sector organisations for much of its R & D needs. But Table 9 shows there are many entities and individuals able to assist, with their particular expertise and resources. Although the emphasis in this table is on the scientific there are of course professionals in many other fields such as marketing, materials handling, business systems etc.

Table 9. Selected R & D Resources available to the Oyster industry

Commonwealth Departments DPI & E (Fisheries, Agribusiness etc) Dept Employ. EducTraining, central and regional offices. Dept Industry Science Technology :Marinet
CSIRO many divisions around Australia (fisheries, food, engineering etc)
University and TAFE departments (food, business, engineering, biology, health, microbiology sociology, economicsetc
Cooperative Research Centre Aquaculture
State bodies NSW Fisheries, Agriculture, Regional Development, Land and Water Conservation, Environmental Protection Authority. Water Boards etc
Public sector consultants in Universities etc
Private sector consultants in many disciplines; research and testing laboratories, animal health services and business advisers
Community groups Rotary, diving or fishing clubs, and others

The mechanisms available for tackling long term R & D issues and needs cover the full spectrum of public sector and private R & D providers and their various sources of funding as well as interdepartmental groups, whole of government bodies (such as ASSMAC) or joint working groups of government and industry.

The mechanisms for tackling incidental or local issues are less obvious and more debatable because of differing interpretation of the term "development": taken in its broadest sense the resolution of a small problem indirectly contributes to the development of an industry.

Thus several oyster farmers may seek government or public sector assistance for a local issue of limited impact, while the majority would deem it as a personal or local problem and not eligible for R & D assistance from the public sector. The latter interpretation has greater support in the wider community too.

R & D Response Mechanisms to Incidents and Long Term Issues

We believe that NSW Fisheries, FRDC and other essentially public sector resources be used to address long and mid term issues of statewide or great local importance while specific industry funds, levies and local resources and mechanisms be used to address small local issues. Emergency issues eg an oil spill, may require a combination of resources from the public sector and industry.

While local impacts can have a disastrous effect on a particular estuary, business or family they sadly must still be regarded as a local and sometimes minor problem in the context of an industry and government with limited funds for R & D.

There also needs to be a recognition by industry that not all problems are amenable to resolution by R & D; the current shortage of promotion for example is one that should be addressed by industry alone, albeit based on information gathered through market research.

Local resources can often be brought into play for regional issues. Local government organisations, regional offices of State or Commonwealth departments as well as community groups should be utilised.

A recent exercise by Clyde River oyster farmers, NSW Fisheries and divers in cleaning up PO from the Clyde River serves as a good example. In October last year divers from a nearby diving club as well as local people helped to remove large broodstock PO from the estuary (Broadcast Newsletter NSW Fisheries November 1995).

Recent initiatives by NSW Fisheries and NSW Fishing Industry Training Council to utilise training programs in the control of PO are further examples of looking widely or laterally for solutions to problems.

NSW Fisheries and other agencies such as the Environment Protection Authority should also assist industry in local problems and issues (emergency or long term) by making available specialist resources.

The provision of Health Diagnostics services is an example. NSW Fisheries has fish health (including oyster) expertise and facilities at Wollongbar that should remain available to industry for at least the next few years as the oyster industry and NSW aquaculture generally improves its profitability.

Local environmental issues of long term or immediate importance are best managed at a local level for effectiveness and maximum efficiency. As indicated earlier there is a need to develop and strengthen the local groups such as the local oyster industry management, QAP, estuary management and TCM committee however the challenge is to develop linkages between the groups so that resources (time and money) are not wasted.

NSW Fisheries has expertise in oyster biology and disease identification while the EPA has better facilities for water testing and the farmers are on the water daily. Although some farmers believe that the oyster industry should not be relied on by local or State government as the community's watchdog on the environment, the industry really must continue in that role for its own self preservation, for the short term at least.

To get best use of the limited resources however, protocols and response plans should be established by industry and government agencies, probably as part of the local SQAP, to deal with situations when water quality falls to a prescribed level. The protocols should cover water and biological sampling and testing, and industry should have a public relation (crisis) management plan ready.

These local committees should also develop a register of R & D providers and other resources so that assistance can be mobilised quickly as needed.

Although many in the NSW industry complain of rising costs, government charges and levies we recommend that a new levy be imposed to provide for an emergency or fighting fund. These funds can be available for tackling issues according to industry's wishes and can be accessed immediately for dealing with issues at a local or state level.

In short, industry must call more on its own resources, human and financial to overcome troubling issues as there is ever increasing greater pressure on public resources and application of the user pays principle.

9.2 Extension of R & D Results and Technology Transfer

The results of research and development will not be adopted by industry unless it feels that the innovation, improved technology or market information will be beneficial. The results and benefits of R & D therefore need to be communicated to industry if the nation is to benefit.

Communication is necessary at the beginning, during the research program and at the conclusion of the research or development project. This communication, and the technology transfer at the successful conclusion of a project, can be done by the research staff and/or extension staff.

We believe that the research staff should take an active role in the industry consultation and communication at least in the early stages of a project, preferably in the field, so that the industry gets a clear understanding of the objectives of the project and the likely outcomes in order to get the participation, support and "ownership" needed for the adoption of the projects results.

Extension staff should not be the only person involved in industry communication and technology transfer. Researchers must undertake some extension work, in a programmed and wholehearted manner just as they expect industry to be supportive and motivated in on-farm research projects. Not much progress can be achieved in on-farm R & D projects or with technology transfer without the farmers support.

The extension of results and technology transfer can be carried out through various ways:

- personal presentations at field days
- personal presentation at Industry open days at Port Stephens station
- news releases in trade, departmental or association magazines or newsletters
- electronic recordings such as video or audio cassette
- one to one personal presentations by research or extension staff
- special seminars or training sessions

or some combination of the above options.

Field Days

The open days at the Port Stephens station were apparently very successful in the early years but industry feels that these have now become repetitive, less effective and lost much of their appeal. Nevertheless the chance to meet face to face with colleagues from around the coast (and interstate) is valued by most farmers as is the opportunity to view new plant and equipment.

We recommend that field days are organised by NSW Fisheries, on an as needed basis, when there is new technology or substantial information to transfer to industry. Farmers should take an active role in planning and running these days too and use them to help unite their industry.

We suggest that in the next instance such field days are held at a locality both north and south of Sydney, and not at Port Stephens, because this locality still recalls unpleasant meetings for some. The Port Stephens station can be used again at a later time as a venue for industry open days.

These field days and the face to face discussion with other farmers on "neutral territory" can also assist in breaking down some of the lingering suspicion and personal differences that still prevail amongst a few farmers. Thus they can assist in technology transfer as well as building up a more unified and professional industry.

To maximise attendance and the effectiveness of these functions, the program should include presentations by oyster farmers on their new ideas or developments and a commercial trade show where suppliers of goods and service can present and promote their wares too. This should thereby allow for maximum exchange of ideas and viewpoints and not just be a forum for presentations by professional researchers.

Communications

The NSW Fisheries' Aquaculture Newsletter is well received by many farmers and the OFA Newsletter is also widely read and these media should be used wherever possible to facilitate interaction and news exchange.

The transfer of new information and technology may also be undertaken by means of a specially commissioned audio tape or video cassette film. A good quality 15 minute video tape can be produced for some $15000 and mailed out for about $10 per copy. This may prove to be a more cost effective way of demonstrating and promoting some valuable innovations to this widely scattered industry. Audio tapes are even cheaper but would not be suitable for disseminating information requiring visual interpretation.

Whatever medium is selected for technology transfer it is imperative that people with adequate communication skills are used to carry out this work. Too many times in the past people with great research, management or other ability but poor communication skills have failed in their attempts to get the gist or results of their work across to industry.

There has been considerable high quality research done at Port Stephens, and elsewhere, of direct benefit to industry but because farmers commonly collaborate in field trials the contribution of the researchers has largely been forgotten or undervalued.

We believe that much of the current perception of many farmers that NSW Fisheries researchers have done little research of use to industry is a result of poor communication; the medium and language (in print or personally) used has not been appropriate for the audience.

Farmers are not all conversant with the technical jargon and acronyms in use today and researchers cannot assume that the farmers have an encyclopaedic knowledge of previous oyster research. Technology transfer is essentially the marketing of intellectual product and it will not be achieved unless both parties speak the same language in a comfortable setting.

Another area that needs examination relates to the different motivating forces and rewards in research and in farming. The researcher is rewarded personally and professionally with a great scientific discovery whereas the farmer is interested in the economic implications of the research and not research *per se*. This suggests that the researchers should highlight the economic implications of their work and not assume that it is clear to an industry audience.

The communication difficulties described above suggest that there may be a need for some researchers and organisations to budget for the employment of someone with communication skills to assist with the extension of the results and technology transfer at the end of a major project, much as they currently budget for the assistance of special computing or laboratory staff.

For a scientist the question of relative merits of research performance *vis a vis* extension work is a vexed one. Many scientists quite rightly point to the current promotion system which is heavily weighted by the output of research publications in scientific journals.

Regrettably, little value is currently placed by many of the employing organisations on extension work and related publications. One solution to this problem is to recognise it as such and employing a person to undertake extension work.

The employment of an extension officer by NSW fisheries for oyster work is warranted because it is a valuable industry with potential for expansion and the subject of major research projects which require considerable liaison and industry involvement.

We would recommend the appointment of an extension officer for oyster research in support of our general recommendation of further R & D work on oysters in Chapter 8.

The funds for an extension officer may perhaps be obtained from outside sources such as DEET or regional development agencies because of the opportunities of generating more employment in the industry.

9.3 Evaluation and Accountability of R & D

The evaluation of R & D can be a difficult task in regard to an evaluation of a single application, the selection of a portfolio or assessment of performance after the work has been executed. This subject area itself has in fact been researched by the Australian Bureau of Agriculture and Resource Economics (Lal et al. 1994) for the Fisheries R & D Corporation and the Corporation gives an outline of its criteria for evaluating applications for funding in its Research and Development Plan 1996 to 2001.

Evaluation of R & D Applications

The make up of the panel evaluating research applications warrants discussion. In NSW, the Oyster Research Advisory Committee (ORAC), a statutory body advising the Minister for Fisheries, has unfortunately had a high turnover of membership. It currently has a mix of oyster industry representatives and one researcher. This mix, and some stability, is critical as the farmers are needed to assist in identifying problems and other areas for R & D but professional researchers are also needed with their technical experience, knowledge and capacity for peer assessment.

The suggestion of several oyster farmers that the ORAC should consist entirely of farmers " so that we can direct the research" is not a sound one. A group of farmers is unlikely to have the expertise or time needed to adequately assess the *bona fide* of researchers or the viability and performance of many publicly funded projects, some of which can be quite technical.

Even with a fully industry funded or commissioned project it would be advisable to have outside professional assistance. The constitution of ORAC should remain with at least one professional researcher as member.

Evaluation Criteria

The evaluation criteria described by the Fisheries R & D Corporation represent a good model and the following discussion largely parallels these. Applications should be considered according to the:

- attractiveness of the project ie magnitude of the net benefits
- feasibility of the project, the likelihood of realising and maintaining the benefits without leakage to overseas competitors

Attractiveness

- Prospective net benefits, quantitative and qualitative for the industry, consumers and the community at large
- the level of contribution by the applicant, beneficiary or others
- relevance to industry's plans and objectives
- the level of support from the various sectors of the industry

Feasibility

- experimental design or research approach in relation to objectives
- the applicants capacity to undertake the particular R & D
- the competence of the principal investigator to complete on budget and on time
- capability and commitment of the team for extension of results
- likelihood of results or technology being adopted by the industry and not lost to competitors overseas.

Portfolio mix

One of the most difficult tasks is to select a mix of projects that takes account of short term and long term needs, the applied and more basic research. There is no rule of thumb and one should aim for a balance, which also takes account of cumulative research projects with a series of sub projects.

In the NSW oyster R & D plan outlined in Chapter 8 for example there are a number of simultaneous and sequential projects: The industry survey is designed to provide data which will assist in the development of the industry strategic plan and the marketing studies. We recommend high priority support for development of hatchery technology because we see this as an essential investment now to facilitate the industry's future development and growth through shellfish genetically selected to meet consumers wants.

Industry has often been critical of the type of research undertaken at Port Stephens in past years, and at other research institutions. *There is not enough practical stuff, its too academic* are typical comments. Farmers often do not fully understand that universities and other research institutions seek prestige through the excellence and innovation of their research.

Routine experiments comparing growth rates of oysters/prawns etc on two different sites/ponds do not provide much opportunity for new scientific discoveries and such research is in fact quite demanding if it is to be scientifically sound and able to be replicated by others. Hence such work has little appeal to the brilliant researcher or prestigious university.

Nevertheless now that farmers are contributing to research funds they want to see more "routine research" to answer questions of great economic importance to them. A solution, with University linked research, is to acknowledge this problem and to seek Masters degree students rather than students seeking the higher Doctorate degree.

The pressure for innovation is not as great for the Masters as it is for the Doctorate and the Masters student can earn a degree with more "routine or technological research" without sacrificing excellence. The University of New South Wales School of Food Science and Technology is exemplary in this regard: many students have gained their Masters degree (and BSc degree) with high quality technological research on seafood.

Accountability

R & D projects should be monitored during and at the end of their lifetime and where appropriate or necessary the cost benefits evaluated ***ex post*** ie after completion (and sufficient time has elapsed for any results of change to appear). The cost of these performance evaluations and any accounting audit are themselves an expense on the R & D budget and can be considerable. An *ex post* cost benefit analysis therefore would not be cost effective in low budget projects but could be worthwhile on lengthy costly projects.

The progress of projects should be monitored by the funding organisation through half yearly reports, outlining performance relative to milestones and budget; these reports need not be lengthy but they should be compulsory.

Principal researchers supervising graduate students or technical staff may need to be reminded of their responsibility to supervise and assist their junior staff in order to achieve the desired outcome on time. They should not be allowed to take on the responsibility of research supervision unless they have the time to do so.

Financial accountability should be maintained by means of the normal financial reports prepared by the organisation, at the end of projects (or annually) but in large projects or at other times where there may be cause for concern an independent audit may be required. As indicated above, consideration needs to be given to the costs and likely benefits of specific evaluation and financial auditing of projects.

At the completion projects should be evaluated against the objectives and final payment withheld until the extension component of the project has been fulfilled and a report suitable for dissemination to industry completed.

These final reports to industry should highlight the economic implications of the work, make recommendation for future research where necessary, be in language appropriate for the audience, avoiding technical jargon and not assuming that acronyms are understood. Importantly, they should be kept as short as possible.

Lengthy final reports to FRDC, CRC (Cooperative Research Centre for Aquaculture) etc should not be accepted as the only report on the project.

REFERENCES

Bosch D J and L A Shabman, 1990. Simulation modeling to set priorities for research on oyster production. Amer. J Agric Econ. May 1990: 371-381.

Catt, C., 1992. Comparing oyster production methods: An economic modelling project on stick and single seed oysters in Port Stephens, New South Wales. Department of Agriculture, Manuscript. 52 pages.

Espinas V, Marshall G and B Rish, 1988. Economic survey of the New South Wales oyster farming industry: 1981-82 to 1983-84. Part 2- Physical aspects. Misc. Bull. 54, 48 pp. NSW Dept Agriculture.

Lal P, Holland P. and D. Collins, 1994. Benefits and costs of fisheries research in Australia. ABARE Res Rept. 94.3. 104 pp.

Longley, A., 1982. Sensory analysis of oysters. University of NSW BSc thesis.

Marshall G. and V. Espinas, 1987. Economic survey of the New South Wales Oyster Farming industry : 1981-82 to 1983-4. Part I. Financial aspects. Misc Bull 48. 59 pp. NSW Dept Agriculture.

Nell, J., 1993. Farming the Sydney rock oyster (Saccostrea commercialis) in Australia. Rev. Fish. Science 1(2): 97-120.

Nell J. and R. Chovska, 1992. The effect of bis-tributyltin oxide(TBTO) and copper on the growth of juvenile Sydney rock oysters *Saccostrea commercialis* (Iredale & Roughley) and Pacific oysters (*Crassostrea gigas*) Thunberg. Sci. Total. Env. 125: 193-201.

Nell J. and J. Holliday, 1986. Effects of potassium and copper on the settling rate of Sydney rock oyster(*Saccostrea commercialis*) larvae. Aquaculture. 58:263-267.

NHMRC, 1987. Code of hygienic practice for oysters and mussels for sale for human consumption. Aust. Govt. Publishing Service. 20 pp.

Oyster Industry Task Force Report, 1990. The NSW Oyster Industry. Report of the Oyster Industry Task Force to the Minister for Agriculture and Rural Affairs. 36 pages + appendices. NSW Department Agriculture & Fisheries

Souness, R. Bowery R. and G. Fleet, 1979. Commercial depuration of Sydney rock oysters Crassostrea commercialis. Food Technol. Aust. 31(12) : 531-537.

Sydney Technical College, 1988. Marketing of the Sydney Rock Oyster. Marketing 1988.

NSW Oyster R & D Study 1996 Ruello & Associates, Sydney

1. What was your market oyster production in 1994/5 ?
Sydney Rock .....bags Pacific .....bags

2. What do you think/hope to produce in 5 years ?
Sydney Rock .....bags Pacific .....bags

3. What is the most important oyster growing estuary for you .....

4. What industry associations are you a member of ?
....

5. What is the major problem your oyster business faces today?
.....
.....

6. What do you think is the major problem facing the industry today ?
.....
.....

7. What do you think is the major long term problem facing the industry
.....
.....

8. What would you nominate as the industry's goal or vision for the next 5 years, what would you like to see the industry achieve over the next five years ?
.....
.....

9. Please describe five research or development projects you would like to see done for the industry, Rank them 1 to 5, with the 1 rank for the most important and 5 for the least important. They can be on oyster breeding/genetics, farm costs, depuration, diseases, industry issues, economics, estuary, public health, marketing, promotion, Quality Assurance, technological problems, seminars, training or workshops, anything to help your industry develop profitably.

( ) .....
.....

( ) .....
.....

( ) .....
.....

( ) .....
.....

( ) .....
.....