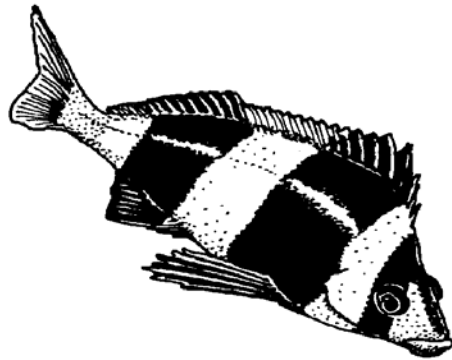


Queenscliff Marine Station



Annual Report

1996

**Annual Report of the
Queenscliff Marine Station
1996**

Member Institutes and Representatives

n Deakin University

Professor David M Stokes
Dean, Faculty of Science and Technology
(Associate Professor Peter J Hanna until June, 1996)

n Marine & Freshwater Resources Institute

Dr Garth Newman
Director

n Monash University

Dr Gerald P Quinn
Department of Ecology and Evolutionary Biology

n Royal Melbourne Institute of Technology

Associate Professor Douglas A. Holdway
Department of Applied Biology and Biotechnology

n The University of Melbourne

Associate Professor Michael J Keough
Department of Zoology

n Victoria University of Technology

Dr Trevor R Burridge
Department of Environmental Management

STAFF

Administrative Secretary
Elizabeth McGrath

Technical Officer
Roderick P Watson

Contents

	Page
Member Institutes and Representatives	4
Introduction	6
Chairman's Report	7
Operations	
Field courses	8
Research vessels	8
Diving	9
Aquarium	9
Research	9
Other	10
Services and Facilities	
Teaching facilities	11
Research facilities	11
Finances	
Statement of Assets and Liabilities as at 31 December 1996	12
Operating Statement to 31 December 1996	13
Publications and Reports	
Publications, Referred Book Chapters, Conference and Symposia Publications	14
Research Projects	21
Grants Received	27

Introduction

The Queenscliff Marine Station was established in 1989 to provide a facility dedicated to marine research and tertiary education. The Station was initially planned and funded by a consortium comprising Monash University, the Royal Melbourne Institute of Technology (RMIT), The University of Melbourne and the Victorian Institute of Marine Sciences (Marine & Freshwater Resources Institute). Deakin University and the Victoria University of Technology have since joined the consortium.

The Station commenced operation in 1991 in two relocatable buildings transferred from The University of Melbourne. A new aquarium building was also completed at this stage. In 1992, \$635,000 was received from the Australian Research Council, following a cooperative proposal for research infrastructure funding. The proposal was to provide 'a flow-through seawater system supporting experimental facilities, emphasising ecotoxicology at the Queenscliff Marine Station'. Construction of the new facility began in August 1994 and was completed in January 1995.

Today, the Station is a unique facility catering for researchers, educators, undergraduate and postgraduate students. The Station provides an ideal environment for interaction amongst specialists with major interests in marine science.

The Station is located on the southern end of Port Phillip Bay on the Bellarine Peninsula, providing convenient access to a diverse range of marine habitats. Sandy beaches, intertidal and sub-tidal rocky reefs, seagrass meadows, mangroves, the protected waters of Port Phillip Bay and the open seas of Bass Strait are all within easy reach, making the Station an ideal centre for research and education.

The facility primarily serves the member institutes but is available to researchers and educators from Australia and overseas. The Station also offers industry, commerce and the public sector opportunities to conduct new and relevant research.

Chairman's Report

During 1996 the Queenscliff Marine Station was well utilised and provided valuable facilities to all members of the Consortium associated with the Station.


There was an increase in the use of the Station by both researchers and students by comparison with previous years. Projects undertaken at the Station involved 11 Ph D, 1 Masters and 4 Honours degree students. In addition, 1 post-doctoral and 5 other research projects were undertaken at the Station.

Facilities were also provided to researchers from the Environment Protection Authority, the Museum of Victoria and the University of Waikato, New Zealand, who were working on co-operative projects with member institutes.

Utilisation of the Station for under graduate training has also increased during the past year and this is welcome because provision of these facilities is a major role of the Station.

A successful seminar day was conducted in December to invited guests from Government, the private sector and academia. Members of the Management Committee provided an overview of the operation and purpose of the Station and researchers and students made poster presentations which illustrated the range and quality of the work which was being undertaken. About 65 persons attended the Seminar and gained a better understanding of its purpose and achievements.

I would like to thank the members of the Management Committee for their continued co-operation and input during the past year. This unique partnership between five universities and a major marine research institute provides worthwhile and cost effective facilities for research training which would probably be beyond the means of any one member of the Consortium.

A handwritten signature in black ink, appearing to read 'Garth Newman', is written over a faint, light-colored outline of a signature.

Garth Newman
Chairman, Queenscliff Marine Station Committee of Management

Operations

Field courses

The following undergraduate courses were conducted at QMS during 1996:

Institute	Date	Course	Students
Deakin University	• 23-24 March	Marine biology	37
	• 4-5 May	Marine biology	31
	• 10-11 August	Marine biology	45
	• 7-8 September	Animal diversity	30
	• 21-22 September	Marine biology	40
	• 19-20 October	Animal diversity	30
Monash University and The University of Melbourne	• 10-18 February	Marine ecology	54
Monash University	• 26 Feb-1 March	Marine botany	21
The University of Melbourne	• 28-29 September	Marine ecology	30
	• 12-13 October	Marine ecology	30
Victoria University of Technology	• 19-25/2/96	Marine ecology	12

Research vessels

The Station's 6.5 metre research vessel, *Veleva*, spent 105 days at sea during 1996. Activities included research into King George whiting, larval ecology, specimen collection, including abalone, octopus, six-spine leatherjackets, flathead and 11-armed seastars.

During February, the starboard motor on *Veleva* was rebuilt. In April, the boat trailer was replaced using funds generated by consultancy fees.

The 4.1 metre punt was used as an inshore netting vessel for whiting and leatherjacket research. It was also used as a diving platform for octopus and leatherjacket research.

The research vessel *Korrong* is owned by the Geomatics Department of The University of Melbourne and located at the Station. It was used for mapping work, as a research dive

boat and for research into the spread of *Undaria* by MAFRI staff. A remotely operated video is available.

Diving

During 1996, 145 person-dives were logged. The dives related to reef-fish research, reef biodiversity research, abalone, octopus and seastar collection. The great majority of diving occurred in depths under 10 metres.

Aquarium

Projects utilising the aquarium during 1996 included biochemical indicators of tainting in *Salmo salar*, abalone research, macroalgal recruitment, temperate reef fish research, ageing and growth of rock lobsters and cancer research involving sharks. The aquarium was also used for short-term housing of animals for research and for undergraduate courses.

Research

During 1996, the following projects were undertaken at the Station. A more detailed description of each project is contained under *Research*, p17.

Deakin University

Gwyther, Janet	Meiofauna ecology	PhD
Porter, Chris	Temperate reef biodiversity	PhD

Marine & Freshwater Resources Institute

Jenkins, Dr Greg	Whiting larval ecology/recruitment	Research
Jenkins, Dr Greg	Sampling for post-settlement in <i>Pagrus auratus</i>	Research

Monash University

Bellgrove, Alecia	Macroalgal recruitment	PhD
Wheatley, Melissa	Temperate reef fish	PhD

Royal Melbourne Institute of Technology

Butty, Jill	Octopus as biomarkers	Research
Cheah, Daphne	Validation of in vitro biomarkers for environmental pollution	Masters
Cohen, Adam	Effects of oil spill on <i>Macquaria novemaculeata</i>	PhD
Gagnon, Dr Monique	Biochemical indicators of tainting in <i>Salmo salar</i>	Post-doc
Gulec, Ismail	Oil spill toxicology	PhD
Long, Sara	Biological indicators of exposure in <i>Octopus pallidus</i>	PhD

The University of Melbourne

Gleeson, Katie	Growth and shell repair of <i>Haliotis rubra</i>	Honours
Gomulyuk, Victor	Abalone research	Research
Karunajeewa, Nimal	Seastar ecology	PhD
Macmillan, Prof. David	Ageing and growth of Rock lobsters	Research
Saunders, Thor	Comparison of fish assemblages	Honours
Trivett, Melanie	Cancer research via sharks	PhD

Victoria University of Technology

Brown, Michael	Effects of copper on feeding and survival of marine gastropod <i>Haliotis rubra</i>	Honours
Campbell, Stuart	Marine algae as indicators of effluent toxicity and coastal eutrophication	PhD
McArthur, Matthew	Systematics, introduced status and food selection of <i>Euchone</i> (Polychaeta: <i>Sabellidae</i>) in Victorian waters	Honours
Scarpaci, Carol	Behavioural study of the Bottlenose dolphin <i>Tursiops truncatus</i> in Port Phillip Bay : links between sound and behaviour	PhD

Other

The Management Committee met on five occasions during 1996.

During June, Professor David Stokes, Dean, Faculty of Science and Technology at Deakin University, replaced Associate Professor Peter Hanna on the Management Committee.

The first consultancy work undertaken at the Station took place during March, April and May. Three separate tests were carried out for Applied Chemicals Pty. Ltd. testing biocides for the removal of mussels from the Shell refinery's water cooling inlet pipes. Total income received from the consultancy was \$8,350.

Planning for replacement of the Station's ageing vessel took place throughout the year. Subsequently, it was decided that a proposal be put forward to the ARC in 1997 for funding under the Research Infrastructure (Equipment and Facilities) Program.

Services and Facilities

Teaching facilities

Teaching facilities available include a lecture room with seating for 40. The adjoining general/teaching lab has bench space for approximately 25 students. Both rooms can be used separately or combined into one large area suitable for conducting presentations to in excess of 70 students.

Research facilities

Researchers and postgraduate students have access to bench space in the general/teaching lab, the ecotoxicology lab and the aquarium. Two controlled temperature rooms and a large prep room adjoin the toxicology lab.

Seawater is supplied to aquaria via a high quality flow-through system. The ecotoxicology lab has 24 seawater taps to service benchtop aquaria. The aquarium houses a dissecting table, 6 double-tiered and 4 single aquarium stands; seawater is supplied to each stand. Compressed air is available in the ecotoxicology laboratory and aquarium. Seawater and compressed air are also available in the constant temperature rooms.

Limited office space is available to visiting researchers and postgraduate students along with access to computers, fax and photocopier.

The *Velella* is available for field activities and other vessels can be made available by arrangement.

No accommodation is provided at the Station.

Finances

Balance Sheet as at 31 December 1996

Current Assets	\$	\$
- Cash held by Deakin University	<u>34,002</u>	34,002
Non Current Assets		
- Equipment	70,284	
Less : Provn. Depn.	<u>-22,721</u>	47,564
- Motor Vehicles	24,407	
Less : Provn. Depn.	<u>-7,322</u>	17,085
- Furniture	1,056	
Less : Provn. Depn.	<u>-132</u>	924
- Land & Buildings	126,114	
Less Provn. Depn.	<u>-21,439</u>	104,675
Liabilities		
Sundry Creditors - Accruals		-683
Provision for Annual Leave	-4,098	
Provision for LSL	<u>-3,608</u>	-7,705
Income in Advance		0
NET ASSETS		<u>195,861</u>
Represented by:		
Consortium Members funds		204,822
Current Year Profit/-Loss		-8,961
		<u>195,861</u>

Operating Statement for the period ended 31 December 1996

INCOME	
Consortium Contributions	85,374
Interest	1,959
Other Income	<u>8,350</u>
TOTAL INCOME	95,683
LESS EXPENDITURE	
Salaries	47,000
Payroll Tax	3,290
Superannuation	9,027
Workcover	329
Employee Entitlements	<u>7,705*</u>
Total Salary Expenditure	67,352
GENERAL	
Catering	436
Cleaning	2,128
Consultants	150
Consumables - Computer	230
Consumables - General	890
Depreciation	15,198*
Electricity	1,800
Library & Teaching Aids	40
Minor Equipment	557
Photocopier & Stationery	568
Postage	381
Postage Recoveries	-158
Promotions & Publicity	288
Registration/Insurance-Boat & Trailers	757
Rent/Lease Expenditure	104
Repairs & Maintenance	6,654
Staff Training	301
Subscriptions & Memberships	105
Telephone, Fax	4,222
Telephone Recoveries	-284
Travelling Expenses	124
Vehicle & Boat Fuel	<u>2,800</u>
Total General Expenditure	37,292
TOTAL EXPENDITURE	104,644
NET OPERATING RESULT	-8,961

* No provisions were made in the 1996 budget for the non-cash items of depreciation and employee entitlements and the income received from consortium members falls short by these two amounts. This has led to the negative net operating result for the year of \$8961.

Publications and Reports

Publications

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- Stuart, T., Macmillan, D.L. and Thomas, M. (1996). The effects of background colour on the colour of developing juvenile rock lobsters, *Jasus edwardsii* (Crustacea: Decapoda). *Marine and Freshwater Behaviour and Physiology* 27(4):269-273.
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Burridge, T.R. Introduction of *Undaria* into Port Phillip Bay. Invited speaker, CSIRO Hobart.

Day, R.W., Hawkes, G.P., Wallace, M.W. and Williams, M.C. The value of research to age abalone, and how to time-stamp them. *Second World Fisheries Congress*, Brisbane July 1996.

Gagnon, M.M. and Holdway, D.A. (1996). Physiological disturbances in Atlantic salmon exposed to crude oil. *Proceedings of the 17th Annual Meeting of the Society of Environmental Toxicology and Chemistry (SETAC)* pp269. Washington DC 17-21 November 1996.

Gulec, I. and Holdway, D.A. (1996). Toxicity of oil dispersant, crude oil, and dispersed crude oil to a marine amphipod and gastropod. *Proceedings of the International Symposium on Environmental Chemistry and Toxicology (INTERSECT 96)* pp 0176. Sydney 14-18 July 1996.

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Holdway, D.A., Butty, J.S. and Ahokas, J.T. (1996). The effect of laboratory holding conditions on mixed function oxidase metabolism of *Octopus pallidus*. *Proceedings of the International Symposium on Environmental Chemistry and Toxicology (INTERSECT 96)* p16. Sydney 14-18 July 1996.

- Holdway, D.A. In: Environmental Toxicology. An introduction to environmental toxicology. Invited lecture, *Department of Pharmacology, Monash University*, Clayton 28 October 1996.
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- Van Dam, R.A., Barry, M.J., Ahokas, J.T. and Holdway, D.A. Toxicity of the chelating agent DTPA and its iron complex, Fe(111)-DTPA to Australian freshwater biota. *Proceedings of the 17th Annual Meeting of the Society of Environmental Toxicology and Chemistry (SETAC)* pp230. Washington DC 17-21 November 1996.
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Research

Use of Octopus as a potential bio indicator species: baseline studies

D.A. Holdway, J.S. Butty, S.E. Brennan & J.A. Ahokas. Key Centre for Applied and Nutritional Toxicology, Royal Melbourne Institute of Technology.

Important limitations of fish liver enzyme bio markers are: difficulties in defining chemical exposures in mobile and migrating species; and lack of knowledge regarding the relationship between observed bio marker effects and population-level effects in the field.

The Australian octopus *Octopus pallidus*, has several inherent advantages as a bio indicator species. It is abundant in Australian coastal waters; its territorial nature makes it representative of resident water/sediment quality; it has a large digestive gland for tissue analyses, and the relatively "stress-free" entrapment method possible allows for representative metabolic activities to be determined.

This study was undertaken to establish the efficacy of capturing octopi using inexpensive custom-built trap-lines, and to determine the impact of the biotic modifying factor sex, and the abiotic modifying factors season and sampling site, on the activities of cytochrome P-450 mediated mixed function oxidase (MFO) digestive gland enzymes including ethoxyresorufin O-deethylase (EROD), ethoxycoumarin O-deethylase (ECOD) (determined fluorimetrically) and total P-450 (measured using CO difference spectra). "Clean" and "potentially contaminated" zones were sampled within Port Phillip Bay. Octopus trap lines, each containing 40 traps set at 4 m intervals, were set on the bottom of each site.

Trap success rates were 15-28% for the "potentially contaminated" Corio Bay test site and 85% for the "clean" Portarlington reference site. Cytochrome P-450 showed highly significant ($p < 0.0001$) seasonal differences, with no site or sex differences. Mean (\pm SE) Autumn P-450 values of 74.8 (\pm 5.5) pmol/mg protein were higher than Winter values of 51.2 (\pm 7.6), which were higher than Spring values of 21.8 (\pm 4.0) pmol/mg protein. Summer P-450 values of 61.4 (\pm 9.8) pmol/mg protein were only different from Spring values. Mean (\pm SE) Spring ECOD activity of 3.3 (\pm 0.7) pmol/min/mg protein was lower than Summer, Autumn and Winter ECOD values of 8.9 (\pm 1.6) 6.5 (\pm 1.2) and 8.6 (\pm 2.3) pmol/min/mg protein respectively. Females had roughly half the ECOD activities of males (3.8 \pm 0.8 compared to 7.4 \pm 0.9 pmol/min/mg protein). All octopi digestive gland EROD activities were low (roughly 0.2 pmol/min/mg protein) and showed no significant sex, site nor seasonal differences. Octopi MFO seasonal and sex differences may be related to their reproductive cycle, with decreases in digestive gland protein previously reported in post-spawning females. Potential for using octopus as a bio indicator species appears promising but sensitivity to chemical exposure has yet to be determined.

Biochemical Indicators of tainting in Atlantic Salmon (*Salmo salar*)

Dr Monique Gagnon, Royal Melbourne Institute of Technology.

Atlantic salmon (*Salmo salar*) farming represents a multi-million dollar industry for Australia. Pen-reared at sea in areas where intensive oil exploration and extraction take place, Atlantic salmon are at high risk of exposure to oil spills. In a simulated oil spill, Atlantic salmon are exposed to Bass Strait light crude oil. The effects of using dispersant during a major oil spill is also tested by exposing the fish to dispersed crude oil.

The uptake of chemicals and the acquisition of a taint in the edible part of the fish are tested for both oil and dispersed oil. Selected biochemical indicators are measured in order to establish relationships between biological indicators and taint. In addition to physiological measurements, hepatic mixed function oxygenases (MFOs) enzymes, which are part of a detoxification mechanism, are measured. Excretion of petroleum-related compounds is

monitored by measuring bile metabolites. As a shift in the carbohydrate metabolism would affect the type of lipids produced and consequently affect the taste of the flesh, aerobic and anaerobic mitochondrial enzymes are quantified in the gills and muscle. SSDH, indicator of liver damage, as well as DNA breaks are measured in blood samples.

Results of this experiment will determine uptake and disappearance of the taint, and relate tainting to easily measurable biochemical indicators, in order to provide the Australian fish farming industry with reliable bioindicators of tainting after the occurrence of exposure to crude oil.

Investigation how to age abalone

Victor Gomulyuk and The University of Melbourne.

The object of this project is to validate ageing techniques in abalone in Tasmania, New South Wales, Victoria and South Australia. If abalone can be accurately aged, this will provide a fundamental tool for more effective predictive management of abalone. This project seeks to determine both timing and the process of layer formation in abalone shell to allow the interpretation of layers to estimate age. To achieve this, we are marking the growing layer in abalone shells with a staining agent - manganese (Mn^{+}), then tagging and releasing the stained abalone so that the number and timing of subsequent growth layers can be determined by collecting tagged abalone at various intervals after release.

The aim of the study carried out at QMS was to test the effect of various manganese concentrations on marks achieved. The significance of immersion time and volume of water provided to experimental abalone during staining process was also estimated.

Abalone were caught at Pt Lonsdale 18.6.96. Animals were placed in 9, 38 litre plastic tanks. Water in each tank was aerated, but water flow was turned off during staining.

Animals were kept after staining for 40 days. Extensive water flow and aeration were provided during consolidation period. Excess of red algae as a food was added to tanks each week to aid fast abalone growth and subsequent shell layer deposits. All abalone were tagged with Floyd individual pore tags. After 4 days of experiment, abalone were sacrificed. Their shells were processed using standard methods. We would like to thank Rod Watson for his great assistance during this study.

Larval transport and recruitment of King George whiting to Port Phillip Bay

Dr Greg Jenkins, Paul Hamer, Dirk Welsford. Marine & Freshwater Resources Institute and The University of Melbourne.

This work forms part of an ongoing research program on fish ecology based at the Queenscliff Marine Station. The major aim is to understand the factors that cause variation in the number of young whiting coming into the population each year, which will in turn influence the number available to be caught by recreational and commercial fisherman.

Larval whiting are collected in plankton nets and small juveniles are collected after settlement with seine nets in seagrass and algal beds. Artificial seagrass beds are also used as settlement substrates.

Using daily rings on earbones of juvenile whiting we know that larvae are already 3 to 4 months old when they reach the bay, and may have been spawned as far as 500 km away.

We now know that certain weather conditions will lead to an influx of larvae to the bay, and that tidal currents will deliver larvae to a few areas only, such as Swan Bay and Portarlington. As juveniles grow they migrate further into the bay. Computer modelling of current patterns has helped us to understand these processes.

Sampling of newly-settled snapper, *Pagrus auratus* and identification of preferred habitats in Port Phillip Bay - a pilot study.

Dr Greg Jenkins, Paul Hamer, Dirk Welsford; Marine & Freshwater Resources Institute and The University of Melbourne.

There is very limited knowledge of the early life history of snapper in Australia, particularly from the end of the larval stage to the end of the first year of life. The aim of this project is to develop procedures for sampling newly-settled snapper from a relatively small boat (ie. 8m.) and to obtain information on the habitat preferences of newly-settled snapper in Port Phillip Bay.

Growth and ageing in Rock Lobsters

Assoc. Prof. David L. Macmillan in collaboration with Victorian and Tasmanian Fisheries. Funded by The Fisheries Industry Research & Development Corporation. Collaborating staff at The University of Melbourne - Tobi Stuart; Mark Thomas; Shaun Sandow.

Most of us associate a feed of cray with celebrations and special occasions. So does the rest of the world, although they call it lobster, and they are willing to pay a lot for it. The Rock Lobster fishery has developed into a multi-million dollar industry for Australia so it is important for us to use the best possible practices to manage such an important fish stock.

One vital piece in the fisheries management jigsaw is the age of the animals. If you want to be sure that adult animals have a chance to breed a few times before they are harvested you have to be able to tell how old they are. Size is not a good indicator of age or maturity in lobsters any more than it is in humans. In some populations, such as those in southern Tasmania, the animals grow slowly and are quite small when mature. In others, such as those around King Island, the animals grow much faster and are much larger at maturity. Our research is testing a method that might be able to tell us how old a lobster is from markings on the outside of the animal.

The work is based on an idea proposed by the late Michael Laverack, formerly a Professional Fellow at The University of Melbourne. He surmised that parts of the nervous system might grow at the same rate irrespective of the size of the animal. Because lobsters shed their shells as they grow, we can obtain a permanent record of their growth by collecting the moult cases. By using a scanning electron microscope, we can make out the history of many of the animal's sense organs on the outside of these moult cases. We are collecting moult cases from a large number of animals we have been holding for over a year at Queenscliff and also at the University in Parkville. We are documenting the growth of a group of sense organs called Cuticular Articulated Pegs (CAPS for short) that are found in the joints of the legs.

Our results so far show a clear correspondence between the number of CAPS and the age of the animals. It is still too early to tell whether this will prove useful to the fishery in the long term because quite a number of morphological features correlate in this way in young animals. The test will really come when we see whether the relationship holds as the animals approach maturity.

PhD Research Projects

Factors affecting intertidal macroalgal recruitment

Alecia Bellgrove, Monash University.

In the life cycle of an alga, as with many marine organisms, there are essentially three stages: the *established plants*, which release their *dispersive propagules* into the water, which are transported in the oceans currents for a period, before *recruiting* to available substrata on which they then grow and establish themselves. Although the importance of recruitment processes to the structure and dynamics of marine communities has recently been recognised, this research has largely focused on invertebrates and fish. There remain very few studies on algal recruitment, and no field studies of the very early microscopic stages.

My research has involved examining the temporal and spatial variation in intertidal macroalgal recruitment at Cheviot Beach, an exposed rock platform on the Mornington Peninsula. Additionally, I have been examining the impact of various crustacean and molluscan herbivores on the recruitment of intertidal macroalgae, involving both field and laboratory experiments.

The use of marine algae as indicators of effluent toxicity and coastal eutrophication

Stuart Campbell, Department of Biological Sciences, Victoria University of Technology.

Marine macroalgae and seagrasses stabilise near shore marine habitats and are important nursery, feeding and breeding grounds for many species of marine fish and invertebrates. These communities are susceptible to pollution events and may be constantly exposed to effluents discharged from sewage outfalls and urban runoff. Marine effluents vary substantially in their concentration and constituents and may contain a range of nutrients and potential toxicants.

Nutrients in marine effluents may affect marine algae in nearshore marine ecosystems (e.g. Port Phillip Bay) by promoting growth of opportunistic species which outcompete other more established plants (e.g. seagrasses, kelps) for light and nutrients. This may lead to the process of eutrophication where enhanced productivity of algal species results in an increase in biological oxygen demand as organic material decays. Depletion of oxygen may then lead to reduced species diversity in nearshore marine environments with negative impacts on the ecology of local fisheries.

Toxicants in marine effluents can reduce recruitment, growth and productivity of marine plant populations and may lead to the decline of some species of macroalgae (e.g. kelps) which are important structural components of high energy coastal ecosystems. This also has important implications for local fisheries.

At Victoria University we are examining the responses of marine macroalgae to a range of potential toxicants including sewage effluents, oil and oil dispersants. This work has involved studying the effects of toxicants on the reproductive life cycle stages (e.g. germination, germ tube growth) of dominant brown macroalgae of southern Australia. Work has also been undertaken on the occurrence of macroalgal blooms in Port Phillip Bay and their responses to the physiochemical parameters light, temperature and nutrients.

The sublethal effects of oil spill remediation techniques on Australian Bass

Macquaria novemaculeata

Adam Cohen, Royal Melbourne Institute of Technology.

This project will examine the chronic effects of oil spill remediation techniques on Australian Bass *Macquaria novemaculeata*. Behavioural and physiological impacts will be examined as a measurement of chronic effects. The project will also investigate how the

different remediation techniques affect oil partitioning, by analysing hydrocarbons in the water column and food web and concluding which groups of hydrocarbons are available for direct uptake and which may be bioaccumulated.

A temperate marine ecosystem will be mimicked, by taking into consideration physico-chemical factors and population dynamics. These factors will be incorporated into the project, so that unnatural stress is kept to a minimum. Realistic exposure concentrations will be utilised and the physical and chemical parameters which are present in an oil spill situation will be taken into account.

Project significance : there has been minimal research conducted on Australian crude oils and the combined effect of the different remediation techniques on native species. This project is significant because it involves an investigation of Bass Strait crude and the effects dispersant, burning and natural recovery procedures have on the toxicity to native species. This project relates closely to a temperate marine ecosystem and takes into consideration the pollutants effect on species behaviour and physiology, making this project ecologically relevant and a significant contribution to ecotoxicology.

Ecotoxicological effects of oil spill countermeasures on Australian marine organisms

Ismail Gulec, Department of Applied Biology & Biotechnology, Royal Melbourne Institute of Technology.

Crude oils are very complex mixtures and their composition varies widely. However, they can be divided into three groups of compounds, namely: light-weight components, medium-weight components and heavy-weight components. The physical and biological characteristics of those components vary, such as water solubility, evaporation, bioaccumulation and their acute and chronic toxicity. The acute and chronic toxicity of crude oil also varies between exposed species and can be affected by the life stage (egg, larva, juvenile, adult), habitat and food availability.

The ecotoxicological effects of crude oil on those marine organisms inhabiting Australian waters have not been examined to any significant extent. Extensive studies of toxic effects of crude oil have been conducted on marine organisms overseas. However, such information is not always applicable for Australian marine environments.

The object of this project is to investigate the ecotoxicity of crude oil, oil dispersants, dispersed oil and burned oil residue on Australian marine organisms (amphipod *Allorchestes compressa*, sand snail *Polinices conicus*, Octopus *Octopus pallidus* and Fish *Atherinosoma microstoma*) by employing both acute and chronic toxicity bioassays. A second objective of the project will be to determine the most suitable marine organisms for use in oil spill bioassays and to develop appropriate toxicity test protocols using these organisms.

A study of intertidal meiofauna of Victorian mangroves

Janet Gwyther, Deakin University.

“Meiofauna” encompasses organisms between 0.063-0.500 mm in length, which are too small to be easily seen with the naked eye, and yet do not fall within the scope of microbiological studies. The meiofauna live in the spaces between sediment particles at densities in the order of a million organisms per square meter; they have been comparatively neglected even on a global scale, but particularly so in the little-known temperate mangrove ecosystem.

The initial stage of the study is aimed towards 1) developing methodology, and 2) investigating the distribution and taxonomic composition of the intertidal meiofaunal

community in the Barwon estuary, and in acquiring sufficient data to predict assemblages characterising particular physico-chemical environments. Development of an integrated identification package is underway, which will include drawings, photomicrographs, habitat notes and sample processing details for the taxa collected from the study site. Preliminary observations suggest that species assemblages from different physico-chemical habitats (eg from bare mud-flats compared with from sediment bound by mangrove roots and shaded by canopy) may reveal particular morphological adaptations of organisms.

Preliminary tasks are assessment and development of optimum quantitative techniques for sampling the meiofauna, separating the animals from sediment particles and elutriating them from interstitial spaces, followed by suitable staining, photomicrographic and scale-drawing methods.

The two initial experiments are: 1) sampling strategy: the optimum core size to minimise variance between replicates will be investigated. 2) efficiency of extraction: the relationship between flow rate, flow time and particle size of sediment with the efficiency of meiofaunal extraction will be calculated.

The potential use of meiofauna as an ecological tool in monitoring the state of the benthic environment is topical at present. I am interested in the potential of using meiofauna as a benthic monitoring tool in deep-sea habitats where macrobenthic samples are difficult and expensive to obtain. Examination of benthic samples, and photomicrographs of the organisms from 40-70 metres of water in Bass Strait has commenced, and provided interesting assemblages of organisms, several taxa of which may be presently undescribed.

Larval ecology of the eleven-armed seastar, *Coscinasterias calamaria*

Nimal Karunajeewa, The University of Melbourne.

The eleven-armed seastar, *Coscinasterias calamaria*, is an abundant predator of molluscs in southern Australian waters. It feeds primarily on mussels, abalone, and scallops. This seastar has been reported to occur in large aggregations in Port Phillip Bay in recent years. The origin of these aggregations and the role of recruitment in their formation, is unclear. *C. calamaria* reproduces via a planktonic larva that feeds on naturally occurring particles such as phytoplankton - these larvae require food in order to complete development. If the amount of food available to larvae is variable, this might affect the number of larvae surviving to settlement, and therefore influence later recruitment to the adult population.

This study aims to investigate the effects of variation in food supply on growth and development of larvae of *C. calamaria* by rearing larvae under controlled conditions and varying the nutritional status of the larval cultures (e.g. adding nutrients or phytoplankton to some treatments). This approach is also being used to assess the contributions of various potential sources of larval nutrition such as dissolved organic matter, bacteria, and detritus.

Biological indicators of exposure of crude oil and dispersants in *Octopus pallidus*

Sarah Long, Royal Melbourne Institute of Technology.

The aim of the project is to investigate molecular bioindicators of exposure of *Octopus pallidus* to Bass Strait crude oil and an oil/dispersant combination.

Octopus pallidus is a native Australian marine organism, relatively abundant along the south-eastern coast of Australia. It is territorial in nature; therefore it is a good species bioindicator of water quality from the area where it is caught. It is easily caught alive in large numbers in Port Phillip Bay using inexpensive, easily made traps.

The expression of stress proteins and the induction of hepatic cytochrome P450 mixed function oxidase (MFO) enzyme mRNA will be measured as bioindicators of pollutant

exposure.

Stress proteins exert a protective effect in cells in response to xenobiotics. They ensure the correct assemblage and subsequent release of nascent proteins and facilitate the removal of damaged (and therefore biologically inactive) proteins from the cells.

Hepatic MFO enzymes are the first part of a detoxication mechanism. Prior to induction of the cytochrome P450 protein there will be an increase of mRNA for the isozyme; therefore, measuring the induction of mRNA will allow early detection of the response to contaminant exposure.

The second part of my project will be to look at developmental changes as a result of exposure of egg-bearing females to the pollutants. I will investigate whether the exposure of the mother causes demasculinisation and feminisation of males and defeminisation and masculinisation of females, through detection of sex-specific proteins, and developmental changes of the next generation of octopus.

There have not been many studies investigating the ecotoxicological effects of crude oil and oil spill remedial actions on Australian marine organisms. Such information is necessary when an oil spill occurs and decisions required as to the best remediation action to be taken.

Temperate reef biodiversity

Chris Porter, Deakin University.

The purpose of this assessment is to assess how effective marine protected areas (mpas) in Victoria have been in achieving their conservation objectives. Biological diversity, impacts of use and user awareness of and compliance with regulations are the principle performance indicators used in this assessment.

A major case study of Pt. Lonsdale Marine Reserve, one of Victoria's first mpas, is near completion. A major case study of Victoria's newest mpa, Bunurong Marine Park is intended. The performance of these mpas will be compared with what is known about the performance of mpas in New Zealand and Queensland; places which have applied two very different strategies for marine protection (no-take marine reserves, multiple use parks, respectively). The results will be used to formulate a strategy for mpa establishment and management in Victoria.

Distribution and population structure of the bottlenose dolphin *Tursiops truncatus* in Port Phillip Bay, Victoria

Carol Scarpaci, Department of Environmental Management, Victoria University of Technology.

The behaviour, ecology and vocalizations of bottlenose dolphins, *Tursiops truncatus*, were studied in Port Phillip Bay, Australia. Sightings of bottlenose dolphins were significantly greater during the summer months of December to February towards the mouth of the bay, which was the most common area inhabited by the dolphins. Calves were first observed in December and were seen throughout the summer. Vocalizations were greatest during social behaviour and increased in the presence of swimmers. Future studies on the vocal production and whistle variability in the bottlenose dolphins in Port Phillip Bay for potential associations in their behaviour will be undertaken. The study aims at better understanding the function of the signature whistle in free ranging bottlenose dolphins by monitoring sound production simultaneously with behavioural analysis. The study also aims to assess the possibility of defining individuals in this population of dolphins by their signature whistle.

PTHrP in lower vertebrates

Melanie Trivett, The University of Melbourne.

In the late 1980's, a protein with homology to PTH was discovered, cloned and named

parathyroid hormone-related protein (PTHrP). It was isolated from tumour cells and in certain types of malignancy it elevates plasma calcium levels by its actions on bone and kidney, via the PTH receptor. PTHrP has also been found in non malignant tissues, such as skin, kidney and ovary where it is likely to have paracrine actions. In normal adult mammals, circulating levels of PTHrP are undetectable. In the marine teleost, *Sparus aurata*, (sea bream) and in the dogfish, *Scylliorhinus canicula*, PTHrP has been found in high circulating levels, and has widespread tissue distribution.

The aim of my project has been to elucidate physiological roles for PTHrP in sharks and to gain insight into its evolutionary history. Immunohistochemistry and *in situ* hybridisation have shown that PTHrP is present in a range of elasmobranchs in a number of tissues, such as gills, skeleton, rectal gland, skin and kidney. The results indicate that there is high homology between the PTHrP found in mammals and fish and that it may have fundamental physiological roles among all vertebrates. With captive gummy sharks held at Queenscliff, manipulations of water salinity and temperature will be conducted to examine what environmental factors may affect circulating PTHrP in these animals, and if correlations between PTHrP and plasma electrolyte levels exist. Histological analysis will be used to see if tissue distribution of PTHrP is altered by different ambient water conditions.

Ecology of a temperate reef fish

Melissa Wheatley, Monash University.

Unlike many fields of marine ecology, where most effort has been concentrated in temperate waters, our knowledge of the processes structuring reef fish communities comes mainly from tropical environments. The factors establishing and changing temperate reef fish communities are of fundamental importance and it is not yet possible to say whether recruitment or post-recruitment processes are more important.

The first aim of this project is to collect data on the distribution and abundance of reef fish species from 3-4 sites on a monthly basis for approximately 12-18 months. Patterns identified from this baseline sampling will lead to the generation of hypotheses of the processes structuring reef fish communities. These hypotheses will form the basis of manipulative experiments which will be conducted in the second and third years of the project. Experiments could include the manipulation of algal cover utilising artificial reefs and light traps and plankton tows to link the abundance of larval fish with settled juveniles. This project will provide an accurate record of the natural variation in distribution, abundance and recruitment of reef fish in Port Phillip Bay, which is essential for use as a baseline in monitoring the effects of human impact.

Masters Project Studies

Validation of in vitro biomarkers for environmental pollution

Daphne Cheah, Royal Melbourne Institute of Technology.

My Masters project aims to develop a reliable in vitro test system for monitoring industrial effluents. It uses cultured sand flathead liver cells which are exposed in vitro to model test compounds and industrial effluents. Biomarkers are then assessed and include: (a) biochemical parameters, such as activities of enzymes which metabolise compounds and increase in response to exposure from particular compounds, i.e. cytochrome P450 activity; and (b) cytotoxicity, measured by the leakage of a cellular enzyme constituent into the culture media, as an indicator of the direct toxic effect of compounds on the cultured cells.

Honours Research Projects

The effects of copper on feeding and survival of the marine gastropod *Haliotis rubra* (Leach, 1914)

Michael Brown, Victoria University of Technology

A study which investigates feeding, growth and mortality of the black lipped abalone *Haliotis rubra* under chronic exposure to copper contamination. This study determined that abalone exposed to copper exhibited a 7 day LC50 concentration of 100 µg Cu⁺⁺ L⁻¹, and sub-lethal stress (with regard to feeding and growth) at concentrations of 32 µg Cu⁺⁺ L⁻¹. The sub-lethal stress was determined using an integrated feeding and energy budget methodology. The results showed that copper can significantly reduce the capacity for growth of individual abalone through a decrease in energy uptake (feeding), and an associated increase in physiological output due to copper exposure.

Shell repair and the pattern of shell deposition in the abalone, *Haliotis rubra*

Katie Gleeson, The University of Melbourne.

Boring organisms such as polychaetes (*Polydora* spp.) and sponges (*Cliona* spp.) are commonly found on abalone shells in many parts of the world. The damage caused by these organisms interferes with the interpretation of growth lines which are used in ageing studies of abalone. Ageing abalone is important to improve the knowledge of abalone fishery, particularly age structure within populations.

Shells were drilled in particular places on the shell, near the spire and at the growing edge. Abalone were stained with manganese chloride which is incorporated into the shell during growth and which fluoresces under a cathodoluminescent microscope. Two sections from each shell were analysed to determine the pattern of repair, deposition rates and the spatial extent of repair. These sections were then compared to sections of shells with natural boring damage to determine whether growth rates differ.

Systematics, introduced status and food selection of *Euchone* (Polychaeta: Sabellidae) in Victorian waters

Matthew McArthur, Victoria University of Technology.

During 1996, I carried out work from the Queenscliff Marine Station for my honours project. The aims of my project were to determine the taxonomic status of the specimens of *Euchone* recently found in large numbers in Port Phillip Bay. I also undertook to determine whether or not these species are to be considered as introductions and what the *Euchone* utilises as food.

The influences of habitat depth and habitat complexity on fish assemblages associated with the seagrasses *Heterozostera tasmanica* and *Zostera muelleri* in

Swan Bay, Victoria.

Thor Saunders, The University of Melbourne.

Habitat complexity has often been suggested as a major factor in structuring seagrass related fish assemblages. This is thought to be a result of high complexity habitat providing more shelter for fish against predators. *Heterozostera tasmanica* and *Zostera muelleri* are two species of seagrass in Swan Bay that differ both in habitat complexity and the depth of habitat they are associated with. Artificial seagrass of constant habitat complexity was used to investigate which of these factors was more important in structuring seagrass associated fish communities. Differences found in fish communities associated with artificial seagrass at different depths, suggested that depth of habitat was the more important of these two factors. This may be related to higher food abundances being associated with deeper waters.



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