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The Victorian Marine Science Consortium is a collaborative venture between:



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Front cover – Isopod *Cymodoce gaimardii*, on the oral arm of a blue blubber *Catostylus mosaicus*, Port Phillip Bay, Victoria. Photo by Joanna Browne, PhD candidate, Griffith University / Museum Victoria

Back cover – Sea jelly, *Pseudorhiza haeckeli*, with juvenile mosaic leatherjacket, *Eubalichthys mosaicus* inside, Port Phillip Bay, Victoria. Photo by Jessica Smith, Master of Science student, the University of Melbourne

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## INTRODUCTION & BACKGROUND

In 1989 four major marine research and teaching agencies in Victoria established the Queenscliff Marine Station to provide a facility dedicated to marine research and tertiary education in south-eastern Australia.

Foundation partners were the universities of Melbourne, Monash and RMIT, along with the statutory body of the Victorian Institute of Marine Sciences (VIMS). In 1992 Deakin and Victoria universities joined the organisation, and in 1996 VIMS became part of the Victorian Government's marine research institute. Two years later the VIMS Act was repealed. The Marine and Freshwater Fisheries Research Institute (MAFFRI) is now the State Government partner (formerly Primary Industries Research Victoria up until December 2007).

In early 2004, after fifteen years, the *Queenscliff Marine Station* was relaunched as the *Victorian Marine Science Consortium (VMSC)*.

VMSC operates by pooling resources and working collaboratively. It embodies an active research community from a range of institutions, facilitating relevant and sustainable research to effectively manage Victoria's coastline.

Queenscliff is at the tip of the Bellarine Peninsula where Port Phillip Bay meets Bass Strait. It is an area offering a diverse range of marine habitats, from high-energy ocean beaches to low-energy sheltered beaches, rocky intertidal platforms and sub-tidal reefs, estuaries, mud flats, seagrass meadows, mangroves, salt marshes, and bay and shelf waters. It is a geographical area offering a unique combination for marine research and teaching.

Visiting researchers and educators have easy access to field locations with boats available for general work or diving.

Researchers at VMSC have strong links to other state and federal marine agencies together with interstate universities. A wide range of grants from national competitive funds, state sources and private sector contracts supports research. The major current research areas are fisheries biology and ecology, environmental biology, ecotoxicology, and animal physiology.

VMSC is used by all partners for undergraduate courses in marine science at all levels. Some courses are taught collaboratively between members of the consortium.

The original facility was small and best suited for field-based studies. The construction of an ecotoxicology laboratory in 1994 resulted in a remarkable increase in the range of research conducted, and in the overall general use of the facility. In November 2004, VMSC relocated to the new DPI Queenscliff Centre, and now shares a state-of-the-art marine research facility with its state government partner, MAFFRI.

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## DIRECTOR'S REPORT



I am pleased to present the 2009 VMSC Director's Report.

During 2009 a total of 289 undergraduate students attended field courses in marine zoology, ecology, biology, botany, marine and

coastal ecosystems and ocean engineering at Queenscliff.

Postgraduate research projects included twenty-six PhD's, two Masters by Research and nine Honours projects. Three PhD theses were submitted during the year.

The winner of the 2009 VMSC Postgraduate Award was Isla Fitridge, PhD candidate from the University of Melbourne. Isla is investigating the hydroid communities of Port Phillip Bay and her thesis will be the first documented assessment of the species in the area. The Management Committee initiated this award in 2004 to offer support and encouragement to young scientists conducting their research projects at Queenscliff. The award was presented by the Minister for Environment, Climate Change and Innovation, The Hon. Gavin Jennings MLC, as part of the Victorian Coastal Awards.

VMSC also extends its support to young scientists through the Australian Marine Sciences Association (AMSA) by awarding a prize for best presentation on temperate marine science at AMSA annual conferences. The 2009 winner was Jo Banks, PhD candidate from the University of Melbourne for her presentation titled - *From sink to source: how changing oxygen conditions can remobilise heavy metals from contaminated sediments.*

VMSC further broadens its support to our potential young scientists in co-hosting *The Siemens Science Experience*. The program is jointly coordinated by the Marine Discovery Centre (MDC) and offers 3 days of inspiring hands-on scientific activities. The program is conducted by VMSC postgraduate students and researchers, together with MDC education officers. This hugely popular program is promptly booked out by enthusiastic Year 9 students wishing to gain an insight into the world of marine science.

VMSC and MDC again coordinated the training and assessment of 23 undergraduate students in obtaining their *Certificate 111*

*Tourism (Guiding)*. Together, VMSC and MDC subsidise this training program which is offered to undergraduate students from VMSC member universities. Part of the course content is streamlined and takes into account prior learning received by the students at VMSC through their home institutes in marine ecology, biology or marine botany. The certificate is a nationally recognised accreditation endorsed by the William Angliss Institute of TAFE.

Our past and current postgraduate students have, and will continue to contribute significantly to our knowledge and better management of the temperate marine environs in south-eastern Australia.

My thanks to VMSC staff – Liz McGrath and Rod Watson – for the enthusiastic and comprehensive administrative and technical support they provide to the postgraduate students, researchers and academic staff at Queenscliff.

Thank you to each member of the VMSC Management Committee; your continual support, cooperation and input into VMSC operations is appreciated, and reflected in the steady stream of PhD graduates and enthusiastic undergraduates who pass through VMSC each year.

**Professor Michael J Keough**  
**Director**

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## MANAGEMENT COMMITTEE

A management committee comprising representatives from each institute governs VMSC.

A Director is elected from the management committee to provide academic leadership, oversee and maintain quality scientific practices and organisational standards, and manage general operations at Queenscliff. Professor Michael J. Keough of the University of Melbourne is the nominated Director of VMSC up until February 2011.

### CSIRO

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Dr David C Smith

Centre for Marine and Atmospheric Research

### Deakin University

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Associate Professor Geoffrey Wescott

School of Life and Environmental Sciences

### EPA Victoria

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Dr Anthony Boxshall

Marine Sciences

Ms Dianne Rose (January-June)

### Monash University

---

Professor John Beardall

School of Biological Sciences

### Department of Primary Industries

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Mr Jon Presser

Marine & Freshwater Fisheries Research Institute

### RMIT University

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Professor Dayanthi Nugegoda

School of Applied Sciences

### The University of Melbourne

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Professor Michael J. Keough

Department of Zoology

### Victoria University

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Dr Carol Scarpaci

Faculty of Health Engineering and Science

### Staff

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Elizabeth McGrath

Administrative Officer

Rod Watson BAppSc (Deakin)

Technical Officer

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## RESEARCH VESSELS AND FIELD TRIPS

VMSC's *Pelagia* carried out the majority of boat work assignments in Swan Bay, Port Phillip and Westernport Bays throughout 2009. The punt was used in Port Phillip and Western Port Bays, the Barwon River and Lake Connewarre, and inland waters of Victoria.

To help offset fuel and maintenance costs, a nominal fee is charged to consortium members for vessel use. Users are charged at the following rates :

*Pelagia* : students and researchers \$15 and \$30 per engine running hour, respectively. Night use is charged at \$20 (students) and \$40 (researchers).

The punt is charged at a flat daily rate of \$5 to students, and \$50 to researchers. An additional overnight charge of \$25.00 is charged to researchers over continuous days use.

\$2935.00 was recovered from vessel users in 2009.

Field trips and activities relating to the following projects were conducted from the two vessels:

- Reef fish ecology – Port Phillip Bay
- Introduced species – Port Phillip Bay
- Flathead physiology – West Channel Entrance
- Fish-seagrass associations – Swan Bay, Grassy Point, Blairgowrie
- Meiofauna ecology – Barwon River and Lake Connewarre
- Fish ageing – Port Phillip Bay
- Plankton tows – Port Phillip Bay
- Collection of material for laboratory work
- Reef fish larval collection – Port Phillip Bay
- Asterias collection – Port Phillip Bay
- Acoustic tagging – Swan Bay and Port Phillip Bay
- Fish recruitment in marine parks (MPA's)
- Echinoderm breeding strategies – Port Phillip Heads
- Undergraduate field excursions – Port Phillip Bay, Swan Bay, Barwon Heads, Barwon River
- Stingaree physiology – Swan Bay
- Parasite ecology and sea-jellies - Port Phillip Bay
- Elasmobranch physiology and stress - Swan Bay and Port Phillip Bay
- Ecology of Hulafish, a reef fish - Port Phillip Bay

- Introduced algae ecology - Swan Bay
- Dumpling squid collection - Port Phillip Bay
- Gannet foraging - Pope's Eye
- Dolphin movement - Port Phillip Bay

### DIVING

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During 2009, 80 dives were logged. The majority of dives were shallow, in less than 10 metres.

Dives involved research into:

- Fish-seagrass associations
- Various species collection for ecotoxicology and undergraduate classes
- Introduced species collection
- Reef fish ecology
- Photography
- Fish 'attracters' placement
- Hydroid settlement plates
- Temperature loggers
- Artificial seagrass units placement
- Acoustic tagging
- Dumpling squid collection
- Chlorophyll logger placement

Undergraduate snorkelling trips were conducted during some field courses. Classes involved reef assemblages, modular organisms, fish diversity and fouling organisms.

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## RESOURCES AND FACILITIES

VMSC is located at the DPI Queenscliff Centre, together with the state government marine research platform and the Marine Discovery Centre.

This outstanding facility allows access to the following infrastructure available to all VMSC users:

### TEACHING

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- A conference room equipped with the latest in audio visual and video conferencing; accommodates up to 50
- A General/Teaching lab with bench space for 45 students. Ambient seawater on-tap

### RESEARCH

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- Bench space is available in the general/teaching lab
- An ecotoxicology lab with bench-top aquaria individually serviced with compressed air, ambient and temperature controlled seawater
- Separate bench space is also available
- Separate preparation and washrooms are adjacent to the ecotoxicology lab
- A controlled temperature room supplied with ambient seawater and compressed air
- An aquarium equipped with dissecting table, 6 double-tiered and 4 single aquarium stands. Ambient and temperature controlled seawater, freshwater, and compressed air supplied to each stand
- Storage area for dive gear

### VESSELS

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- *Pelagia* – VMSC's 6.5-metre, purpose-built research vessel
- A 4.2-metre punt
- Various other small craft are available for use

### OTHER

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- A comprehensive range of scientific equipment available for use
- Office space for visiting researchers and postgraduate students
- Computing and web access
- Access to the comprehensive collection and resources of the MAFFRI Information Centre is available to all researchers and postgraduate students

### ACCOMMODATION

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- Accommodation for visiting researchers can be arranged at the University of Melbourne research residence in Ocean Grove. Bookings are essential and can be organised through the Zoology Department at the University of Melbourne, or through VMSC
- A range of accommodation options are available in Queenscliff and Point Lonsdale and listed on the VMSC website

## COURSES, USE AND OTHER INITIATIVES

2009	Institute	Course	U/Grads
7-14 February	University of Melbourne	Marine zoology	37
19-21 February	University of Melbourne	Experimental marine ecology	23
23-27 February	Monash University	Marine biology	24
3-5 April	RMIT University	Marine biology	22
7 September	MAFFRI	Aquaculture workshop	20
14 October	Victoria University	Ocean engineering	34
19-21 October	Deakin University	Marine and coastal ecosystems	55
21-23 October	Deakin University	Marine and coastal ecosystems	55
7-13 December	University of Melbourne	Marine botany	19
			<b>289</b>
<i>Other users</i>			<i>Other</i>
20-22 January	Year 9 students	The Siemens SCIENCE Experience	24
23 March	Marine Discovery Centre	Lab session	25
2 April	Marine Discovery Centre	Lab session	16
22 – 24 April	University of Tokyo	Professor Susumu Hyodo	
23 April	Marine Discovery Centre	Lab sessions x 2	50
9 – 17 May	University of Tokyo	Professor Susumu Hyodo	
29 June – 2 July	University of Tokyo	Professor Susumu Hyodo	
22 – 24 September	University of Tokyo	Professor Susumu Hyodo	
8 November	General	Public Open Day – whole of site	
7-13 December	Undergraduates	Certificate 111 Tourism (Guiding)	23

Undergraduate field courses were held during February, April, October and December. These ranged from two days to two weeks and were attended by 289 undergraduate students.

A public open day was held in November in conjunction with MAFFRI and the Marine Discovery Centre with over 1,000 attending. VMSC research projects were showcased by postgraduate students and academic researchers.

### The Siemens SCIENCE Experience

VMSC and the Marine Discovery Centre jointly hosted the Siemens SCIENCE Experience at Queenscliff for the second consecutive year. The program is designed for Year 9 students who are keen to pursue further studies and a career in science. Hands-on activities and presentations held on a tertiary campus, give students a glimpse into university life and learning. Thirty-six universities Australia-wide participate in the 3 day program. In 2009, twenty-three students enrolled for the marine science program at Queenscliff.

Scientists and postgraduate students representing each VMSC member university were involved in presenting a stimulating and informative range of activities and experiments to those in attendance.

### Certificate 111 Tourism (Guiding)

In 2009, 23 participants enrolled for the Certificate 111 Tourism (Guiding) course. Undergraduates from member universities who have undertaken study at VMSC in marine ecology, biology or marine botany, are eligible for the 'fast-track' training with course content streamlined in recognition of prior learning. The cost is subsidised through VMSC. Training and accreditation is provided by the William Angliss Institute – a leading provider of tourism training in Australia.

The course covers a wide range of basic theory in ecotourism communications, introductory tourism, ecotourism marketing, eco-tour guiding, plant and animal identification, and outdoor recreation skills.

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## STUDENT AWARDS

### VMSC POSTGRADUATE AWARD

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The VMSC Management Committee offer support and encouragement to young scientists by awarding a stipend each year. The committee desires to encourage research that will lead to increases in scientific knowledge of Port Phillip Bay and surrounding coastlines and habitats. Students based at Queenscliff in the early stages of their degree, are eligible to apply.

The recipient of the 2009 VMSC Postgraduate Award was **Isla Fitridge**, PhD candidate at the University of Melbourne. The award was presented by the Minister for Environment, Climate Change and Innovation, The Hon. Gavin Jennings MLC, as part of the Victorian Coastal Awards for Excellence ceremony held in April.

Isla's project *Seasonality, seduction and foul play : the hydroid fauna of Port Phillip Bay*, aims to study how the hydroid communities of Port Phillip Bay are composed, and how these communities change temporally and spatially with regards to larval recruitment and the presence, absence, growth and fertility of adult colonies. The study also examines hydroids as fouling species within local mussel culture operations, and the positive and negative role that non-indigenous hydroid species may play within farms in the bay. Isla's thesis will be the first documented assessment of the region's hydroid fauna, present in many marine communities and habitats throughout the world. Project supervisors are Professor Mick Keough and Dr Jan Watson.



Prior to commencing her PhD, Isla completed an Honours degree at Edinburgh's Heriot Watt University, before moving to Australia with her Australian husband-to-be. After a stint of volunteering and paid work at Charles Sturt University, Isla worked as a marine ecologist with the National Institute of Water and Atmospheric Research (NIWA) in New Zealand for 7 years. While working at NIWA, Isla developed a fascination with fouling communities on man-made structures; she then realised it was time to begin her own research and moved back to Australia to commence a PhD in July 2007.

### VMSC / AMSA AWARD

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Jo Banks, PhD candidate from the University of Melbourne received the VMSC sponsored prize at the 2009 Australian Marine Sciences Association (AMSA) Conference held in Adelaide in July. Jo's presentation titled - *From sink to source: how changing oxygen conditions can remobilise heavy metals from contaminated sediments* was judged best presentation on temperate marine science.

### ASFB BEST STUDENT PAPER 2009

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Jodie Kemp from the University of Melbourne received the Australian Society for Fish Biology (ASFB) *Best Student paper* in 2009. The announcement was made at the 8th Indo Pacific Fish Conference and the Australian Society for Fish Biology 2009 Conference held in Fremantle, Western Australia in June. Jodie submitted a research paper titled - *Otolith shape and chemistry to distinguish cod species (Genus Pseudophycis) in the diet of Australian fur seals*. The award will enable Jodie to attend the 4th International Otolith Symposium in Monterey California USA in August 2009. She will also give the plenary presentation at the 2010 ASFB Conference to be held in Melbourne.

Jodie is undertaking her PhD entitled - *Population and trophic dynamics of red cod (Pseudophycis bachus)*. The project is jointly supervised through the University of Melbourne, Arthur Rylah Institute (DSE), Phillip Island Nature Park and Fisheries Victoria.

A range of other awards and funds granted to VMSC postgraduates included:

**Emi Ab Rahim** – PhD candidate, Deakin University

- VMSC Postgraduate Award 2009 - Certificate of Commendation

**Joanna Browne** - PhD candidate, Griffith University

- Systematic Research Fund financial grant for the project: Browne J.G., Cribb T.H. and Pitt K.A. Life-cycles and spatial variation of digenean parasites of the upside-down jellyfish *Cassiopea* sp

**Madhavi Colton** – PhD candidate, the University of Melbourne

- 2009 Gilbert Whitley Award (ASFB 2009)

**Isla Fitridge** - PhD candidate, the University of Melbourne

- University of Melbourne Drummond Award

- Melbourne Abroad Travelling Scholarship
- Holsworth Wildlife Research Endowment research grant
- FRDC Best Oral Presentation (AMSA2009)
- VMSC Postgraduate Award 2009

**Corey Green** – PhD candidate, University of Tasmania

- AFMA Best Poster (AMSA2009)

**Jacques Monk** – PhD candidate, Deakin University

- Travel grant to attend AMSA2009

**Amanda Peucker** – PhD candidate, Deakin University

- Travel grant to attend AMSA2009

**Ruben Lee Roennfeldt** - PhD candidate, Deakin University

- John Glover Travel Fund - ASFB 2009

**Athol Whitten** - PhD candidate, the University of Melbourne

- John Glover Travel Fund - ASFB 2009

**Joel Williams** - PhD candidate, the University of Melbourne

- John Glover Travel Fund - ASFB 2009

## RESEARCH

Numerous projects involving environmental biology, fisheries biology and ecology, ecotoxicology, aquaculture, marine botany, ornithology, introduced species and animal physiology were undertaken throughout the year. Project funding was derived from national competitive funds, state sources and private sector contracts. The following researchers, postgraduate students and their supervisors were actively involved at Queenscliff during 2009 (see project abstracts commencing on page 11).

### ACADEMIC RESEARCHERS / SUPERVISORS

#### **Deakin University**

Dr John Arnould  
 Dr John Donald  
 Dr Janet Gwyther  
 A/Prof. Laurie Laurenson  
 Dr Paul Lewandowski  
 Professor Gerry P Quinn  
 Dr Craig Sherman  
 Dr Giovanni Turchini  
 Dr Tes Toop  
 A/Prof. Geoff Wescott  
 Dr Michael Weston

#### **RMIT University**

Dr Andreas Lopata  
 Dr Jackie Myers  
 Professor Dayanthi Nugegoda  
 Dr Jeff Shimeta  
 Dr Sylvia Urban

#### **The University of Melbourne**

Dr Jan Carey  
 Dr Rob Day  
 Professor Michael Keough  
 Dr Devi Stuart-Fox  
 Professor Marilyn Renfree  
 A/Prof. Stephen Swearer  
 Dr Jan Watson

#### **Victoria University**

Dr Carol Scarpaci  
 Dr Xiao Su

#### **Monash University**

Professor John Beardall  
 Dr Richard Reina  
 Dr Bob Wong

#### **CSIRO**

Dr David Smith

#### **DPI Fisheries**

Dr Matias Braccini  
 Mr Simon Conron  
 Dr Patrick Coutin  
 Dr Jeremy Hindell  
 Dr Brett Ingram  
 Dr Greg Jenkins  
 Dr Greg Parry  
 Mr Terry Walker

#### **Australian Institute of Marine Science**

Ms Susan Codi King

#### **Flinders University**

Dr Charlie Huveneers

#### **Griffith University**

Dr Rod Connolly  
 Dr Kylie Pitt

#### **Museum Victoria**

Dr Mark Norman

#### **Parks Victoria**

Dr Anthony Boxshall

#### **University of Tasmania**

Dr George Jackson

#### **University of Tokyo**

Professor Susumu Hyodo

#### **University of Waikato**

Professor Kerry Black

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## POSTGRADUATE RESEARCH PROJECTS

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### Deakin University

#### PhD candidates

Emi S Ab Rahim  
Justin Bell  
Daniel Grixti  
David Phillips  
Tania Pyk  
Fabian Trinnie  
Meagan Underwood

#### Honours

Tim Kenner  
Amanda Pettersen

### The University of Melbourne

#### PhD candidates

Rachael Bathgate  
Isla Fitridge  
John Ford  
Christian Jung  
Jodie Kemp  
Malcolm Lindsay  
Peter Macreadie  
Matthew Reardon  
Michael Sams  
Tim Smith  
Zoe Squires  
Joel Williams

#### Honours

Lauren Dagley

#### Masters

Carlie Alexander  
Jessica Smith

### Monash University

#### PhD candidate

Lorenz Frick  
Benjamin Wegener

#### Honours

Jay Van Rijn

### RMIT University

#### PhD candidate

Daniel Dias  
Kathryn Hassell  
Lisa Toogood

#### Honours

Justin Cutajar  
Graham Van der Steen  
Stewart Dick  
(Summer Scholar)

### Victoria University

#### PhD candidate

Hints Mateos

#### Honours

Zac Lewis

### Other

#### Flinders University

Matthew Heard (Honours)

#### Griffith University

Joanna Browne (PhD candidate)

#### University of Tasmania

Corey Green (PhD candidate)

#### University of Waikato

Malte Stuecker (PhD candidate)

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# RESEARCH ABSTRACTS

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## STAFF RESEARCH

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### **Osmoregulation in elephant fish, *Callorhynchus millii* (Holocephali)**

**Professor Susumu Hyodo<sup>1</sup>, Dr A. Kawakoshi<sup>1</sup>, Mr Justin Bell<sup>2</sup>, Dr John A. Donald<sup>2</sup>, Professor Y. Takei<sup>1</sup> and Dr Tes Toop<sup>2</sup>**

University of Tokyo, Ocean Research Institute<sup>1</sup> / Deakin University, School of Biological and Chemical Sciences<sup>2</sup>

Osmoregulatory mechanisms in holocephalan fishes are unknown except that they conduct urea-based osmoregulation as in elasmobranchs. We therefore examined changes in plasma parameters of elephant fish, *Callorhynchus millii*, after gradual transfer to concentrated (120%) or diluted (80%) seawater (SW). In control fish, plasma Na and urea concentrations were about 300mM and 450mM, respectively. These values were equivalent to those of sharks and rays, but the plasma urea concentration of elephant fish was considerably higher than that reported for chimaeras, another holocephalan. After transfer to 120% SW, the plasma Na concentration markedly increased, while a conspicuous decrease in plasma urea concentration was observed following transfer to 80% SW. In elephant fish, we could not find a discrete rectal gland. Instead, approximately 10 tubular structures were located in the wall of post-valvular intestine. Each tubular structure was composed of a putative salt-secreting component consisting of a single-layered columnar epithelium, which was stained with anti-Na<sup>+</sup>,K<sup>+</sup>-ATPase serum. It is most likely that the tubular structures in the posterior intestine represent a primitive form of the rectal gland in elephant fish. In addition, we have identified two C-type natriuretic peptides (CNP) from the heart and brain of elephant fish, which may contribute to the control of NaCl excretion from the rectal gland of elephant fish as it does in elasmobranchs.

### **The importance of edge effects in determining the value of seagrass landscapes as fish nurseries**

**Dr Greg P. Jenkins, Dr Jeremy Hindell, Dr Rod Connolly**

The University of Melbourne / MAFFRI / Griffith University

Seagrasses are a conspicuous element of Australian marine environments and are crucial in the conservation and maintenance of biodiversity. Degradation of seagrass ecosystems from climatic extremes, increased sediment and nutrients in the water, and other pollutants results in loss and fragmentation of meadows. These changes to seagrass are linked with increased coastal erosion, severe loss of biodiversity, and collapse of fisheries. Increased understanding of how biological processes such as predation and food availability influence animal associations with seagrasses and how these effects change with landscape structure, will have important applications in the sustainable management of Australia's threatened coastal habitats.

### **A health risk assessment for cyanobacterial toxins in seafood from the Gippsland Lakes**

**Dr Jackie Myers**

RMIT University / Department of Health / Department of Primary Industries

The project addressed the Department of Health's need for examination of the recent knowledge on nodularin toxicity, accumulation and depuration in both field and laboratory situations, with specific reference to assessing uptake and depuration of nodularin in seafood species. Specifically this project assessed the uptake and depuration of nodularin into Black bream, *Acanthopagrus butcheri*, and Eastern King prawns, *Melicertus plebejus*, using pure nodularin compound. Results suggested that at the low, environmentally relevant exposure concentrations utilised, black bream and eastern king prawns accumulated very little or no nodularin toxin into the body tissues (liver/viscera and muscle). In this study, what little nodularin uptake occurred was observed in the liver/viscera, which is consistent with reports in the international literature. Results of this work along with that published in the wider literature were incorporated into a health risk assessment to provide acceptable residue levels for cyanobacterial toxins in seafood, in the event of a bloom.

### **Aquatic Ecotoxicology and Environmental Biology at RMIT University**

**Professor Dayanthi Nugegoda and Dr Jeff Shimeta**

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RMIT University, School of Applied Sciences

The Ecotoxicology and Environmental Biology research group at RMIT University has been an integral part of the Victorian Marine Science Consortium since its establishment in 1990. It is currently led by Professor Dayanthi Nugegoda and Dr Jeff Shimeta of the School of Applied Sciences with a number of Honours, postgraduate and postdoctoral researchers based at VMSC. The ecotoxicology component includes a number of research projects evaluating the effects of toxicants and environmental stressors on native aquatic organisms with special emphasis on biomarkers of exposure to toxicants and developing new methods of assessing risk to biodiversity. The marine ecology and environmental science component investigates coastal processes involving invertebrates, microbes, and marsh plants, focusing on environmental issues.

In 2009, the research group consisted of three postdoctoral fellows, six PhD, one Masters and two Honours students. One postdoctoral fellow is from Germany on a German research fellowship and one an APDI funded through the ARC Linkage Scheme. The group operates out of the VMSC laboratories, a research laboratory on the RMIT Bundoora campus with an adjacent aquatic facility and an aquatic lab at the RMIT centre on Bullock Island in East Gippsland.

Marine ecotoxicology projects within the group include a study on the effects of environmental stressors on black bream (PhD Kathryn Hassell) in collaboration with the EPA, DPI and the Australian Institute of Marine Sciences (AIMS); assessing the tolerance of Antarctic and sub-Antarctic invertebrates to metal contaminants (Post Doctoral Fellow Dr Ben Kefford) in collaboration with the Australian Antarctic Division; risk assessment from cyanobacterial toxins in seafood from the Gippsland Lakes (post doctoral researcher Dr Jackie Myers based at DPI) funded by the Department of Health, and bioaccumulation of toxicants in little penguins in collaboration with Victoria University and Parks Victoria. For further details on ecotoxicology research activities contact [dayanthi.nugegoda@rmit.edu.au](mailto:dayanthi.nugegoda@rmit.edu.au).

Marine ecology projects currently in progress include the consequences of ocean acidification for molluscan shellfish biology; larval settlement of invertebrates and their interaction with protozoa in marine biofilms; and impacts of the invasive salt marsh grass, *Spartina anglica*, on infaunal communities in Victoria. For further details contact [jeff.shimeta@rmit.edu.au](mailto:jeff.shimeta@rmit.edu.au).

## **Ecology and Environmental Management at Victoria University**

### **Dr Carol Scarpaci**

Victoria University, School of Engineering and Sciences

The Ecology and Environmental Management research group at Victoria University has expanded their research on anthropogenic impacts on marine megafauna. The marine research team at Victoria University is currently led by Dr Carol Scarpaci and encompasses collaborative work with academics from within Australia (eg Port Stephens Fisheries Institute), and overseas (Massey University, New Zealand). The research team includes both Honours and postgraduate students. The current research projects evaluate the impact that tourism exerts on marine animals (primarily bottlenose dolphins, common dolphins, Australian fur seals and grey nurse sharks), and trace metal uploads in little penguins in Victoria. The research team has also evaluated the impact that the recreational pipi harvest exerts on pipi stock structure. Research publications on these topics have been well accepted in the peer reviewed literature and feature in both international and national journals. Research projects have been funded by a range of research bodies and grant schemes that include, Birds Australia, Earthwatch, Holsworth Wildlife Research Endowment, Department of Primary Industries and DolphinCom. For further details on ecotoxicology research activities contact please contact [Carol.Scarpaci@vu.edu.au](mailto:Carol.Scarpaci@vu.edu.au).

## **Marine ecology and evolutionary biology at Deakin University**

### **Dr Craig Sherman**

Deakin University, Centre for Integrative Ecology, School of Life and Environmental Sciences

In 2009, my research group carried out project work based at the VMSC labs in Queenscliff. This work involved an Honours student and myself and included investigations into understanding the importance of genetic compatibility in determining fertilization success in a number of marine invertebrates, the effect of mating system on population genetic structure, and the effect of thermal tolerance on reproductive success. The Honours project investigated the effects of different dietary microalgae on survival, growth, settlement and fatty acid composition of blue mussel, *Mytilus galloprovincialis*, larvae. While substantial research has been dedicated to determining the most cost-effective and optimal

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feed for mussels in aquaculture hatcheries, the specific dietary requirements for larvae through development remain unclear. The objective of the study was to optimise algal multispecies diets for larvae of the blue mussel, *Mytilus galloprovincialis*, with particular focus on reducing the use of *C. calcitrans*. Results showed that the micro-algae composition of the diet is crucial to the viability and fitness of the larvae and that mussel larvae will preferentially consume certain algal species. The subsequent results were accepted for publication in the international journal *Aquaculture*.

### **Ecology of aquatic protozoans, including their roles in biofilms and settlement of invertebrate larvae**

**Dr Jeff Shimeta**

RMIT University, School of Applied Sciences

Protozoans such as flagellates and ciliates play key roles in aquatic food webs by consuming microbes, recycling nutrients, and serving as prey for invertebrates. We are studying several aspects of protozoan species assemblages, distributions, activities, and interactions with environmental factors and other species in aquatic habitats. A current focus is on protozoa in microbial biofilms, and their interactions with settling larvae of invertebrates. Most marine invertebrates have a free-swimming larval stage that selects a suitable substratum site on which to settle and metamorphose into the adult form. Interactions between larvae and microbial biofilms on substrata are important for determining invertebrate recruitment and adult distributions. We are investigating the roles of protozoa in microbial biofilms and their influences on settlement rates and survival of marine invertebrates, focusing on fouling species (e.g. tube worms, bryozoans, mussels, etc.) that colonise hard substrata including rocks, boat hulls, and marine infrastructure. We are also investigating new technologies for anti-fouling coatings on marine infrastructure that will inhibit larval settlement.

### **Impacts of ocean acidification on marine invertebrates**

**Dr Jeff Shimeta**

RMIT University, School of Applied Sciences

Anthropogenic, atmospheric CO<sub>2</sub> is being absorbed into the oceans where it forms carbonic acid, reducing the pH of seawater as well as the dissolved carbonate available to marine organisms that manufacture calcium carbonate

skeletons (corals, shellfish, plankton, etc.). Detrimental impacts of ocean acidification have already been documented in tropical coral reefs, and there is great concern that major areas of the oceans will become corrosive in the near decades. We are investigating the impacts of reduced pH and elevated temperature on molluscan shellfishes of commercial importance (e.g. abalone, oysters, scallops, mussels). Using controlled laboratory experiments with manipulated CO<sub>2</sub> levels and temperature in aquaria, we are measuring threshold levels of acidification that disrupt various aspects of shellfish biology.

### **Impacts and control of the invasive saltmarsh grass, *Spartina anglica*, in Australia**

**Dr Jeff Shimeta**

RMIT University, School of Applied Sciences

*Spartina*, known commonly as rice grass or cord grass, was introduced to Australia intentionally to stabilise estuarine sediments, but its extensive spread is altering intertidal habitats and native ecosystems across Victoria and Tasmania. Large-scale control programs are underway to spray these habitats with herbicides, but little research has been done on the specific impacts of *Spartina* in Australia or the environmental consequences of herbicide application. We are investigating the ecological changes in sedimentary communities associated with *Spartina* invasion, and we will begin ecotoxicology studies on herbicide impacts. This research will improve our understanding of invasive species dynamics and will help to inform local management decisions.

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## **PhD**

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### **Blue mussel: utilisation of genetics approach for breeding and population studies**

**Emi Sherizan Ab Rahim**

Deakin University / MAFFRI

Supervisors – Dr John Donald / Dr Brett Ingram

Blue mussel, *Mytilus galloprovincialis*, is one of Victoria's most important aquaculture industries. In 2006/07 blue mussel production was 3,116 tonnes (valued at \$8.4 mil.) nationally, which represented 16% of total mollusc production. Research has been conducted on the blue mussel across many biological disciplines, however in the area of blue mussel hatchery

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breeding there is currently a paucity of knowledge. This study describes a genetics approach to assist blue mussels breeding program by improving the growth rate, health and quality of blue mussel in a hatchery based system using genetic markers to assist the breeding strategy with the aim to produce a superior strain of seedstock. In November 2008, mussels collected from different locations across Victoria were spawned to produce a genetically diverse founder population for the breeding program. Published and new EST derived SSR molecular markers will be used to assess blue mussel genetic diversity across Australia and parentage assignment test to trace parents which had passed down the desirable traits to the offspring in the breeding program. A preliminary study of genetic diversity suggests there is moderately low genetic variation in eleven populations in Australia. Populations from Spring Bay and Port Arthur in Tasmania and Port Lincoln and Wallaroo in Southern Australia appear to have less variation between the individuals sampled compared to populations from Victoria, New South Wales and Western Australia. However, this analysis was based on 25 samples, with 2 to 3 individuals per population using only 6 SSR molecular markers. Thus, more markers and samples are essential to obtain more precise outcomes.

### **Connectivity of intertidal gastropod populations in a system of marine protected areas**

**Rachael Bathgate**

The University of Melbourne, Department of Zoology

Supervisors - Professor Michael J. Keough and Dr Steven Swearer

My project focuses on gastropod assemblages found on intertidal rocky reefs in marine protected areas (MPAs) in Victoria. The overarching objective of my PhD research has been to determine how the recently proclaimed Marine National Parks and Marine Sanctuaries may act as larval sources or sinks for gastropods with different larval dispersal potentials. One of the ways that highly protected MPAs may help to conserve biological diversity is by protecting and enhancing resident spawning stocks. An increase in the size and number of reproductive individuals may result in increased production of gametes or larvae than then disperse to other areas or are retained locally. For most species of marine gastropods, the extent and direction of larval dispersal, and degree of connectivity between

local populations are unknown. The creation of a system of MPAs in Victoria (Marine National Parks and Marine Sanctuaries) provides a unique opportunity to investigate these processes in a local context. I am combining biological data (e.g. abundance of adults, recruits, reproductive output, larval duration and abundance) and physical measures (e.g. wind direction, current direction and speed) to see if populations within MPAs are likely to be self-replenishing and the extent to which they act as recruitment sources or sinks.

I have completed the field work component of my project and am focusing on finishing laboratory tasks such as plankton sorting, dissection of specimens for gonad indices and analysing egg masses. I have also undertaken a genetic study to determine the extent of population differentiation in 3 gastropod species having short, long or no larval dispersal.

### **Age, growth and reproduction of southern Australian holocephalans (*Rhinochimaera*, *Chimaera* and *Hydrolagus spp.*) and the white-fin swell shark (*Cephaloscyllium spp.*)**

**Justin D Bell**

Deakin University, School of Ecology and Environment / MAFFRI

Supervisors - Dr Laurie Laurenson / Mr Terry Walker

Holocephalans are an ancient lineage of cartilaginous fishes (chondrichthyans) closely related to elasmobranchs (sharks, skates and rays). Holocephalans typically inhabit waters beyond the continental shelf and in consequence have received little scientific research, despite being a regular commercial catch. Similarly, the white-fin swell shark (*Cephaloscyllium spp. A*) is one of the most commonly caught bycatch species in Australia however has received no biological research.

My PhD research aims to gain biological information relating to age and growth, diet, reproductive biology and fishery interactions of all southern Australian holocephalan species and the white-fin swell shark, thus providing a basis for sustainable management.

### **Biodiversity of gelatinous zooplankton and their symbionts in eastern Australia**

**Joanna Browne**

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Griffith University / Museum of Victoria  
Supervisors – Dr Kylie Pitt / Dr Mark Norman

My project involves the study of parasites of gelatinous zooplankton. Jellyfish are increasingly being recognised as an important part of the marine ecosystem. In regions around the world jellyfish are increasing in abundance and frequency of occurrence, however, their parasites are poorly studied. One part of my project is investigating the relationships between parasitic hyperiid amphipods, isopods and the blue blubber (*Catostylus mosaicus*) in Port Phillip Bay. I am studying temporal variation in abundances of the parasites, whether they are also found on other hosts in the Bay and will use stable isotopes to determine whether they feed directly on the blue blubber.

The other part of my project is studying digenean flukes (Platyhelminthes) parasitic on the upside-down jellyfish *Cassiopea* spp. I am studying the spatial variation of the flukes in Queensland, in *Cassiopea* as well as other jellyfish and comb jellies and have recently returned from collection trips on reefs off Townsville, Cairns and Lizard Island. Jellyfish act as intermediate hosts for the digeneans and this relationship has not been studied before in Australia. Using DNA analysis I will attempt to link the larval digeneans found in the jellyfish with the adult form found in vertebrates (most likely fish).

### **Natural product studies of terrestrial and marine organisms**

#### **Daniel Dias**

RMIT University, School of Applied Sciences  
Supervisor – Dr Sylvia Urban

The history of natural products in relation to current medicinal agents is well recognised in drug discovery ventures. Natural products offer a diverse array of unique structures, which simply cannot be matched through even the most active imaginations of organic synthetic chemists. An untapped source is the marine environment which has resulted in “lead compounds” that have successfully passed through the arduous, drug discovery process (Phase I, II and III clinical trials) and resulted in the successful manufacture and commercialisation of synthetic analogues for treatment of disease and illness.

The Marine and Terrestrial Natural Product Research Group (MATNAP) at RMIT endeavours to identify biologically active secondary metabolites from both marine and terrestrial sources. The identification of novel bioactive active secondary metabolites could lead to the

development of new therapeutic agents. My research project investigates novel biologically active compounds derived from Australian marine and terrestrial sources for the purposes of drug discovery and/or agrochemical applications (eg. herbicides and/or pesticides).

This research involves collaborations with various institutes: the Victorian Institute for Chemical Sciences (VICS); Professor Ann Lawrie (RMIT Bundoora); Associate Professor Jonathan White (The University of Melbourne); Dr Jonathan Burton (University of Cambridge, UK). Some marine collections have been made by the Victorian Marine Science Consortium (VMSC) at Queenscliff and Dr Brian Leonard (ex-RMIT, Bundoora) during the period of my candidature.

### **Seasonality, seduction and foul play: the hydroid fauna of Port Phillip Bay**

#### **Isla Fitridge**

The University of Melbourne, Department of Zoology

Supervisors – Professor Michael J Keough and Dr Jan Watson

Hydroids are an important and frequently abundant component of marine sessile communities associated with natural and artificial habitats. Many non-indigenous hydroids are known to exhibit 'invasive' behaviour and have the potential for economic impacts through extensive fouling of piles, pontoons, aquaculture facilities and vessel hulls. Unfortunately, they are often overlooked in ecological studies. My PhD research documents how the hydroid communities of Port Phillip Bay are composed and how these communities change temporally and spatially with regards to larval recruitment and the presence, absence, growth and fertility of adult colonies. The study also examines hydroids as fouling species within local mussel culture operations, and the positive and negative role that non-indigenous hydroid species may play within farms in Port Phillip Bay.

In 2009 I completed much of my fieldwork including monitoring of hydroid larval recruitment and adult populations at several sites around the bay, a study into the timing of recruitment of mussel and hydroid larvae at two mussel farms, and an experiment looking at the recruitment dynamics of mussel larvae onto morphologically distinct hydroid 'mimics'. I presented my research at two conferences: the 16th International Conference on Aquatic Invasive Species (Montreal, Canada) and the Australian Marine Sciences Association annual conference

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(Adelaide). In Adelaide I was awarded the Fisheries Research & Development Corporation Award for best oral presentation. Other awards in 2009 included a University of Melbourne Drummond Award, a Melbourne Abroad Travelling Scholarship, a Holsworth Wildlife Research Endowment research grant and the VMSC Postgraduate of the Year Award.

### **Meta population dynamics in temperate reef fish**

**John Ford**

The University of Melbourne, Department of Zoology

Supervisor – Dr Stephen E Swearer

I commenced my candidature in late 2008 and am involved in a project identifying rocky reef habitats of high conservation value in Port Phillip Bay, Victoria. Principally I am investigating connectivity of reef fish populations, their productivity and the role of artificial reefs in increasing more persistent and biodiverse assemblages.

To understand productivity, I intend to survey population size, fish condition and fecundity in our target species the Southern Hulafish, *Trachinops caudimaculatus*, in numerous location around Port Phillip Bay. Like many reef fish this species has larvae which spend up to two months developing in the open waters of the Bay. To identify where these larvae go, and the level of exchange between different reefs, I will use natural elemental markers (otolith microchemistry) to trace the origin of newly settled fish. With knowledge of dispersal pathways and connectivity, I can identify important source populations, which are crucial to the survival of less productive populations. This will better enable managers to target productive source habitat of high conservation value.

My current experiments in the summer of 2008/09 involve the use of artificial reefs deployed off Altona in the northwest and Carrum in the east of Port Phillip Bay. I am investigating the factors driving mortality in juvenile *T. caudimaculatus* by manipulating reef size, reef location and density of fish on artificial reefs. Through this I hope to determine to what degree habitat size and quality, location of that habitat in a larger matrix, and fish density are determining either population persistence or extinction in *T. caudimaculatus*.

### **Capture-related stress physiology and post-release survival of sharks**

**Lorenz Frick**

Monash University, School of Biological Sciences / MAFFRI

Supervisors – Dr Richard Reina and Mr Terry Walker

Only a few shark species are targeted by commercial fisheries in Australia, but many more are caught as by-catch, and subsequently discarded dead or alive. The fate of sharks released alive is an essential factor for the assessment of the impact of fisheries on shark populations, but is so far completely unknown.

A few studies have addressed the effects of capture on sharks caught in the wild. However, an unambiguous interpretation of results obtained in the wild can be difficult, because many factors, such as water temperature or dissolved oxygen, affect exercise-related physiological processes. To avoid these uncertainties, fisheries capture in this study is simulated in a controlled setting with captive sharks.

The primary aim of this study is to establish reference curves of physiological parameters relevant to the sharks' stress reaction in the lab, demonstrating the change of these parameters over time. Sharks are subjected to various durations of capture stress exposure using longline, gill-nets and trawling.

Aside from providing insight into a poorly understood aspect of elasmobranch biology, the results will help increase the accuracy and power of large scale tagging studies by providing information on a so far unknown, but important factor influencing the probability of recapture of an animal. Data on the post-capture fate of sharks will refine mathematical fisheries management models, and being able to account for the effect of initial capture will benefit other studies that interact with animals in the wild.

### **Temporal and spatial population structure of arrow squid, *Nototodarus gouldi*, off south-eastern Australia**

**Corey Green**

University of Tasmania / MAFFRI / CSIRO

Supervisors – Prof Natalie Moltschanivskyj / Dr. Patti Virtue / Dr George Jackson / Mr Terry Walker / Dr David Smith

My research revolves around studying population dynamics of the arrow squid *Nototodarus gouldi* from southern Australia. The project focuses on the use of squid statoliths which are paired calcareous structures found in the cranium. From a fisheries management perspective, statoliths are considered valuable and routinely used in acquiring biological and population based

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parameters. Statoliths are like an aeroplanes 'black box', capable of recording and storing information over time. They can be prepared to reveal daily growth increments, and may be capable in providing life history information. I aim to correlate spatial and temporal parameters with environmental and oceanographic processes; to compare the biological catch of two squid fishing methods, jig and trawl; to study ontogenetic migration characteristics using chemical signatures of statoliths and to use statolith shape to discriminate between spatially separated stocks.

At the recent AMSA conference (Adelaide 2009), I received the AFMA poster award for my poster entitled 'Stock discrimination of arrow squid, *Nototodarus gouldi*, using Fourier shape analysis'. I was successfully able to discriminate between squid stocks from the Great Australian Bight and Victoria; which may impact future management decisions. I also travelled to Vigo (Spain) in September 2009, where I attended the Cephalopod International Advisory Council Symposium, and presented my stock discrimination work orally. I also had a poster on 'Temporal and spatial variation in elemental composition of arrow squid statoliths'. I am currently writing up and due to submit in October 2010.

### **Estimating and improving the survival of recreationally caught and released fish**

**Daniel Grixti**

Deakin University / MAFFRI

Supervisors – Professor Gerry Quinn / Mr Simon Conron

Legal minimum length (LML) and daily bag limit (DBL) are widely used management tools for recreational fisheries. The use of a LML and DBL is based on the presumption that released fish survive. If survival rates after capture and release are low then the total kill in the fishery will be under-estimated and the value of management measures will be compromised. Snapper, *Pagrus auratus* and black bream, *Acanthopagrus butcheri*, are two principal target species in Victorian marine and estuarine recreational fisheries and both are managed by LML and DBL. The National Recreational and Indigenous Fishing Survey (NRIFS) (Henry and Lyle 2003) reported that 401,000 snapper and 840,000 black bream were caught and released by anglers fishing in Victorian waters in 2000/01.

My PhD is investigating the survival of recreationally caught snapper and black bream

after their release to the water. Experiments are based on capture and holding methods commonly used in this type of research. I am also exploring ways of improving this release survival through hook and angling technique changes. A post mortem procedure has been developed to enhance outcomes of this released fish survival research.

My project is part of the National Released Fish Survival program initiated by Fisheries Research and Development Corporation (FRDC). FRDC and Fisheries Victoria have jointly funded this research.

### **Effects of environmental stressors on black bream, *Acanthopagrus butcheri***

**Kathryn Hassell**

RMIT University / MAFFRI / AIMS

Supervisors – Professor Dayanthi Nugegoda / Dr Patrick Coutin / Ms Susan Codi King

2008 marked the end of my field sampling and laboratory work from black bream field sites around Victoria. I completed writing my thesis in early 2009, and look forward to commencing a post-doctoral fellowship at Melbourne University under the supervision of Dr Steve Swearer and Dr Vin Pettigrove, investigating endocrine disruption in estuarine fishes.

During 2009, I was fortunate to have the opportunity to go and work at the Institute for the Environment, Brunel University in London, to learn specific experimental techniques relevant to my post-doctoral research. I was involved in laboratory studies where adult fathead minnows were exposed to treated sewage effluents to determine if there were compounds present in the effluents that could adversely affect reproductive output. I was also involved in a study with three-spined sticklebacks to determine the effects of exposure to either an estrogenic compound (octylphenol) or an androgenic compound (dihydrotestosterone) on early life stage survival, gonad differentiation and reproductive development.

Thesis submitted : March 2009.

### **Anthropogenic effects on the fish fauna in Port Phillip Bay, Victoria**

**Christian Jung**

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The University of Melbourne, Department of Zoology

Supervisors – Dr Stephen E. Swearer and Professor Michael J Keough

My PhD studies, involve working on anthropogenic effects on the fish fauna in Port Phillip. Studies assessing the spatial and temporal variation of ichthyo-assemblages on shallow rocky reefs around the Bay are concluded. Studies assessing whether any evidence for impact of boating and angling on fish communities can be found, will be concluded by the end of 2008. Simultaneously I am analysing whether those impacts, or 'natural' habitat features seem to be of more importance in shaping the fish communities in the areas I survey. To assess the angling and boating activity I am using time lapse photography. This enables me to gather direct empirical data of those disturbances.

Of all the anthropogenic impacts, I am particularly interested in noise pollution. Contrary to popular belief, the underwater world is a noisy environment. Fishes utilise sound as a source of information about their immediate surroundings and actively communicate via sound. Yet growing input of sound from anthropogenic sources, i.e. noise pollution from boats, ships etc., threatens to mask natural sound signals or otherwise disturb the reef fish communities. I am currently compiling a 'soundscape' of Port Phillip, recording and analysing sound, both natural and anthropogenic. Experiments around the effect of such noise pollution are under way and will continue until mid 2009.

Finally my studies entail a sociological component. I am conducting qualitative interviews with long time bay divers and anglers, about their perception of changes in and around the waters of Port Phillip. I plan to complete my PhD studies by the end of 2009.

### **Population and trophic dynamics of red cod, *Pseudophycis bachus***

**Jodie Kemp**

The University of Melbourne, Department of Zoology

Supervisors - Dr Stephen E. Swearer and Dr Greg P. Jenkins

Otolith shape is often used to facilitate the identification of teleost prey species in marine diet studies. However, fine-scale variation in otolith shape among different species, and the added effect of partial digestion of otoliths, can often limit the ability to identify prey species. The objective

of this research was to evaluate the potential use of 1) fine-scale shape differences using Fourier shape analysis and 2) microchemical differences using laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS), in digested otoliths to identify fish prey species within the diet of predators. Belonging to the family Moridae, red cod, *Pseudophycis bachus*, and bearded rock cod, *Pseudophycis barbata*, are found in the shelf waters of south-eastern Australia and New Zealand. *Pseudophycis* species are important to a range of predators including the Australian fur seal, *Arctcephalus pusillus doriferus* at Phillip Island Australia. Both techniques revealed that the abundance of red cod is higher in the diet of the seals relative to bearded rock cod. The use of otolith shape analysis techniques to identify prey species where otoliths have fine-scale shape differences were found to be effective, however, should be used with caution as the effects of digestive processes can be significant. The use of core-region otolith microchemistry as a method to distinguish prey species was also found to be effective, and shows potential to provide a means to establish more direct links between predators and the geographical source of their prey.

### **Larval recruitment patterns in Victoria's marine reserves**

**Malcolm Lindsay**

The University of Melbourne, Department of Zoology / Parks Victoria

Supervisors - Dr Stephen E Swearer, Professor Michael J. Keough / Dr Anthony Boxshall

Worldwide, marine reserves are being widely advocated as a tool for the conservation and management of biodiversity and fisheries. The successful siting and management of a marine reserve is dependent on the biological processes of the species involved. Of these processes, larval dispersal and recruitment is critical yet difficult to manage due to knowledge gaps and logistical difficulties. My project aims to investigate the recruitment patterns of different taxa at a number of Victoria's marine reserves. I will achieve this through quantifying both the oceanographic and recruitment conditions within and around the marine reserves. Oceanographic data collected using Acoustic Doppler Current Profilers (ADCP) and temperature loggers will be matched to weather conditions to look for commonly occurring oceanographic patterns. This will then be linked to recruitment data, gathered from different larval collectors, to model links between the oceanographic and recruitment patterns. Different areas within and around the

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reserves can then be given dispersive indices, which directly relate to management goals. For example, highly dispersive sites allow spillover to unprotected areas, while low dispersive sites allow self-recruitment and population persistence. Through the linkage of this project with Parks Victoria, Victoria's reserve management body, the results will directly aid the management of the current reserves and the siting of any in the future.

### **Fish responses to seagrass habitat fragmentation**

**Peter Macreadie**

The University of Melbourne, Department of Zoology / MAFFRI

Supervisors – Professor Michael J. Keough / Dr Greg Jenkins and Dr Jeremy Hindell

Understanding the consequences of habitat fragmentation has come mostly from comparisons of patchy and continuous habitats. Because fragmentation is a process, it is most accurately studied by actively fragmenting large patches into multiple smaller patches. I fragmented artificial seagrass habitats and evaluated the impacts of fragmentation on fish abundance and species richness over time (1 day, 1 week, 1 month). Fish assemblages were compared among 4 treatments: control (single, continuous 9 m<sup>2</sup> patches); fragmented (single, continuous 9 m<sup>2</sup> patches fragmented to 4 discrete 1 m<sup>2</sup> patches); prefragmented/patchy (4 discrete 1 m<sup>2</sup> patches with the same arrangement as fragmented); and disturbance control (fragmented then immediately restored to continuous 9 m<sup>2</sup> patches). Patchy seagrass had lower species richness than actively fragmented seagrass (up to 39% fewer species after 1 week), but species richness in fragmented treatments was similar to controls. Total fish abundance did not vary among treatments and therefore was unaffected by fragmentation, patchiness, or disturbance caused during fragmentation. Patterns in species richness and abundance were consistent 1 day, 1 week, and 1 month after fragmentation. The expected decrease in fish abundance from reduced total seagrass area in fragmented and patchy seagrass appeared to be offset by greater fish density per unit area of seagrass. If fish prefer to live at edges, then the effects of seagrass habitat loss on fish abundance may have been offset by the increase (25%) in seagrass perimeter in fragmented and patchy treatments. Possibly there is some threshold of seagrass patch connectivity below which fish abundances cannot be maintained. The immediate responses of fish to

experimental habitat fragmentation provided insights beyond those possible from comparisons of continuous and historically patchy habitat.

I undertook a short-term postdoc from April to August 2009 at the University of North Carolina's Institute of Marine Science, on the effects of habitat patchiness on food web dynamics.

Thesis submitted – April 2009.

### **The effect of feed supplemented with Omega – 3 polyunsaturated fatty acids on cultured abalone**

**Hints Mateos**

Victoria University, School of Biomedical and Health Sciences / Deakin University, School of Medicine

Supervisors – Dr Xiao Su / Dr Paul Lewandowski

Abalone is a rich source of omega -3 long chain polyunsaturated fatty acids (n -3 LC PUFA). There is an increasing interest in these fatty acids because studies have shown that they can reduce the risk of cardiovascular disease as well as a range of other disorders.

Abalone is an important fishery in Australia and its production accounts for more than 50% of the global market. Currently the Australian wild abalone fishery earns about AU\$200 million each year. However, due to rapidly increasing demands from local and global markets, the wild fisheries are under strict and limited production quotas, and there is now growing investment and research interest in aquaculture production of abalone.

Previous studies showed that cultured abalone contained lower level of n-3 PUFA than wild abalone. The similar results have also been reported on fish. Therefore concern has been expressed in recent years worldwide that consumption of cultured marine species would not give the same nutritional value as the wild species.

The proposed research will investigate the effects of feed incorporated with fish oil on the lipid profiles of cultured adult hybrid abalone. The study also aims to examine the growth and development of cultured abalone fed by different concentrations of fish oil supplements. In addition this project will investigate the effects of replacement of fish oil with vegetable oils on the growth performance and lipid profiles of cultured abalone. Furthermore the effects of fish oil and vegetable oil supplementation on mRNA proteins associated with lipid metabolism in abalone will be investigated. The study will provide useful

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information for aquaculture and food industries as well as to nutrition and consumer groups.

### **Ecological risk assessment from the effects of fishing for batoids in south-eastern Australia**

#### **David Phillips**

Deakin University, School of Ecology and Environment / MAFFRI

Supervisors – Dr Janet Gwyther / Mr Terry Walker

Declines have been reported in chondrichthyan by-catch populations around the world. Chondrichthyan populations are particularly vulnerable to harvesting pressure because of the life history traits they exhibit, such as low fecundity, low natural mortality, delayed maturation and slow population growth. Most population analyses require large data sets collected over an extended period. In the case of many chondrichthyan species, management action is required long before such data sets can be available. Rapid assessment of ecological risk should be applied to chondrichthyan species to evaluate and rank on their need for immediate management and further research. Such assessments require information about the basic biology of species, such as age at maturity, average fecundity and maximum age. These variables can be used to rate species in their ability to withstand harvesting pressure.

This project aims to collect biological information about the basic biology for the purpose of ecological risk assessment for three species of large batoid chondrichthyans; southern eagle ray, *Myliobatis australis*, smooth stingray, *Dasyatis brevicaudata* and the black stingray, *Dasyatis thetidis*.

Animal movements are being studied with manual acoustic tracking, and 24 Vemco VR2 passive acoustic listening stations set up in Swan Bay (Port Phillip Heads Marine National Park), and off Queenscliff and St Leonards. Southern fiddler rays, *Trygonorrhina fasciata* and eastern shovelnose stingree, *Trygonoptera sp.* have been both manually tracked to study detailed habitat preference and movements. Passive monitoring has revealed broader differences in habitat preference, emigration rates and site fidelity. The degree of protection provided by the marine protected areas has been quantified. Smooth stingray and southern eagle ray are also to be tagged, tracked and monitored. The existing ecological risk assessment framework is being adapted to include these data.

### **Variation in individual quality of Australasian gannets, *Morus serrator* : implications for seabird conservation and management**

#### **Tanya Pyk**

Deakin University, School of Ecology and Environment

Supervisor – Dr Mike Weston

A series of recent long-term studies have indicated that only a few 'high quality' individuals within a population may contribute most to subsequent generations. Protecting these 'high quality' individuals is therefore of critical conservation importance in ensuring the long-term survival of a population. However, identifying these individuals and defining what distinguishes them has proven difficult due to technical limitations in studying the foraging behaviour and energetics of marine predators at sea. Recent developments in technology have enabled the creation of 'bio-loggers', small recording devices capable of collecting detailed information on the foraging behaviour and energy expenditure of marine predators at sea. Taking advantage of this recent advance in technology, this project is using multiple recording devices attached to free-ranging Australasian gannets breeding in Port Phillip Bay to measure the foraging performance and movements of individuals of differing parental quality. Therefore, this project will improve our ability to identify and protect those 'high quality' individuals within a population that will make a significant contribution to subsequent generations. Such information is of critical conservation importance, particularly for populations of threatened or endangered species.

The fieldwork for this study is being conducted at the colony of Australasian gannets, *Morus serrator*, established at Pope's Eye marine Reserve (38°16'42"S. 144°41'48"E.). This site is part of the Port Phillip Heads Marine National Park, located near the entrance to Port Phillip Bay, approximately 3km southeast of Queenscliff, Victoria. The colony was established in the mid 1980s and all suitable nesting space is now fully occupied, with approximately 200 pairs breeding annually.

### **Uterine accommodations for gestation and ecological risk assessment in the southern fiddler ray, *Trygonorrhina fasciata***

#### **Matthew Reardon**

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The University of Melbourne, Department of Zoology / MAFFRI / The University of Indiana Supervisors – Professor Marilyn Renfree / Mr Terry Walker / Dr W.C. Hamlett

The southern fiddler ray presents an interesting case study of myriad reproductive modes of chondrichthyans. My project is investigating what role the uterus plays in nutrient transfer, waste disposal and gas exchange during gestation, through histology, electron microscopy and analysis of uterine fluids. This will uncover what function the uterus performs at various stages of gestation by looking at cell morphology, and identifying any secretory activity and its composition. The southern fiddler ray is viviparous yet the embryos are contained in a substantial tertiary egg envelope similar in appearance and thickness to some egg-laying, or oviparous species. This species may represent a kind of transitory phase between viviparity and oviparity and will provide an interesting insight into the modifications of uterine function if this is the case.

This project is part of a larger project assessing the ecological risk of chondrichthyans affected by commercial and recreational fishing activities. By taking length and weight measurements and classifying the reproductive state of animals through the use of both validated and un-validated indices, we can construct models of the populations being studied to understand the relative risk each species faces from a particular fishing activity.

I will incorporate my reproductive studies as a means to validate assumptions of the stage of maturity, essential to the accuracy of these population models. This will determine if previously used indices are accurate for the southern fiddler ray.

### **The influence of variable recruitment on the structure and development of marine epifaunal communities**

**Michael Sams**

The University of Melbourne, Department of Zoology

Supervisor – Professor Michael J Keough

The presence of planktonic larval life stages in many marine animals creates great variability in the timing and location of recruitment. This variation in recruitment is considered to have important consequences for marine populations and communities. Whilst the sources of variation in recruitment and its consequences on populations have been relatively well studied in

many marine environments, the influence of variable recruitment on the structure and development of whole communities is poorly understood. I am adopting an experimental approach that examines how variation in recruitment influences the development and structure of local communities of sessile invertebrates (epifauna) at three sites in Port Phillip Bay, Australia.

Using artificial substrates, I am manipulating the recruitment patterns of common species of sessile invertebrates and following the subsequent development of communities. More specifically, I am examining a) how variation in initial recruitment of single species influence community structure; b) how different temporal patterns of recruitment influence community structure (including the influence of ongoing recruitment); and c) how variation in recruitment interacts with the properties of established communities (e.g. species diversity, structural complexity etc.) to influence changes in community structure. By separating out these various factors I hope to elucidate the complex ways that variation in the recruitment can influence marine community development.

### **The importance of edge effects in determining the value of seagrass landscapes as fish nurseries**

**Tim Smith**

The University of Melbourne, Department of Zoology / MAFFRI / Griffith University

Supervisors – Professor Michael J. Keough / Dr Greg P. Jenkins and Dr Jeremy Hindell / Dr Rod Connolly

Boundaries between adjacent habitats can create unique biotic and abiotic conditions, varying species compositions and abundances between the edge and interior of habitats. As habitats become fragmented, the relative amount of edge increases. Understanding the role that habitat edges have in determining species compositions and abundances is fundamental for conservation and management of habitats, particularly those under threat from fragmentation. Seagrass habitats are common nearshore habitats that harbour a rich and diverse faunal assemblage that are under threat worldwide from human disturbance. Human induced fragmentation, and the propensity of seagrass to form naturally patchy landscapes, makes it an ideal system to study the effects of edges on fauna.

Evidence of fish displaying edge effects in seagrass habitats is equivocal. Assessment of

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fish edge effects was done by sampling seven positions within seagrass habitats at fine spatial scales. Strong, consistent patterns in fish distributions demonstrated clear edge effects both within and alongside seagrass at these sites. The total number of fish sampled was greater at the seaward seagrass edge than the seagrass middle, but there was little difference between the seagrass middle and the shoreward seagrass edge. Four individual fish species showed preferences for the seagrass edges. Further investigation revealed that patch size could influence the magnitude of edge effects in seagrass beds. Fish were sampled in ten variously sized seagrass patches in three positions within each patch. Two species showed variations in edge effects across patches which could be attributed to the area of the patch. Changes in patch size can influence the magnitude of edge effects that species display, suggesting that patch area effects (fish density varying with patch size) could be caused by edge effects.

Food availability and predation are mechanisms commonly used to explain edge effect patterns. Gut analysis was done on *Stigmatopora nigra* sampled at the edge and middle of patches to determine if prey consumption varied between positions, and explain *S. nigra* distribution. There was little difference in prey consumed by *S. nigra* at the edge and middle of patches, suggesting that food was unlikely to be causing *S. nigra* edge effects, or that the influence of prey distribution was being masked by other factors such as seagrass structure. Predator abundances and foraging efficiency may vary at the edge and middle of patches, and consequently influence the distribution of prey fish within patches. Underwater videos were placed at four positions within seagrass habitats to assess predator distributions. Predatory Australian salmon, *Arripis* spp., spend more time over adjacent sand than other positions, while small potential prey species (King George whiting, *Sillaginodes punctata*, recruits) appear to prefer the middle of seagrass patches, possibly to avoid encounters with salmon. To test if the predator-prey distributions reflected actual predation pressure, a tethering experiment was done to determine if predation was causing edge effects in small fishes. King George whiting recruits and pipefish (*Stigmatopora* spp.) were tethered at each of the four positions at different depths. Survival time of whiting recruits was greater in the middle of shallow seagrass patches than other positions. Few pipefish were preyed upon, and survival time was lower over sand adjacent to seagrass than at

the seagrass edge or middle. Video footage revealed that salmon was the dominant predator of both whiting recruits and pipefish. The distribution of predators and associated predation can explain edge effects for some species (whiting) but other mechanisms, or a combination of mechanisms, are determining edge effects for other species (pipefish).

Edge effects were common amongst fish species in seagrass habitats, and included permanent, temporary and predatory species. Patch size was found to influence the extent of the edge effect. There was little evidence to support prey consumption as an underlying mechanism causing higher fish abundances at the interior or edge of patches, however there was evidence that predation could be causing edge effects. Changes in fish distributions within seagrass patches due to patch size and predation when seagrass undergoes fragmentation need to be considered by not only ecologists, but also by managers in the development of plans for seagrass conservation. Future studies should investigate the relative contribution of different edge characteristics in determining the degree of seagrass edge effects.

Thesis submitted – July 2009.

## **Assessing the costs and benefits of polyandry in a native squid**

### **Zoe Squires**

The University of Melbourne, Department of Zoology / Monash University / Museum Victoria  
Supervisors – Dr Devi Stuart-Fox / Dr Bob Wong / Dr Mark Norman

My research investigates why female dumpling squid, *Euprymna tasmanica*, a squid native to Port Phillip Bay and the southern coast of Australia, mate with multiple males (polyandry)? Cephalopods exhibit a diverse array of reproductive behaviours from sexual cannibalism to spermatophore implantation. They have the potential for very strong sexual selection to be occurring, with all species mating multiply, very long sperm longevities and intricate female sperm storage organs. Considering this potential, however, little is known about sexual selection in this group. In addition to this potential in cephalopods, investigating the benefits of polyandry is an important pursuit because of the implications it has for the maintenance of genetic variation, an important issue in evolutionary biology.

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## What drives recruitment variability in Snapper?

**Malte Stueker**

The University of Melbourne, Department of Zoology / MAFFRI / University of Waikato

Supervisors – Dr Terry Healy; Dr Greg Jenkins; Dr Stephen E Swearer / Professor Kerry Black

Understanding the causes of fluctuations in the recruitment of larvae in fish populations is an essential scientific need to make sustainable fisheries management possible. My objective is to integrate biological and physical data into a sophisticated modelling framework to investigate what underlying dynamic processes drive recruitment variation of snapper, a key fishery species in southern Australia. The model will blend representation of all important hydrodynamic processes with biological information on the early life stages of snapper. Location of the study will be Port Phillip Bay, an eminent area of juvenile recruitment. The information derived from this approach will be important to allow predictions of future trends in fishery recruitment. Measurement of climatic variables for short term predictions as well as long term climate change predictions will provide the necessary means for sustainable management strategies, with broad applicability to many socio-economically important fisheries.

## Sublethal effects of mercury and DDE on Australian black bream, *Acanthopagrus butcheri*

**Lisa Toogood**

RMIT University, Department of Biotechnology and Environmental Biology

Supervisors – Professor Dayanthi Nugegoda

Current age structures of *Acanthopagrus butcheri* within the Gippsland Lakes suggest that recruitment have been episodic since 1981 and low for three years in succession. There has been an absence or low abundance in commercial catches of the Gippsland Lakes black bream cohorts spawned in 1988, 1990 and 1991. This indicates poor spawning success and/or low survival of early life history stages of the fish spawned in these years. Toxicants can exert a direct effect on fish, which can range from death (where concentrations are high) to impaired reproduction and growth (as a result of chronic or intermittent exposures). Organochlorine pesticides (such as DDT and its derivatives) are known to have mild oestrogenic effects on fish, leading to reproductive impairment, however, scientific knowledge relating to the endocrine

disruptive properties of this pesticide are still developing. As mercury and DDT are present in the Gippsland Lakes, it is important to understand their physiological effects on the reproductive and thyroid hormone concentrations of *A. butcheri*.

Evidence from toxicological literature suggests the gamete (eggs and sperm), embryo and larval stages of many fish species are the most sensitive to pollutants. There has been little or no biological or physiological assessment of the impacts of contaminants on the early life stages of fish in the Gippsland Lakes. Specific tolerances of *A. butcheri* eggs and larvae to waterborne contaminants (such as heavy metals and organochlorine pesticides) are not known. Thyroid hormones have been implicated as important regulators of early developmental rates in the embryos and larvae of teleosts.

It is important to examine these hormones and the effects of mercury and organochlorine pesticides on these hormones, as a possible explanation for the recruitment failure of *A. butcheri* in the Gippsland Lakes.

## Reproductive biology of Urolophids (stingarees) found in south-eastern Australia

**Fabian Trinnie**

Deakin University, School of Ecology and Environment / MAFFRI

Supervisors – Dr Paul Jones, Dr Laurie Laursen / Mr Terry Walker

Studies of the reproductive attributes such as maturity, maternity and litter size of the sparsely-spotted stingaree, *Urolophus paucimaculatus*, eastern shovelnose stingaree, *Trygonoptera sp B.*, banded stingaree, *U. cruciatus*, wide stingaree, spotted stingaree, greenback stingaree, *U. viridis*, and sandyback stingaree, *U. bucculentus*, of south eastern Australia will be undertaken during this project.

Commercial fisheries including Danish seiners, trawl netters and beach seiners that catch these animals, discard them as bycatch as they have no commercial value, but it is unknown as to whether these fishing techniques have an impact on their populations. The aim of this project is to compare between each species for future fisheries stock assessments, ecological risk assessments and threatened species evaluations.

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## **The breeding biology of the white-faced storm petrel, *Pelagodroma marina*, in Victoria**

### **Megan Underwood**

Deakin University, School of Life and Environmental Sciences

Supervisors – Dr John Arnould and Dr Janet Gwyther

The white-faced storm petrel, *Pelagodroma marina*, is restricted to three breeding colonies within Victoria: Mud Islands and South Channel Fort in Port Phillip Bay, and Tullaberga Island off Mallacoota. Numbers of storm petrels breeding on Mud Islands have declined considerably since early last century possibly a result of the significant vegetation changes, together with increases in local populations of other species of birds, most notably, silver gulls, *Larus novaehollandiae*, Australian white ibis, *Threskoirnis molucca*, and straw-necked ibis, *T. spinicollis*. The breeding area available to the storm petrels appears to be limited by the recent arrival of the ibis which now breed on the islands in large numbers (approximately 50,000 pairs). The impact of these changes on the storm petrels is poorly understood, and knowledge of the breeding biology of this species is currently limited. This study aims to examine the interactions between the storm petrels, ibis, and vegetation through experimental manipulation of different habitat types and recording of the breeding success, burrow density, and chick growth. In addition, further information regarding the breeding biology and ecology of the storm petrels will also be obtained. This information will assist in appropriate management and conservation of this species in the future.

## **Reproductive behaviour in Dumpling Squid**

### **Benjamin Wegener**

Monash University

Supervisor – Dr Bob Wong

In 2009 I started my PhD at Monash University, studying the male reproductive strategies on the Southern Bottletail squid, *Sepiadarium austrinum*. Using this species as a model organism my research focuses on (a) how male investment decisions can be influenced by physical condition and the risk and intensity of sperm competition, and (b) what impact these investment decisions have on eventual reproductive success.

My current experiments running between 2010/11 involve laboratory mating trials and paternity analysis. Juveniles are caught in the wild between

the months of February and May and raised in the lab until sexually mature. Male reproductive effort during mating events is then being assessed through the manipulation of male and female physical condition and mating history. This reproductive effort is then going to be correlated with eventual reproductive success by comparing mating strategy with the proportion of offspring sired. Through this research I hope to further the recent developments made by male mate choice and sperm competition models on current sexual selection theory.

Funding for this project is being provided by Monash University, the Hermon Slade Foundation and the Holsworth Wildlife Research Endowment.

## **The influence of freshwater flow on salt-wedge dynamics and fisheries productivity in the Gippsland Lakes**

### **Joel Williams**

The University of Melbourne, Department of Zoology

Supervisors – Dr Stephen E Swearer, Dr Greg P Jenkins and Dr Jeremy Hindell

*Acanthopagrus butcheri*, black bream is the only estuarine dependant sparid species in the world. There are large commercial and recreational fisheries for black bream and over the past decade CPUE data from the commercial fisheries has shown a decline. A potential reason for this decline could be due to a decrease in freshwater flow into the estuaries resulting in decreased optimal spawning habitats. Freshwater flow into estuaries is an important component as it supplies nutrients and sediments that are important to productivity as well as maintaining necessary levels of dissolved oxygen and salinity.

My research aims were to determine the spatial and temporal patterns of black bream eggs and larvae and relate this to physico-chemical structure of the estuary and prey availability. The Gippsland Lakes were chosen as my study site as it is Australia's largest estuarine lagoon system with high environmental significance as well as supporting Australia's largest black bream commercial fishery. In 2007 I surveyed 23 sites in the Mitchell, Nicholson and Tambo Rivers and selected sites in the lakes. I found that although black bream eggs were collected at all 23 sites, more than 99 % for larvae collected came from river sites, in particular upper river sites. In 2008, stratified plankton tows in the Mitchell Rover revealed there was clear spatial coupling between location of the halocline, and high abundances of black bream larvae and their prey. These results

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demonstrate the importance of the freshwater / saltwater interface, therefore freshwater flow, to successful production of black bream eggs and larvae.

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## Masters

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### **An investigation of two introduced species in Swan Bay, Victoria**

**Carlie Alexander**

The University of Melbourne – School of Botany  
Supervisor – Dr Jan Carey

Introduced marine species pose a threat to their recipient environment, and have an impact on the native species living there. The introduction of such species is one of the biggest threats to marine biodiversity worldwide. Swan Bay is located north of Queenscliff, and is a small marine bay that opens into Port Phillip Bay. This habitat is one of the most diverse along the Victorian coastline, and is very ecologically important. In 2008 two invasive species *Codium fragile* ssp. *fragile* (Dead Man's fingers) and *Asterias amurensis* (the Northern Pacific Seastar) had spread into Swan Bay, warranting an investigation into the introduced and invasive species found within Swan Bay. In two separate studies, I examined these species as well as other native inhabitants.

My first study investigated the different invertebrates and algae settling in three sites within Swan Bay and Queenscliff harbour, as well as one site at the Queenscliff boat ramp to use as a comparison, to determine whether there was a difference in the number and types of species present within these three locations.

My second study was a survey of Swan Bay that concentrated on the two invasive species, *Codium fragile* ssp. *fragile* (Dead Man's fingers) and *Asterias amurensis* (the Northern Pacific Seastar). My aim was to determine whether their abundance and location had a relationship with the manmade structures present in Swan Bay.

### **Transgenerational marking of *Gambusia holbrooki* (Mosquitofish) using stable barium and strontium isotopes**

**Jessica Smith**

The University of Melbourne, Department of Zoology

Supervisor – Dr Stephen Swearer

Quantifying the extent to which populations are connected by larval dispersal is vital to furthering our understanding of the dynamics of aquatic populations. Few empirical estimates of larval dispersal and population connectivity exist due to the difficulties associated with conducting mark-recapture studies on species that produce large numbers of small offspring that experience extremely high rates of mortality.

Transgenerational marking offers an opportunity to mass-tag large quantities of larvae in situ before birth with a unique mark. Providing the ability to directly estimate larval dispersal and gather knowledge essential for predicting population responses to environmental change, management strategies, and harvest.

The aim of my project is to conduct a series of laboratory experiments to validate whether unique signatures created from enriched stable isotopes ( $^{135}\text{Ba}$ ,  $^{137}\text{Ba}$ ,  $^{86}\text{Sr}$ ,  $^{87}\text{Sr}$ ) can be maternally transferred and detected in the embryonic otoliths of *Gambusia holbrooki*. Specifically, we aim to determine the minimum dose of single and double signatures for successful marking of *G. holbrooki* larvae and evaluate the period over which females continue to produce marked larvae. Effects of barium and strontium injections on clutch size, larval growth and mortality will also be assessed.

This will be the first study to validate the application of multiple isotopic labelling in fish otoliths and the first investigation with a live bearing species. This validation study will pave the way forward for future investigations using chemical batch marking via maternal transmission in studies of fish movement in a range of aquatic environments.

I had hoped to validate this tagging procedure and use it to identify the level of larval connectivity between natural and artificial reef populations of the Southern Hulafish, *Trachinops caudimaculatus*, a resident reef fish in Port Phillip Bay, Australia. However, due to spawning difficulties and timing constraints, I have decided to use the Mosquito fish as a model studies species.

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## Honours

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### **Macrobenthic community structure in relation to *Spartina anglica* infestation at Anderson inlet, Victoria**

**Justin Cutajar**

RMIT University

Supervisor – Dr Jeff Shimeta

*Spartina anglica* is an invasive ecosystem engineering species that can successfully colonise the intertidal systems of temperate soft-bottom habitats. Consequently, there is considerable concern about its impact on native flora and fauna. The lack of research within Australia involving ecosystem engineering species and the possible degenerative effects to habitat structure and biodiversity of intertidal systems needs to be addressed.

This study addresses the knowledge gap involving *S. anglica* and the possible ecological impacts associated with its invasion. This was achieved by comparing sedimentary characteristics and macrofaunal communities within invaded patches of *S. anglica* to adjacent uninvaded habitats (bare mudflat and native saltmarsh patches) at Anderson Inlet, Victoria.

The macrofaunal communities associated with *S. anglica* were characterised by significantly lower ( $P < 0.05$ ) species richness, species diversity and infaunal biomass, while macrobenthos assemblages within uninvaded habitats did not differ significantly in relation to these measures. Furthermore, ordination of macrobenthic species present/absent clearly separated invaded sites from uninvaded habitats with the mudflat and native saltmarsh habitats showing remarkable similarity to one another. Sedimentary variations between invaded and uninvaded sites can to an extent explain variations observed in species richness and species abundances. Most notably, differences in below and above ground structure, lower salinity and organic matter and increased mud content generally seem to pre-empt habitat for the local macrobenthos community of Anderson Inlet.

This investigation provides evidence to suggest a trophic shift along with the loss of key infaunal species that support higher trophic organisms; hence the presence of *S. anglica* may have negative implications on fish and migratory bird species by shifting dominance to species not widely consumed at higher trophic levels at Anderson Inlet, Victoria.

### **Life history and ecology of the spotted stingaree, *Urolophus gigas*, in south-eastern Australian waters**

**Lauren Dagley**

The University of Melbourne, Department of Zoology / MAFFRI

Supervisors – Dr Rob Day / Dr Matias Braccini

Many shark and ray species are at increasing risk of depletion as a result of the combination of their life history characteristics and anthropogenic impacts such as fishing, habitat fragmentation and degradation, and pollution. The life history traits of sharks and rays (e.g. low fecundity, slow growth, late maturation and long life span) results in low reproductive potential and low capacity for population increase in response to fishing exploitation. Most sharks and rays are incidentally taken in many fisheries. However, little is known about the life history of many species, particularly about coastal stingarees. This project aims to examine the reproductive biology, age and growth, feeding ecology, and movement of the endemic spotted stingaree, *Urolophus gigas*. This will be achieved by determining the age and growth rate of specimens (using band count on vertebrae), the age and size at maturity, the onset of reproduction and the reproductive output (by examination of the reproductive system). The study will also monitor habitat use and movement within a marine park and surrounding areas, and analyse stomach contents to determine the feeding ecology of this species. The result of this study will provide much needed understanding of the life history and ecology of *Urolophus gigas* to improve the management and conservation of this species.

### **Prevalence and effect of fish parasites in 2 species of Flathead on the South East Australian coastline: Tiger Flathead, *Neoplatyhcephalus richardsoni*, and Southern Sand Flathead, *Platycephalus bassensis***

**Stewart I. Dick**

RMIT University (summer scholarship)

Supervisor – Dr Andreas Lopata

Parasites are found in many different species of fish throughout the world. These parasites can have negative effects of fish and humans. Anisakis parasite loads have been found in Tiger Flathead on the Victorian coastline. The aim of this study was to quantify the levels and effects of parasite loads in Tiger and Southern Sand Flathead species on the southern Australian coastline. This study found heavy Anisakis

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parasite loads in Tiger Flathead on the Victorian coastline and heavy cestode parasite loads in Southern Sand Flathead in Port Phillip Bay. There was no significant difference in parasite loads between sexes. Significant difference in average parasite loads was seen between Lakes Entrance and Eden. This study was unable to determine the reasons behind different parasite loads due to experimental error and lack of data. The study highlighted the need for further research into parasite loads in flathead on the Victorian coastline.

### **Post-release stress physiology and mortality associated with trawl capture of stingarees (Family: Urolophidae)**

**Matthew Heard**

Flinders University, School of Biological Sciences  
Supervisors - Dr Charlie Huvneers and Dr Richard Reina

Research on physiological stress and post-release mortality of threatened species caught as by-catch is critical for the management of fisheries. The present study used laboratory simulations of trawl capture to examine the physiological stress response of stingarees subjected to the different trawl durations as well as ancillary stressors of air exposure and crowding. Physiological indicators (plasma lactate, urea, potassium, and glucose and haematocrit) measured from blood samples taken throughout a 48-hour recovery period were compared between simulations and were related to mortality. Plasma lactate and urea concentrations were identified as reliable indicators of physiological stress while haematocrit, plasma glucose and plasma potassium did not cause changes that would be expected to have biological consequences for stingarees. High levels of lactate and depressed urea were recorded in the air exposure treatment indicating that this is the primary source of stress in stingarees caught in trawling operations. Mortality was low throughout this study (15 % overall), only occurred after more than 48 hours following simulations, and was linked to substantial decreases in plasma urea concentration.

### **Variation in the diet of the globefish, *Diodon nictemerus*, in Port Phillip Bay between 1993 and 2009**

**Tim Kenner**

Deakin University / MAFFRI

Supervisors – Dr Janet Gwyther / Dr Greg Parry

Gut contents of 286 globefish were analysed to determine whether a change in diet correlated with a major change in abundance of demersal fish in Port Phillip Bay between 1993 and 2009. A study designed to monitor fish communities in Port Phillip Bay found a major decline in demersal fish abundance in the deep and shallow regions of the bay in 2009, with the exception of the globefish which showed an increase in biomass in the shallow region. This study found that there was a spatial difference in the diet of the globefish between the shallow and deep regions of the bay. There was also a major temporal change in the diet between 1993 and 1999. This change in diet does not correlate with the change in abundance of demersal fish. There have been a few environmental changes in Port Phillip Bay between 1990 and 2002 (Parry *et al* 2003), but the most alarming was the peak abundance of the invasive northern Pacific sea star *Asterias amurensis*. This peak abundance occurred in 2000, which coincides with the change in abundance of demersal fish, but this study confirms that a change in diet had already occurred before the sea star was fully established in the bay. This study also suggests that it is possible to use predatory diet analysis to monitor prey abundances in marine systems.

### **Recreational harvest: characteristics and impacts on the pipi, *Donax deltoides*, at Venus Bay, Victoria**

**Zac Lewis**

Victoria University / MAFFRI

Supervisor – Dr Carol Scarpaci

Over the last decade there has been considerable growth in the recreational fishing sector, particularly surf clam harvesting, which has placed surf clam fisheries at increasing risk of over-exploitation. Recreational harvest of the pipi, *Donax deltoides*, has been increasing in Venus Bay, Victoria (Australia), with potential impacts on pipi stock unknown. The Department of Primary Industries has reduced recreational catch limits within this area to mitigate potential impacts from this increasing recreational harvest.

This study investigated the potential effects that recreational harvest may exert on pipi stock abundance, distribution and age structure. It also evaluated the harvesting habits, regulatory knowledge, biocentrism and Catch Per Unit Effort (CPUE) of recreational harvesters within the fishery. Results were used to gauge the

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effectiveness of current management of Victorian pipi fisheries.

Survey results indicated that CPUE at Venus Bay was 0.426 kgp-1h-1 (n=20); 95% of harvesters were first-time pipi collectors. Harvest effort was highly localised, with all harvesters collecting pips solely within Venus Bay. Comparisons of response between harvester and non-harvesting beach users demonstrated no difference in regulatory knowledge or biocentrism between user groups. Harvesters exhibited poor knowledge of regulatory catch limits and evaluated their harvesting actions as not significant on the sustainability of pipi stock. Furthermore, harvester pipi catch was significantly composed of sexually immature pips posing a potential risk on population recruitment.

These findings highlighted that recreational harvest has a significant impact on pipi stock structure. Therefore, it is vital that appropriate management strategies are implemented to ensure the sustainability of this activity. It is recommended future management strategies include: continuation of reduced pipi catch limits at Venus Bay and implementation of minimum size limits to protect adult stock and alleviate recruitment pressure within this fishery. Biocentric and regulatory knowledge results indicate there is a need for harvester education to promote sustainable practise and more effectively communicate regulatory catch limits.

### **Effects of different dietary microalgae on survival, growth, settlement and fatty acid composition of blue mussel, *Mytilus galloprovincialis* larvae**

**Amanda Pettersen**

Deakin University / MAFFRI

Supervisors – Dr Giovanni Turchini and Dr Craig Sherman

The diatom *Chaetoceros calcitrans* is a major component of many bivalve hatcheries, yet it is expensive and notoriously difficult to culture on a commercial scale. In an attempt to reduce dependence on the diatom *C. calcitrans*, mussel larvae (*Mytilus galloprovincialis*) were subjected to feeding experiments which altered levels of the diatom under controlled hatchery conditions. Growth, survival and settlement success of mussel larvae were determined in response to five mixed algal diets in which the relative contributions of *C. calcitrans* was varied over the experimental period (30 days). Fatty acid profiles of the larvae and algal diets were also assessed. The exclusion of *C. calcitrans* from the diet had

no significant differences on larval growth and only minor differences in total fatty acid content were found between treatments. Fatty acid analysis revealed that larval survival was strongly influenced by the proportions of dietary docosahexaenoic acid (DHA), while settlement was positively correlated with higher ratios of the n-3 long-chained polyunsaturated fatty acid (n-3 LCPUFA) (namely, DHA and eicosapentaenoic acid, EPA), to the n-6 LC-PUFA (arachidonic acid, ARA). Despite similar relative and absolute n-3 LC-PUFA levels in the larvae under different dietary treatments, the larvae receiving high levels of *C. calcitrans* performed significantly better in terms of survival and settlement success. These results indicate that the (DHA+EPA)/ARA ratio is a key factor in determining larval performance, rather than the actual total amount of these fatty acids.

### **Colonisation of artificial reefs in Port Phillip Bay**

**Graham Van der Steen**

RMIT University

Supervisor – Dr Jeff Shimeta

Artificial reefs are increasing in popularity for restoration tools in natural reefs. This study will give detailed explanations of collected data and demonstrate the conclusions reached from the data regarding the artificial reef (AR) and the natural reef (NR). All data obtained was from the surveying of benthos focusing on change over time. Cement modules were deployed to a depth between 2-4 m. The cement modules took the characteristics of a bee hive and a total of six modules/replicates were sampled over a 4 month time frame. Surveys on the artificial reef were completed every 2 weeks weather dependent on either Saturday or Sunday. The natural reef was surveyed towards the end of summer and autumn. The artificial modules were divided into four quarters and each quarter was sampled individually to keep a high level of accuracy while sampling. The natural reef was surveyed using a fixed line transect with 6 replicates sampled along the fixed line transect.

The study demonstrated the recruitment of how benthic organisms differed between the AR and the NR, therefore supporting the primary hypothesis that the community structure changed over time. There was a positive relationship between the first sample and the sixth sample being the last sample of this study. The NR and AR assemblage differed substantially. It was shown when time went on the artificial reef was creating a greater habitat complexity, greater

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levels of species richness and increased species diversity. It was concluded, factors could possibly have a significant effect on the natural reef as well as the artificial reef and why they both differed. These factors include season, temperature, irradiance levels, hydrodynamics, sediment suspension and salinities. The main reason the artificial reef differed from the natural reef was most likely due to different irradiance levels and different salinities due to stormwater outfalls.

**Physiological stress associated with the capture, handling and captivity of the Australian swellshark (*Cephaloscyllium laticeps*), an abundant by-catch species in southern Australian fisheries**

**Jay Van Rijn**

Monash University / MAFFRI

Supervisors – Dr Richard Reina / Dr Matias Braccini

The study of physiological stress and post-release mortality experienced by shark species caught as by-catch in fisheries is critical for the sustainable management of global fisheries and shark populations. In this study I examined physiological stress induced by capture and handling techniques that closely mimic standard fishing operations on an abundant by-catch species, the Australian swellshark, *Cephaloscyllium laticeps*.

I examined the stress and physical consequences induced by fishing capture, handling and the ingestion of water and air (an ability unique to the swellshark family due to its expandable stomach). In this study I also examined the physiological stress experienced by these sharks, associated with long-term captivity. Physiological stress was determined using the physiological indicators of stress of plasma lactate and glucose concentration, plasma osmolarity, haematocrit, and the granulocyte to lymphocyte (G/L) ratio. The G/L ratio having not been previously tested on sharks.

I found that plasma lactate and glucose concentrations, and the G/L ratio are useful indicators of physiological stress. However plasma osmolarity and haematocrit did not change enough to have any biologically detrimental effect on the shark.

Of the capture and handling processes I tested, 120 minutes of air exposure induced the highest measurable physiological stress, followed by gillnet capture gear, and peak physiological stress occurs several hours after release from capture gear. Overall, this study demonstrates that while *C. laticeps* is resilient to capture and handling

stress experienced in fisheries, careful consideration must be taken when holding this species captive. Furthermore the granulocyte to lymphocyte ratio can be used as a physiological indicator of stress for this shark species.

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## CONFERENCE AND OTHER PRESENTATIONS

### Emi Sherizan Ab Rahim

*Better Blue Mussel: genetic tools for breeding and population studies*

Oral presentation : Molluscs 2009; University of Queensland Brisbane QLD : 24-27 November 2009

### Joanna Browne

*Investigating life cycles and host specificity of digenean parasites of gelatinous zooplankton using DNA*

Oral presentation : Australian Marine Sciences Association Conference; Adelaide SA : 5-9 July 2009

*Investigating life cycles and host specificity of digenean parasites of gelatinous zooplankton using DNA*

Oral presentation : ASP & ARC/NHMRC Research Network for Parasitology Conference; Sydney NSW : 12-15 July 2009

*Parasites of gelatinous zooplankton*

Oral presentation : Reefwatch (community group) seminar; Melbourne Aquarium : 19 August 2009

### Isla Fitridge

*The ecology of hydroids on man-made structures in Port Phillip Bay, Australia*

Oral presentation : 47th Australian Marine Science Association (AMSA) Conference; Adelaide : July 2009

(FRDC award for best oral presentation)

*The ecology of invasive hydroids on man-made structures in Port Phillip Bay, Australia*

Oral presentation : 16th International Conference on Aquatic Invasive Species; Montreal Canada : April 2009

### Corey Green

*Stock discrimination of arrow squid, (*Nototodarus gouldi*), using Fourier shape analysis*

Poster presentation : Australian Marine Sciences Association Conference; Adelaide SA : 5-9 July 2009

(AFMA award for best poster presentation)

*Stock discrimination of arrow squid, (*Nototodarus gouldi*), using Fourier shape analysis*

Oral presentation : Cephalopod International Advisory Council Symposium; Vigo Spain : September 2009

*Temporal and spatial variation in elemental composition of arrow squid statoliths*

Poster presentation : Cephalopod International Advisory Council Symposium; Vigo Spain : September 2009

### Kathryn Hassell

*Variation in histological appearance of black bream gonads sampled from five Victorian estuaries*

Oral presentation : 13th Australasian Society for Ecotoxicology Conference; Adelaide SA : 20-23 September 2009

### Jackie Myers

*Uptake and depuration of nodularin in seafood species: A human health risk assessment*

Oral presentation : Australian Society for Ecotoxicology; Adelaide : September 2009

*Effects of salinity and light intensity on photosynthetic capacity of the cyanobacterium, (*Nodularia spumigena*)*

Poster presentation : Australian Society for Ecotoxicology; Adelaide : September 2009

### Lisa Toogood

*The effect of p,p-DDE on plasma thyroid hormone levels in juvenile black bream, *Acanthopagrus butcheri**

Oral presentation : Australian Society for Ecotoxicology; Adelaide : September 2009

### Joel Williams

*Egg and larval production of (*Acanthopagrus butcheri*), black bream in relation to zooplankton abundance and estuarine water quality*

Oral presentation : 8th Indo Pacific Fish Conference and 2009 ASFB Workshop and Conference; Fremantle WA : 31 May–5 June 2009

*Environmental flows, prey production and larval fish distribution, within a salt-wedge estuary in south-eastern Australia*

Oral presentation : Coasts and Estuaries Research Federation 20th Biennial Conference; Portland Oregon USA : 1–5 November 2009