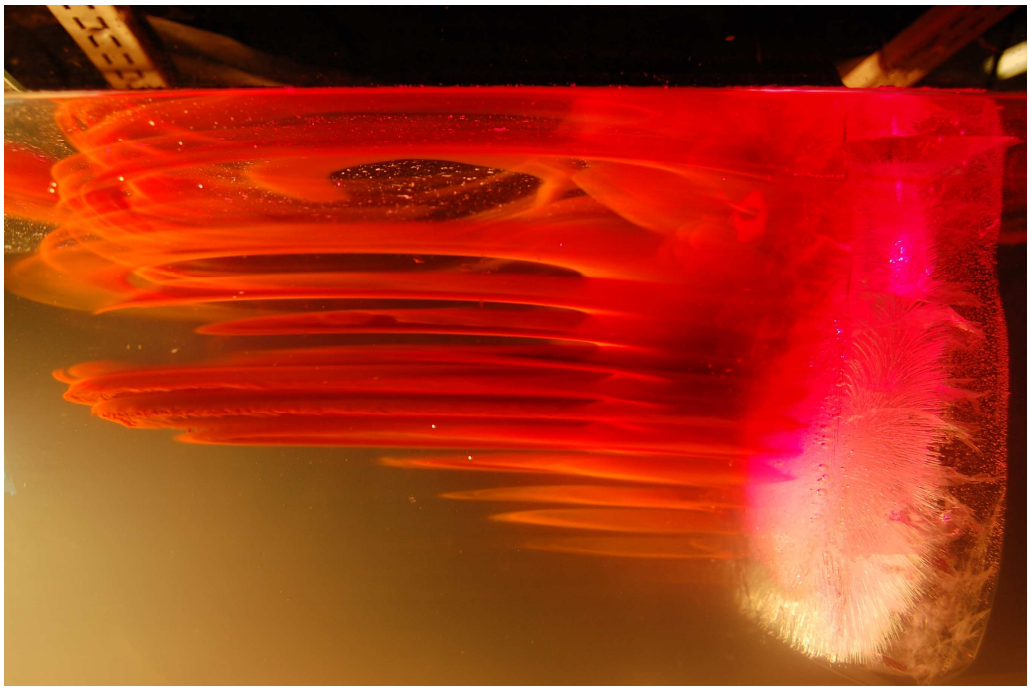
NEW ZEALAND MARINE SCIENCES SOCIETY

REVIEW 49



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new zealand marine sciences society

NEW ZEALAND MARINE SCIENCES SOCIETY

REVIEW 49

A review of marine research carried out in New Zealand during 2007

Cover Photo: 'Double diffusive convection layers formed near an ice wall in a salt-stratified fluid'
(Rhodamine dye injected near the ice wall. Vertical scale of image is around 25 cm)
Craig Stevens and Natalie Robinson

Edited by Natalie Robinson, May 2008

I would like to thank Lucy Jack, Bob Hickman, Alison MacDiarmid and Abby Smith for helping out with various aspects of this review. I would also like to thank those of you who have made and collected contributions for this year's review. Your time and effort is very much appreciated.

Prepared by the NZMSS for distribution to members

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NEW ZEALAND MARINE SCIENCES SOCIETY

ABOUT THE SOCIETY

The New Zealand Marine Sciences Society is a non-profit organization formed in 1960 to foster an understanding and appreciation of our marine environment, to provide a means of communication within our marine science community, to encourage and assist marine science students and young scientists, and to provide advice to government on marine policy issues.

The NZMSS membership for 2007/08 consisted of: 167 Full members, 2 Institutional members, 7 Retired members, 102 Student members and 14 Life members.

Subscription rates for 2007-2008 were:
Full member $45.00
Student member $20.00
Retired member $20.00

The NZMSS holds an annual conference, usually between July and September, in conjunction with the Annual General Meeting. Student participation is strongly encouraged, and the Society awards student prizes each year. Students who present their research at the conference are also eligible for assistance with their travel costs.

Members receive the annual Review, which details abstracts from the preceding conference, activities of the society, summaries of research activities, and lists of recent publications. The Review is available as a pdf file from the Society website, or as printed hardcopy upon request.

Inquiries and correspondence should be addressed to:

The Secretary, Alison MacDiarmid (email: a.macdiarmid@niwa.co.nz)
NIWA
Private Bag 14901, Kilbirnie
WELLINGTON

Membership inquiries should be directed to:

Membership Secretary,
Emma Sommerville
email: eso15@student.canterbury.ac.nz

THE SOCIETY COUNCIL

2007-08

President:	Abby Smith
Vice President:	Sheryl Miller
Immediate Past President:	Bob Hickman
Secretary:	Alison MacDiarmid
Treasurer:	Claire Conwell
Council Members:	Colin McLay
	Andrea Alfaro
	Conrad Pilditch
	Mark Costello
	Mary Sewell
	Ann McCrone
Honorary Members:	Mike Hickford - Conference Organiser
	Emma Sommerville - Membership Secretary
	Natalie Robinson - Review Editor
	Brian Paavo - Webmaster
Student Representatives:	Suzanne Garrett, Auckland
	Phil Ross – Waikato
	Emma Sommerville - Canterbury
	Natalie Robinson – Otago
	Anna Wood - Otago

Alphabetical List of Council Members 2007-08

Andrea Alfaro	andrea.alfaro@aut.ac.nz
Claire Conwell	claire.conwell@cawthron.org.nz
Mark Costello	m.costello@auckland.ac.nz
Suzanne Garrett	s.garrett@auckland.ac.nz
Mike Hickford	michael.hickford@canterbury.ac.nz
Bob Hickman	b.hickman@niwa.co.nz
Ann McCrone	amccrone@doc.govt.nz
Alison MacDiarmid	a.macdiarmid@niwa.co.nz
Colin Mclay	colin.mclay@canterbury.ac.nz
Sheryl Miller	s.miller@niwa.co.nz
Brian Paavo	paavo@benthicscience.com
Conrad Pilditch	c.pilditch@waikato.ac.nz
Natalie Robinson	n.robinson@niwa.co.nz
Phillip Ross	pmr16@waikato.ac.nz
Mary Sewell	m.sewell@auckland.ac.nz
Emma Sommerville	eso15@student.canterbury.ac.nz
Abby Smith	abby.smith@stonebow.otago.ac.nz
Anna Wood	wooan929@student.otago.ac.nz

NEW ZEALAND MARINE SCIENCES SOCIETY RULES

1. NAME

The name of the Society shall be the New Zealand Marine Sciences Society, hereinafter called the Society.

2. OBJECTS

The objects of the Society shall be:

(a) To encourage and assist marine research in New Zealand.

(b) To provide means of communication among persons interested in research in the marine sciences and to provide opportunity for them to foregather by the holding of an annual conference.

(c) To act as spokesman when required, on behalf of the interests of marine research in New Zealand.

(d) To co-operate with other scientific bodies and to seek such affiliations as may be appropriate.

3. MEMBERSHIP

(a) Members shall be classified as follows:

(i) Full New Zealand Members and New Zealand Institutions
(ii) Student Members (of New Zealand educational institutions)
(iii) Overseas Members and Institutions
(iv) Retired Members
(v) Honorary Life Members
(vi) Corporate Members

(b) The Council may elect any person as an ordinary member of the Society on recommendation of two members (2) of the Society.

(c) Any member who has given outstanding service to marine science in New Zealand may, on the recommendation of the Council, be elected as an Honorary Member at any Annual or Special General Meeting.

(d) Any member of the Society may resign by giving notice in writing to the Secretary and paying all subscriptions due; provided that any member giving such notice before 30th April shall not be liable to pay the subscription for that year.

(e) Any member whose annual subscription is more than two years in arrears shall be removed from membership of the Society and may be re-admitted by resolution of the Council on payment of all arrears.

4. SUBSCRIPTION

(a) The annual subscription shall be one dollar ($1.00) or such other sum as any Annual or Special General Meeting shall from time to time decide.

(b) The first subscription for membership shall be forwarded to the Secretary or Secretary/Treasurer with the completed application form.

(c) All subscriptions after the first shall become due and payable on the first day of each financial year.

(d) Each person elected as a member shall be given notice thereof in writing by the Secretary.

(e) Any member requiring a copy of the rules of the Society may do so by requesting a copy from the Secretary.

(f) In exceptional circumstances the Council may by resolution remit the payment of an annual subscription or part thereof.

5. OFFICERS

The Officers of the Society shall consist of a President, a Vice-President, a Secretary and a Treasurer (or a Secretary-Treasurer), a Membership Secretary and an Auditor, all of whom except the Auditor shall be members of the Society.

6. COUNCIL

(a) The Council shall consist of the following:

(i)The officers except the Auditor

(ii)The Immediate Past President

(iii)A minimum of five (5) members elected by the Annual General Meeting.

(b) The President, Vice-President, Secretary and Treasurer (or Secretary-Treasurer) shall be elected by successive ballots in that order at the Annual General Meeting.

(c) The members of the Council shall be elected by ballot at the Annual General Meeting after the officers have been elected.

(d) Candidates for positions as officers or members of the Council shall be nominated by members of the Society at the Annual General Meeting, or in writing signed by any two (2) members, received by the Secretary before the time of such meeting. Every candidate shall before election signify personally or in writing his or her acceptance of nomination.

(e) All officers and members of Council shall be eligible for immediate re-election PROVIDED ALWAYS that no person having held the same office either of President or Vice-President for two successive years shall be eligible for immediate re-election to that office.

(f) The Council shall have powers to appoint members of the Society to fill any casual vacancies.

(g) The officers and Council shall take office immediately after the close of the Annual General Meeting at which they are elected and shall have full control of the management of the Society except where otherwise provided in these rules.

(h) At any meeting of the Council four (4) shall form a quorum

(i) The Council may delegate any of its powers and duties to sub-committees consisting of such member or members of the Society as it may resolve, provided that at least one member (1) of each sub-committee shall be a member of the Council, and may grant to such sub-committees the power to co-opt other persons whether members of the Society or not.

(j) Meetings of the Council shall be called by the Secretary (or Secretary Treasurer) on the instructions of the President or on the receipt of a requisition signed by not less than four (4) members of the Council.

7. FINANCES

(a) The control and investment of the funds of the Society shall be wholly within the power of the Council, which may open and operate accounts at any bank or banks as it deems fit, including the Post Office Savings Bank. The Trustees of any such accounts shall be the Treasurer (or Secretary-Treasurer) and any two officers or members of the Council appointed by the Council for that purpose, cheques and withdrawal warrants shall be signed by any two of the Trustees.

(b) The Treasurer (or Secretary-Treasurer) shall keep a correct account of all funds received and expended by the Society, and shall prepare at the end of each financial year a Balance Sheet and Statement of Accounts for that year.

(c) The accounts of the Society shall be audited at the end of each financial year by an Auditor, who shall hold professional qualifications in accountancy. The Auditor shall be appointed each year at the Annual General Meeting.

(d) The financial year of the Society shall end on the 31st March in each year.

(e) The Society shall not have the power to borrow money.

8. MEETINGS

(a) The Society shall hold at least one General Meeting in each financial year. At one such meeting there shall be a business session, which shall constitute the Annual General Meeting of the Society. At this meeting the Society shall:

(i) Receive from the Council a Report, Balance Sheet, and Statement of Accounts for the preceding financial year.

(ii) Elect the Officers and Council and appoint an Auditor for the ensuing year.

(iii) Decide on any motion which may be duly submitted to the meeting.

(b) A Special General Meeting shall be held at any time by resolution of the Council or within six weeks of receipt by the Secretary of a requisition signed by at least ten (10) members specifying the purpose for which the meeting is to be called.

(c) Notice and agenda of each Annual and Special General Meeting shall be posted to each member at least fourteen days before that meeting. At any Special General Meeting no motion not included in the notice calling the meeting may be proposed, discussed, or put to vote except by consent of two thirds of the members present.

(d) The Annual Report, Balance Sheet and Statement of Accounts for each financial year shall be posted to all members at least fourteen days before the next Annual General Meeting.

(e) At any Annual or Special General Meeting fifteen (15) members shall constitute a quorum.

(f) At any Annual or Special General Meeting, or Council Meeting, the chair shall be taken by the President, or if the President is absent the Vice-President, or failing him a member elected by the meeting.

(g) At any meeting voting shall be on the voices or by show of hands or by ballot at the discretion of the chairman PROVIDED THAT if any member so demand, voting shall be by ballot. The chairman shall have a deliberative and casting vote.

9. ALTERATION OF RULES

(a) Any alteration, addition, or recession in these rules shall be made only at an Annual or Special General Meeting.

(b) Notice of the proposed alteration, addition, or recession shall be posted to every member at least fourteen days prior to the meeting.

(c) The meeting may amend any such proposals.

(d) No resolution shall effect any alteration of these rules unless assented to by two-thirds of the members present at the meeting.

(e) No addition to or alteration of the rules affecting the Society's non-profit aims or winding up clause shall be made without the approval of the Inland Revenue Department, and the provisions and effect of this clause shall not be removed from this document and shall be included and implied into any document replacing this document.

10. INTERPRETATION OF THE RULES

The decision of the Council as to the interpretation of these rules shall be final and binding on all parties except at any Annual or Special General Meeting when the decision of the chairman of such meeting will be final and binding on all parties.

11. COMMON SEAL

The common seal of the Society shall be in the custody of the Secretary (or Secretary-Treasurer), who shall in pursuance of a resolution of the Council to that effect, affix the same to all instruments requiring the same.

12. WINDING UP

If upon winding up or dissolution of the organization there remains after the satisfaction of all its debts and liabilities any property whatsoever, it shall not be paid to or distributed among the members but shall be given or transferred to an income tax exempt organization with similar objectives or to some other charitable purpose within New Zealand.

13. AWARDS

Periodically the Council of the Society may present an award to any person who they feel has made an outstanding contribution to marine science.

NZMSS ON-LINE

Members are encouraged to take advantage of the following online options:

The NZMSS Website
The website has moved from its previous location, and is now to be found at:
http://nzmss.rsnz.org/

The site has:
- Listings of contact details for Society officers
- Guidelines and application form for the First Overseas Conference Travel Fund
- The Society Rules
- Previous NZMSS Annual Reviews
- NZMSS Newsletters
- Copies of submissions made on behalf of the Society to government

The Marine Sciences List Server
A currently underutilised facility. Members are encouraged to make more use of it!
To join the list server either:

(i) Follow the links from the website home page to "Join the Mailing List" (located on the right hand side); or

(ii) Go directly to http://nzmss.rsnz.org/mailman/listinfo/nzmss_nzmss.rsnz.org

To subscribe: Fill in the electronic form on the web page (email address, name, password) and click the subscribe button.

To unsubscribe: Follow the instructions, and fill in the unsubscribe form on the same page.

To distribute your message to everyone on the NZMSS list send your message to: nzmss@nzmss.rsnz.org

You can also check out what other RSNZ lists are available on the web page:
http://www.rsnz.org/directory/elist.php

MINUTES OF THE 2007 ANNUAL GENERAL MEETING

CONVENED AT 12:15 ON 30TH AUGUST 2007 AT THE UNIVERSITY OF WAIKATO, HAMILTON

Present: Abby Smith (chair), Bob Hickman, Andrew Bell, Mary Sewell, Ann McCrone, Emma Summerville, Sheryl Miller, Richard Gorman, Phil Ross, Phil James, Sarah Bury, Kim Currie, Natalie Robinson, Keren Spong, Sam DuFresne, Clair Conwell, Bill Ballantine, Andrea Alfaro, Katrin Berkenbush, Mary Livingston, Alison MacDiarmid, Conrad Pilditch

1. **Apologies:** Kareen Schnabel, Colin McLay,

2. **Minutes of the 2006 AGM** Bob Hickman, seconded by Sam DuFresne, moved these be accepted as correct. Motion carried.

3. **Reports**

a. Presidents Report: The following report was tabled and delivered by Abby:

NZMSS President's Report 30 August 2007

The Society's mission is to provide a means of communication within the marine science community, encourage and assist marine science students and young scientists, and provide advice to government on marine policy issues.

Communication

- Council held 10 meetings, roughly monthly
- Bi-monthly newsletters (both email and on the web)
- NZMSS web site
- NZMSS list server
- Annual conferences

Encouraging and Assisting

- First Overseas Conference Travel Awards
- Student Research Award
- NZMSS award for lifetime achievement.

Raising the Profile of Marine Science

- Public lectures by Dennis Gordon, our previous lifetime achievement award winner
- *NZMSS Review*, many thanks to editor Lucy Jack

Advocacy & Submissions

- Letters to Ministers of conservation and fisheries advocating for establishment of Science Advisory Body to develop MPA Network Design Guidelines
- Letter to International Union of Geodesy and Geophysics in support of the Australian-NZ bid to co-host the General Assembly of the IUGG in Melbourne in 2011
- Letter to Chair of the Marsden Fund, noting the lack of marine expertise on review panels
- Email to Royal Society of New Zealand outlining ideas for their submission on the draft New Zealand Curriculum
- Submission on Draft Biosecurity Strategy for New Zealand
- Submission on Proposed Extension to the Temporary Blue Cod Amateur Fishery Closures in Milford & Doubtful Sounds
- Submission on Proposed Interim Measures for Hector's Dolphins

Abby added that the society was in good heart. There were 270 participants at the conference, there is money in the bank and the society is delivering on its mission. She thanked Bob

Hickman and Alison MacDiarmid particularly for their efforts during the year in keeping the Councils operations performing.

b. **Treasurer's Report** Andrea Alfaro/Bob Hickman

Bob and Andrea prepared the appended Income and Expenditure Account for the year ended 31 March 2007.

The key feature is that expenditure exceeded income by $7,683 because of extra expenditure on supporting student activities, as generally directed by the 2006 AGM. The balance at the end of the financial year was $50,083.

c. **Membership Secretary's Report** Emma Sommerville

Emma reported that as of 30 August 2007 membership stood at 240, compared with 130 at the same time in 2006. Membership appears to be increasing. Email is proving to be the best method for contact with members regarding membership fees. However there have been a few bounced emails mainly from former students who have now left university.

4. **Matters arising from reports and minutes**
   - Student Research Award
     There were 6 applications. These were assessed by a team headed by Mark Costello and including Bob Hickman and Brian Paavo. They agreed that the award for 2007 would be made to Philip Ross.
   - Promotion of marine science to the general public
   - Dennis Gordon, previous winner of the NZMSS Award spoke at SeaWeek. He had also agreed to speak at the Otago Science Festival but this was not held during 2007. Wendy Nelson, the latest winner of the NZMSS Award needs to be asked to give a public lecture.

5. **Forthcoming NZMSS conferences**

   2008 conference is to be joint with AMSA in Christchurch. The organising committee comprises Dave Schiel, Islay Marsden and Mike Hickford. Mike agreed to be the contact person for inclusion in council meetings. The lecture rooms are already booked. The organising committee are open to suggestions for a theme. The theme needs to be attractive to sponsors but wide enough that marine scientists from a range of disciplines in NZ and Australia can fit under it umbrella. Various themes including Antarctic Research, Cumulative impacts, NZ/Australia Tropics to Antarctica. May pay to make the title descriptive to make it general and thus of broad interest.

   2009 Conference – with Meteorological Society in Auckland
   2010 Conference - 50th Anniversary of NZMSS in Wellington
   2011 Conference – joint with Freshwater Society in Dunedin? To arrange this council needs to contact FW Society soon. The current president is Kevin Collier kevin.collier@ew.govt.nz

6. **General Business**

   a. Proposed budgets. Abby raised discussion on planning the finances of the Society. She asked how much of the accumulated assets should the Society spend and still be financially responsible? Abby then discussed the attached indicative budgets for the

next 2 years. She proposed that the society spend $10-$15k of capital over the next two years, conservatively leaving a balance of $20k in March 2009. Islay Marsden and Conrad Pilditch immediately supported the proposal and general agreement was quickly reached. There was no vote. However several points were raised which members requested the incoming council take into consideration when planning over the next few years:

- Need to spend more to get NZMSS prize winners speaking in the main centres. Bill Ballantine offered to speak if other winners were over committed. **Abby to contact Wendy Nelson and discuss speaking over the next 12 months**. Arrangements for speaking could be made through the Royal Society.
- Need better information about NZMSS prise awardees on the NZMSS web page.
- Should we be setting aside some funds now to support the next joint conference with AMSA in Australia?

b Other business. Bill Ballantine urged members to put in a submission of the draft classification and protection standard for MPA's. It was suggested that Bill should send his comments in writing to Alison MacDiarmid and Sheryl Miller who are preparing the NZMSS submission. It was also agreed that a Friday lunchtime meeting be announced to allow other members comments and concerns about the classification and standard to feed into the NZMSS submission.

7. Election of Officers

Officers

President – Abby Smith elected unopposed
Vice-president – Sheryl Miller elected unopposed
Immediate past-president – Bob Hickman
Treasurer – Clair Conwell elected unopposed
Secretary – Alison MacDiarmid elected unopposed

Council members

Colin McLay elected unopposed
Andrea Alfaro elected unopposed
Conrad Pilditch elected unopposed
Mark Costello elected unopposed
Mary Sewell elected unopposed
Ann McCrone elected unopposed

Honorary Members

Conference Organiser, Mike Hickford
Membership Secretary – Emma Summerville
Review Editor – Abby to advertise
Webmaster – Brian Paavo until position is filled

Student Representatives

Suzanne Garrett (Auckland)
Phil Ross (Waikato)
Emma Summerville (Canterbury)
Natalie Robinson (Otago)
Anna Wood (Otago)

The meeting closed at 1:10 pm

ANNUAL FINANCIAL REPORT

for the year ending 31 March 2007

Statement of Income and Expenditure

New Zealand Marine Sciences Society
Income and Expenditure Account for the years ended 31 March 2005, 2006 and 2007

	2005	2006	2007
Income			
Subscriptions Received	8750	3951	9525
Conference Net Income	7590	29440	2885
Donations	300	0	5000
Interest Received	400	2689	1614
Total Income	**$17,040**	**$36,080**	**$19,024**
Expenditure			
NZ Marine Sciences Review	7164	1605	1808
Royal Society of NZ - affiliation fees	643	643	669
First Overseas Conference Travel Awards	1000	3000	9500
Council and General Expenses	1915	1050	3702
NZMSS Prizes	1050	255	700
Student Travel Grants	4412	216	6240
Bank Fees	341	365	388
MFish students sponsorship			3375
Auditor's Fees	150	150	325
Website development	0	149	0
Total Expenditure	**$16,675**	**$7,433**	**$26,707**
Surplus (Deficit) of Income over Expenditure	**$365**	**$28,647**	**-$7,683**

Statement of Accounts

New Zealand Marine Sciences Society
Balance Sheet for the years ended 31 March 2005, 2006 and 2007

	2005	2006	2007
Balance 1 April 2006	28603	28968	57615
Surplus (Deficit) of Income over Expenditure for Year	365	28647	-7683
Balance 31 March	**$28,968**	**$57,615**	**$49,932**
Represented by:			
Westpac - Cheque Account	2309	26918	2730
Westpac - Term Investment	28171	30847	32353
Westpac - Term Investment			15000
	30480	57765	50083
Less Accounts Payable	1512	150	0
	$28,968	**$57,615**	**$50,083**

PRESIDENTS REPORT – AGM – 30 AUGUST 2007

When I sat down to make a list of all we did this year, I was amazed by how much this Council did on the Society's behalf. The Society's mission is threefold: to provide a means of communication within the marine science community, to encourage and assist marine science students and young scientists, and to provide advice to government on marine policy issues.

Communication
A large but manageable council of 20 representing most of the country. We held 10 meetings, roughly monthly. Council communicated with members via bi-monthly newsletters, the NZMSS web site, and list server. Members were able to post notices to the list server, which is a great way to all keep up with developments. An important part of communicating is the annual conference – the council kept in touch with conference organizers and has already begun finding funds for the 2008 conference in Christchurch.

Encouraging and Assisting
It was grand to be able to award First Overseas Conference Travel Awards to 3 deserving students. We also developed the criteria for a new award, the Student Research Award about which you'll hear more under "matters arising." In addition we had the great pleasure of deciding between nominees for the society's premiere award for lifetime achievement, awarded to Wendy Nelson yesterday.

Raising the Profile of Marine Science
We sponsored public lectures by Dennis Gordon, our previous lifetime achievement award winner.
We produced the NZMSS Review, another fine job done by our editor Lucy Jack.

Advocacy & Submissions
Representing the views of the society to the government and other organizations is a time-consuming but necessary task. Among our many submissions were:

Letters to Ministers of conservation and fisheries advocating for establishment of Science Advisory Body to develop MPA Network Design Guidelines
Letter to Chair of the Marsden Fund, noting the lack of marine expertise on review panels.
Submissions on Draft Biosecurity Strategy for New Zealand, Temporary Blue Cod Amateur Fishery Closures in Milford & Doubtful Sounds, and Proposed Interim Measures for Hector's Dolphins.
Members view are always welcome on any submissions prepared by council.

It's appropriate for me to summarise the State of the Society at this time. I would have to say it is in fine shape. There's money in the bank, good people on board, good work being done, and exciting plans for the future.

I would very much like to thank the members of the Council, and in particular Bob Hickman and Alison MacDiarmid, for their support and hard work this year.

Abby Smith, President, 30 August 2007

FIRST OVERSEAS CONFERENCE TRAVEL FUND

In 2007 five awards totalling $5500 were made to Michelle Carter, Sebastien Delaux, Daniel Leduc, Milena Palka and William Rayment for conferences in USA, Switzerland, Brazil, Australia and South Africa respectively.

Guidelines for applicants

NOTE: Fund is open to all postgraduate student members of NZMSS

Rules for eligibility:
1. Applicants must be enrolled in a postgraduate course of study in some aspect of marine science at a New Zealand university.

2. Applicants must be current (financial) members of NZMSS and must have presented a paper or poster at one or more NZMSS conference(s).

3. Applications will be accepted only from members attending their FIRST overseas conference and proposing to present a paper or poster.

General guidelines:
1. The awards will normally be made twice a year. The deadlines for applications to be received are February 1 and August 1 in any year. Late applications will NOT be accepted. Awards may not be made if there are no suitable applicants.

2. Each successful applicant to the FOCTF will be awarded $1500 (or such sum as the Council may specify in the future). The number of awards allocated following each of the two application deadlines will be at the discretion of the Council, and dependent on available funds.

3. Your application should be made on the official application form and must include the following supporting information:
· An abstract of the presentation of poster or paper you are giving.
· Your current CV, including your academic record, any previous publications, reports or theses you have authored, and any prizes or awards you have received.
· A letter of support from your supervisor.

To obtain an application form, visit http://nzmss.rsnz.org or contact the secretary.

Michelle Carter - FOCTF Report to NZMSS Council

Report on the International Bryozoan Association Conference 2-7th July 2007, Boone, North Carolina, USA following successful application for funding from the First Overseas Conference Travel Fund

I wish to start by thanking the NZMSS council for awarding me $1000 towards the cost of attending the IBA conference. I am happy to report that your money was well spent. As a student working on an obscure animal, the meeting provided an opportunity for students to get together, exchange ideas, provide support, and basically form long-lasting connections. Such an opportunity is not possible in New Zealand and a common complaint of student bryozoologists is the isolation (in terms of exchange of knowledge and discussion). As a result of the conference a website (or Blog) has been set up to provide a support network for student bryozoologists plus a knowledge base system whereby questions can be posed to any of the experts in that relevant field.

Prior to the conference proper I took the opportunity to attend a molecular techniques workshop which provided a variety of useful information including recent research on a bioactive compound called Bryostatin, a secondary metabolite produced by symbiotic bacteria associated with *Bugula neritina* that has proven to be useful in the prevention of some cancers and more recently Alzheimer's. Margot Haygood has been actively researching bioactive compounds and I took the opportunity to discuss my findings and show her my images of microbial-coated bryozoans. We discussed ways of locating bacteria in bryozoans using confocal microscopy and offered to send me her protocol.

The conference presentations covered a range of topics related to bryozoans: ecology, paleontology, biology, history, genetics, distribution, and taxonomy. Both my presentations were well received as was my poster. My work has made a substantial contribution to the advancement in bryozoan biology and this was reflected in the subsequent feedback I received.

This conference has provided me with the opportunity to present my research, establish connections, discover recent advances in bryozoan research, and discuss collaborative and potential post-doctoral projects. An all round enlightening experience, of which would not have been possible without the contribution from NZMSS and for which I am extremely grateful.

Yours sincerely

MCarter

Sebastien Delaux - FOCTF Report to NZMSS Council

I would like to take the opportunity to thanks the New Zealand Marine Sciences Society for the grant I was awarded to attend the 6th International Congress on Industrial and Applied Mathematics (ICIAM) hosted by the ETH Zurich and the University of Zurich (Switzerland) from the 16th to the 20th of July 2007.

With more than 3000 participants from more than 100 countries, and more than 2900 presentations, ICIAM is one of the biggest conferences in the domain of mathematics. The size of the ICIAM makes it possible to have a lot of different areas of the applied mathematics research represented. As well, with so many participants, it was possible to organize many sessions dedicated to specific applied mathematics topics, the drawback being that there are more than 60 parallel sessions. Another great thing about ICAM was that even with 2900 presentations, almost each speaker was allowed a full 30 minutes time slot to present their work which leaves enough time to go into detail and present ideas, theory as well as results. The quality of the talks I attended was excellent.

My PhD topic is the study of the attachment or detachment of seaweed zygotes on a rocky substrate in turbulent conditions. I am working on the implementation on a finite-volume solid/fluid interaction model in the Gerris Flow Solver (http://gfs.sf.net) , which is a 3D quadtree/octree based Navier-Stokes solver. I presented my talk "Adaptive simulation of fluid-propagule interaction: application to the settlement of seaweed zygotes" in the "Fluid dynamics related to biology and geosciences" session. I addressed mainly the multi-scale nature of the problem, the Gerris Flow Solver and the finite-volume approach of solid/fluid interaction from a theoretical and numerical point of view. My talk went well with several questions on the code and some useful feedback.

My focus at the conference was the four sessions on "Interface methods and applications in multi-phase problems" organized by Dr Zhilin Li (Leveque & Li, 1994). Most of the presentations were about methods used to deal with membranes and moving boundaries problems. Some people were focusing on problems very similar to mine (A coupled IIM-BEM numerical method for the simulation of cell motion in single-cell traps, Boo Khoo, National University of Singapore). Among them, the Immersed Interface Method (IIM) and the Immersed Boundary Method (IBM) were definitely the most popular ones. Nobody is using a full Finite-Volume approach as used in Gerris which is more complex to implement but which has interesting properties in terms of mass and momentum conservation. I met people working on adaptive meshes with the IIM and having great results.

It was really valuable to meet with people interested in and working on solid/fluid interaction problem. Being exposed to so many different point of view and attended so many talks of fantastic quality was really helpful to provide a more global understanding of where the applied community is at in terms of fluid/solid interactions. As well, it was very helpful from a motivational point of view to be able to meet with the international applied mathematics community. For all that I am extremely grateful to the New Zealand Marine Sciences Society.

Yours sincerely,

Sebastien Delaux

Milena Palka - FOCTF Report to NZMSS Council

Australian Coral Reef Society 83rd Annual Conference
Fremantle, Western Australia on October 9-11, 2007

The experience of attending the 83rd annual ACRS conference proved to be an invaluable one and I would like to thank the NZMSS for allowing me this opportunity through financial support. This conference typically attracts over 200 delegates primarily from Australia, but also from around the globe, and last year established itself as the biggest gathering thus far. Being the only student from New Zealand, my attendance at this event permitted me to illustrate the temperate NZ perspective on symbiosis as well as maintain trans-Tasman relationships.

The conference itself was very informative. It reiterated various global issues concerning coral reef health such as ocean acidification, disease prevalence, bleaching, and marine conservation, among others. I was fortunate enough to be allocated an oral presentation, during which I presented my findings to date. This was the first time I spoke to such a large panel of experts and although it was intimidating, it was a great learning experience. It not only allowed me to present the coral reef community with my findings in return for constructive feedback, but was also good practice for future talks in front of even bigger audiences. In addition, I met several researchers who either work with similar specimens or have previously utilized the same equipment I am currently making extensive use of. It was valuable to meet colleagues whom I can contact with any problems or questions which may arise with during completion of my M.Sc., particularly since they have authored numerous articles which I am referencing within my thesis In addition, because I plan to pursue a Ph.D. the following year delving deeper into coral reef issues, attending this conference has been extremely beneficial in becoming familiarized with the community and receiving both a broad and thorough range of new directions in which the field is heading. It has also allowed me to better plan the direction I wish to take with my own scientific career and has brought potential future collaborators into consideration.

The conference was followed by a student mentoring day which delved into topics young researchers can really benefit from. Several of the speakers were prominent experts in the coral reef community with years of experience producing top quality papers and reports. Their advice on what it was like to be an academic versus working for a government program was truly insightful. They brought to light many of the challenges faced when starting out in the scientific community as well as the pros and cons of heading toward several different directions when first completing a degree. This truly proved to be a bonus added onto an already fulfilling experience.

As a M.Sc. student, I recognize the importance of attending relevant conferences in any researcher's career. Being able to present my hard work this year was beneficial to both myself as well as the school. It permitted me to gain crucial experience in sharing research findings and build essential contacts for my future. It also allowed New Zealand to maintain its place as an important location for coral reef research in the eyes of fellow experts. I recommend all students to participate in a large overseas conference and I am extremely grateful to NZMSS for allowing me to do so with their generous contribution.

Milena Palka

Will Rayment - FOCTF Report to NZMSS Council

17th Biennial Conference on the Biology of Marine Mammals
Cape Town, South Africa 29th November – 3rd December 2007

My attendance at the Society for Marine Mammalogy's biennial conference was a very valuable experience and I am grateful to the New Zealand Marine Sciences Society for providing financial support. This conference was notable as it was the first time it had been held in the southern hemisphere and was attended by delegates from more countries than ever before. New Zealand was well represented, with delegates from Auckland, Massey and Otago Universities and the Department of Conservation.

I was daunted by the prospect of giving my talk in such a large auditorium in front of an audience of internationally recognized scientists. However, I enjoyed the experience and was very glad that I was selected for an oral presentation. I received many positive comments afterwards and was approached by several delegates who were interested to hear more about my research. I would recommend to all PhD students to try and present at a major international conference.

A highlight of the conference for me was the excellent range of plenary presentations at the start of each day. Although they were on a variety of topics, there was a common theme which all the speakers embraced. They felt that with so many marine mammal populations under threat, the time had come for researchers to look beyond their science as an "ivory tower" and become more involved in conservation management. In many situations, governments and managers have failed to make the difficult decisions required to protect threatened species and so it is up to those who really care about the animals (very often the scientists who are studying them) to be more proactive. I believe that this is a sentiment we can relate to in New Zealand and found the presentations and discussions very empowering.

Apart from the studies on Hector's dolphins presented by the NZ contingent, there were only two other presentations on Cephalorhynchus dolphins. Although this was a little disappointing it was still a good opportunity to meet up with other researchers working on similar species. Of particular interest to me was the work presented by Dr Sonja Heinrich on habitat selection by Chilean dolphins. A variety of other presentations were directly relevant to my PhD research, and it was very valuable to be able to discuss with researchers who have encountered and overcome similar challenges to those I am facing.

Another very rewarding experience was the student affairs workshop. A number of internationally recognised experts chaired informal discussions on a variety of topics, enabling students to pose questions and receive immediate feedback. The process was not only valuable in terms of gathering information, but also as a catalyst for promoting cooperation and establishing links with well known scientists.

Again, I would like to thank the NZ Marine Sciences Society for their financial assistance and reiterate the value of the First Overseas Conference Travel Fund.

Will Rayment

THE NEW ZEALAND MARINE SCIENCES SOCIETY AWARD

This highly prestigious award was inaugurated in 1985. Recipients of the award are chosen by the Council from nominations that can be submitted by any member of the Society. Nominations are considered annually but the Council need not present an award each year.

The award is a bronze sculpture in the form of the internal spire of a gastropod shell. It was designed and manufactured by Wellington artist Nick Dryden, and comes with an engraved plaque. The award carries with it lifetime membership of the Society.

The award recognises "a person's continued outstanding contribution to marine science in New Zealand". The three awards bestowed in the inaugural year, to scientists considered to be "founders of marine science in New Zealand", honoured work on ocean physics, marine geology and marine ecology, and the subsequent 13 recipients to date have made their contributions across an equally broad spectrum of our marine science.

Nomination Procedure

Any Society member can make a nomination (in writing) to the Secretary. The nomination need only be a short statement but it should concisely specify the major achievements of the nominee that would make them a worthy recipient of the award. The Council may seek further information about the nominee. The Council will choose the recipient from the nominations, and all nominations remain confidential to the Council. The award is presented at the NZMSS annual conference. The award need not be given every year.

NZMSS Award for Lifetime Achievement 2007
Wendy Nelson

Wendy is New Zealand's foremost authority on algal taxonomy. She has been working in the field for more than 25 years, and has published more than 70 scientific papers, as well as book chapters, reports and popular articles. She graduated with a PhD from the University of British Columbia in 1980 after gaining a BSc and honours degrees from the University of Auckland and Victoria University respectively. In 1981 and 1982 she worked for the Oceanographic Institute in Wellington, then successively held research posts at the Ministry of Agriculture & Fisheries (4 years), Te Papa (15 years) and NIWA (6 years). At NIWA she leads an active algal taxonomy research group and is the Science Leader for Taxonomy and Systematics across the institution. Research highlights in recent years are the collaborative efforts with Australian experts to better describe New Zealand's coralline algae. Wendy has also been very active more broadly on behalf of the New Zealand marine science community (she was on the NZMSS council for several years and had a stint as President in the 1990's if I recall correctly) as well as holding key roles in the NZ Association of Women in Science, and the New Zealand Conservation Authority. It is with great pleasure that I present you, on behalf of the entire society, with this award for lifetime achievement in Marine Science.

NZMSS AWARD PAST WINNERS

Year	Recipient	Conference Venue *(University, except where specified)*
1985	Jim Brodie, George Knox, Norm Barber	Canterbury
1986	Howard Choat	Victoria
1987	*no award*	Otago
1988	John Morton	Auckland
1989	*no award*	Wellington (National Museum)
1990	Pat Bergquist	Waikato
1991	Ron Heath	Wellington (National Museum)
1992	*no nomination*	Otago
1993	*no nomination*	Nelson (Quality Hotel)
1994	Janet Grieve	Waikato
1995	Vivienne Cassie-Cooper	Victoria
1996	Chris Francis	Canterbury
1997	John Jillett	Auckland (joint with AMSA*)
1998	*no award*	Otago
1999	Lionel Carter	Victoria
2000	Bob Creese	Waikato
2001	Bruce Hayward	Townsville (joint with AMSA*)
2002	Bill Ballantine	Nelson (Rutherford Hotel)
2003	Dave Schiel	Auckland and AUT
2004	*no award*	Otago
2005	Dennis Gordon	Victoria
2006	*No award*	Nelson (Rutherford Hotel)
2007	Wendy Nelson	Waikato

(* AMSA = Australian Marine Sciences Association)

NEW ZEALAND JOURNAL OF MARINE AND FRESHWATER RESEARCH

Papers published in 2007

Volume 41 comprises 39 scientific papers and 1 book review, published in four issues (a total of 409 p.).

Papers submitted in 2007

In 2007, a total of 129 papers were submitted including 62 papers for the special issue of the proceedings of the "8th International Conference and Workshop on Lobster Biology and Management" (Charlottetown, Prince Edward Island, Canada, 23—28 September 2007).

Of the 67 manuscripts submitted for standard issues, 52% were focused on freshwater and 48% on marine studies. New Zealand authors submitted 61% of manuscripts compared with 39% submitted by overseas authors. The main New Zealand sources (as a percentage of the total) were: National Institute of Water and Atmospheric Research Limited (13%), University of Otago (12%), University of Auckland (6%), University of Waikato (4%), University of Canterbury (4%). Massey University and Auckland University of Technology each contributed 3% of submitted manuscripts. Overseas papers were from Asia (12%), Europe (8%), Australia (6%), South America (6%), North America (3%), India (3%), and Iran (1%).

Papers were reviewed by 145 referees in 21 countries, with 74% of referees being from overseas: North America (36%), Europe (24%), Australia (10%), Mexico (1%), Asia (1%), Israel (1%), and New Caledonia (1%).

The rejection rate for papers submitted in 2007 is currently 22% (not including withdrawn and lapsed manuscripts).

New Zealand Journal of Marine and Freshwater Research depends on the support it receives from authors, reviewers, readers, and subscribers. Many thanks to everyone who has supported the Journal in 2007.

Katrin Berkenbusch
Scientific Editor
27 February 2007

Endorsed by the Editorial Advisory Board

NZMSS CONFERENCE 2007

Impacts of Climate Change on Marine Systems

Held at Waikato University, Hamilton, August 2007

Welcome Address

Welcome to this Annual Conference of the New Zealand Marine Sciences Society. The theme of today's conference is both timely and important: Impacts of Climate Change on Marine Systems.

Scientific reports on global temperatures, and its influences on climate are coming out thick and fast. I had a look at the table of contents for recent issues of the journals Climate Research and Climate Dynamics. There were 13 papers on weather, ice volume, sea-level rise, modeling, and atmosphere. There were none on the marine environment.

The Third Climate Change and Business Conference is starting tomorrow in Brisbane. Of the 59 talks/workshops listed in their programme, two have a marine component. Two? What's going on here? Are we the only people who know how important the ocean is?

Perched here on the sub-tropical convergence, New Zealand is especially well-placed to investigate the effects of climate change on southern temperate region. In fact, we have to. These are our shorelines, our marine ecosystems, our beaches, our fish, our baches, our surfing breaks, our mussels, our ports and harbours – we must know more about how climate change and warming might affect our maritime country.

The role of carbon dioxide emissions in changing ocean chemistry is becoming more widely understood, under the catch-all of "ocean acidification." Finally being recognized as a major potential problem associated with climate change, an increasingly acidified ocean may affect creatures from fish to plankton, from coral reefs to cool-water carbonates. How – we don't know. Major reports keep coming out, and they all say we don't know enough about the interactions of marine water chemistry, organisms, sediments and ecosystems right now, and yet they are changing around us.

Here in New Zealand we are embarking on yet another year without an Oceans Policy, despite a process which began seven years ago. We still have long stretches of coastline without a single Marine Protected Area. We are presiding over extinctions, over-fishing, and coastal pollution of our almost unparalleled marine biodiversity.

New Zealand's Marine Scientists have a critical role to play in this scenario. There is knowledge, and we must make sure decision-makers have the information they need to create wise and sensible policies. There are gaps in our knowledge, and we must try to fill them. There are ways scientists can be involved in policy-making at both local and national levels, and we must take on responsibility when we can. There is ignorance and misinformation out in the community, and we must do what we can to inform and educate people around us.

The NZMSS exists to represent us as a group, to communicate our deep concern for the marine environment and for marine science itself to the public and the government. This year's conference is an opportunity for us to communicate with each other, as well. I urge you all to talk, to listen, to argue, to eat and drink together, to debate the issues, and to have fun doing it.

Welcome to Hamilton.

Abstracts for Keynote Presentations

Dr Jim Renwick
Science Leader, Climate Variability & Change
National Institute of Water & Atmospheric Research

RECENT CLIMATE CHANGE ASSESSMENT: IMPLICATIONS FOR THE NEW ZEALAND MARINE ENVIRONMENT

The Intergovernmental Panel on Climate Change (IPCC) recently released its fourth Assessment Report (AR4), covering past observations of climate changes and projections of likely future global changes. This presentation will summarise the role of the IPCC, and outline some of the key messages from the AR4 in terms of both the past and the future.
It will then go on to describe the New Zealand scene in more detail, beginning with what has been observed in the past century, and what is expected in broad terms over the coming 50-100 years. The presentation will then focus on changes in coastal and marine environments, changing risks of extreme events, and possible implications for fisheries and marine ecosystems.

Dr James Renwick leads a major research programme on climate variability and change at NIWA in Wellington. His current interests include Southern Hemisphere climate variability and impacts of climate on the New Zealand environment. He has worked in the area of climate and atmospheric dynamics since the late 1970s, starting as a weather forecaster at the Meteorological Service. He acted as a lead author on Working Group I of the IPCC 4th Assessment Report, dealing with observed changes to the large-scale circulation of the atmosphere. He serves on the World Meteorological Organisation Commission for Climatology Expert Team on Seasonal Forecasting and is a member of the Royal Society of New Zealand Climate Committee and is the Earth Sciences and Technology member of the Council of the Royal Society.

Dr Dennis Gordon
Principle Scientist
National Institute of Water & Atmospheric Research

HOW MANY SPECIES IN NEW ZEALAND'S SEAS?

Species 2000 New Zealand", launched in 2000, undertook to review and inventory New Zealand's entire biodiversity. The project concept — "all of life through all of time" — includes New Zealand's fossil biodiversity as well as naturalised-alien species. When launched, the project had four main goals: 1) hold an introductory symposium to launch the project (achieved 1–5 February 2000); 2) publish volumes of phylum-by-phylum reviews of all taxa with checklists of all known species (volume 1 is currently being prepared for publication by Canterbury University Press); 3) produce electronic checklists of definitive species names classified in a Linnaean hierarchy, available online; and 4) amplify these checklists (adding value) through the addition of synonyms, common names, related information, and illustrations. The last two goals may be achieved through NZOR—the New Zealand

Organisms Register— if the March 2007 application for funding it is successful, but checklists of some individual taxonomic groups are already available (e.g. fungi, seed plants, Mollusca).

New Zealand has >54,000 named and known undescribed species of life, including 15,905 marine species. These comprise 40 Prokaryota, 1664 Protozoa, 854 Chromista, 667 Plantae, 3 Fungi, and 12,677 Animalia. How great is undiscovered marine biodiversity? This is impossible to answer, especially for prokaryotes, but all other organisms could conservatively tally 26,000–44,100 species. It will take between four and five centuries to complete the task of inventorying New Zealand's marine biota (known unidentified/undescribed species plus estimated undiscovered species) at the present rate of new species descriptions (c. $100.y^{-1}$), a task not aided by the vastly reduced funding available for marine taxonomy. This presentation discusses the benefits of knowing our marine biodiversity, and how it compares with that in other parts of the world.

Professor David Schiel
Marine Ecology Research Group
School of Biological Sciences
Canterbury University

LIFE CHANGES AS OCEAN WARMS:
CLIMATE CHANGE AND ROCKY REEF COMMUNITIES

There are few things more alarming than the notion that life as we know it is changing inexorably. Climate change is predicted to have numerous large impacts on terrestrial and oceanic habitats and, in many ways, these will coalesce in the marine coastal zone. Predictions include warming seas, melting ice caps, increases in sea level, waves and erosion, increased coastal sedimentation, and numerous societal changes. Although NZ is an active land mass and has seen these sorts of changes over the recent geological past, the pace of change is predicted to increase dramatically. How resistant are coastal marine communities, how resilient are they to environmental changes? Whereas mobile species can simply migrate, benthic species may be much more vulnerable to change, especially key species of primary producers that dominate habitats and others with strong trophic linkages. Together, these drive much of the diversity and productivity of rocky reefs and account for much of their "ecological "function". We know that many species respond in unpredicted ways and that drastic change has been foreshadowed. The robustness of our predictions, however, will depend on much greater understanding of fundamental relationships among coastal communities and their vulnerability to altered circumstances. Ecological science has a key role in this, and in providing the underpinning knowledge, understanding and advocacy that will lead to worthwhile mitigation and adaptation, rather than suffering, the three scenarios often offered to society.

David Schiel is Professor of marine science in the School of Biological Sciences at Canterbury University. He is head of the Marine Ecology Research Group and co-director of the University of Canterbury / NIWA Centre of Excellence in Aquaculture and Marine Ecology. He is principal investigator on several programmes, including FRST and Marsden, investigating nearshore ecological processes, physical processes relating to dispersal and settlement, and life history bottlenecks for species crossing habitats. Funding from the Andrew Mellon Foundation of New York has enabled close linkages with research programmes in several countries. Prof Schiel was awarded the NZ Marine Sciences Society Achievement Award and Life Membership in 2004.

Dr Simon Thrush
Principle Scientist
National Institute of Water & Atmospheric Research

IMPACTS OF CLIMATE CHANGE ON COASTAL SOFT SEDIMENT ECOSYSTEMS

Our coasts and estuaries are on the frontline in terms of likely climate change impacts, yet there is no strategic research programme targeting this issue. Nevertheless, research focused on understanding how benthic ecosystems function, respond to disturbance and change do give us information for making meaningful assessments of how our highly valued coastal and estuarine ecosystems will respond. In this talk, I will briefly review the nature of coastal and estuarine ecosystems and potential key drivers of change. I will discuss analysis of long-term ecological monitoring data to distinguish how broad-scale climatic effects may influence community dynamics. Then I will illustrate insights into ecosystem response to climate change that can be gained from some ecological research in our estuaries and coasts. Next, as Antarctica is such an important region for understanding ecological responses to climate change, I will provide examples of potential change in function along the coast of the Ross Sea. I will finish the talk by discussing the integration of science with management and policy and the need for a focused and funded research agenda

Simon Thrush is the Coastal Ecosystems Science Leader for NIWA and Principal Scientist in Benthic Ecology. His research has focused on the ecology of soft-sediments and has included research on ecological scaling; disturbance and recovery; functional ecology and ecosystem services. Fieldwork for this research has been conducted in a variety of intertidal and shallow sublittoral habitats around New Zealand and in Antarctica. He and his colleagues are involved the development and implementation of strategic research to influence resource management and improve societal valuation of marine ecosystems. This has included work on contaminant effects, the design of ecological monitoring programmes, the environmental effects of fishing and the impacts of sediment runoff. He has published over 130 scientific papers and enjoys extensive international collaboration with colleagues in USA, Canada, Britain, Norway, Finland, Spain, Netherlands and Italy.

Associate Professor Christopher DeFreitas
School of Geography, Geology and Environmental Science
University of Auckland

CURRENT ISSUES IN GLOBAL WARMING SCIENCE: FOCUS ON THE DATA

Confusion about global warming is one reason why progress towards ratifying an international carbon emissions agreement has been slow. This is caused by uncertainty surrounding the science of global warming on the one hand, and public perception of the state of this scientific knowledge on the other. This confusion underlies problems confronting decision makers on how and when to act. Despite the confusion, or perhaps because of it, global warming alarmism has acquired a life of its own.

There is no doubt that carbon dioxide acts to warm the atmosphere. But the key question to ask is not: Is carbon dioxide a major driver of global climate variations? Rather we should ask: Is an increase carbon dioxide likely to have a major effect on global climate? The evidence to date suggests the answer is "no". In fact, there is no evidence at all of high global climate sensitivity to an increase of in carbon dioxide concentration in the atmosphere above present levels. What is rarely mentioned is that carbon dioxide's effect on global temperature is already close to its maximum and adding more has an ever decreasing effect. As one such empirical test, it can be noted that no significant global increase in temperature has now occurred since 1998 despite steadily rising carbon dioxide concentrations in the atmosphere

Climate-change science is bursting with new findings and it is mostly to do with the Sun. Solar-related processes are the main driver of Earth's climate. The evidence is to be found in nonsynchronous Schwabe (11–12 years), Hale (22 years) and Gleissberg (80–90 years) solar cycles, variable solar energy output, periodic changes in solar winds and solar magnetic fields, and other direct and indirect solar-related influences on climate such as changes in the Earth's solar reflectivity and orbit. Some solar scientists predict that global cooling will commence around 2020, or as early as 2012, and reach its peak about 2055. The New Zealand government believes climate warming is a proven fact and will continue. But what if we get global cooling rather than warming? There is no doubt New Zealand would be worse off. Growing seasons would be shorter and frosts more frequent. Crop maturity and pasture growth would be slowed. Perhaps planning for adaptation to such cooling should be a priority for governments. Human influence aside, it is certain that natural climate change will continue. The appropriate public policy response is, first, to monitor climate accurately in an ongoing way; and, second, to respond and adapt to any changes - both warmings and the likely more damaging coolings - in the same way that we cope with other natural events such as tropical cyclones, earthquakes and volcanic eruptions.

Chris de Freitas is a climate scientist in the School of Geography, Geology and Environmental Science at the University of Auckland, where he has been Head of Science and Technology at the Tamaki campus and Pro Vice Chancellor. He has Bachelors and Masters degrees from the University of Toronto and a PhD from the University of Queensland as a Commonwealth Scholar. For 10 years he was as an editor of the international journal "*Climate Research*". He is an advocate of open and well informed reporting on scientific issues. In recognition of this, he has three times been the recipient of the New Zealand Association of Scientists, Science Communicator Award.

Abstracts for Oral Presentations

"Stress on Stress" Assays to Diagnose the Ecological Health of Estuarine Organisms

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Whereas the objective of many conservation programmes in human-affected coastal areas is to safeguard or enhance the "ecological health" of local biological communities, this term is often poorly defined and quantified. In our effort to develop a more differentiated evaluation system to gauge the ecological integrity of New Zealand estuarine communities, we have adopted a multiple-diagnostic approach that measures ecological health as the product of a system's vigour, organisation and resilience (or resistance) to disturbance. Expanding beyond classical abundance and mortality-based ecological indices, we are including physiological and biochemical fitness attributes (biomarkers) in our assessment of ecological integrity, as well as their dynamic response to additional disturbance than encountered in the field ("stress on stress"). Our working hypothesis is that physiological and behavioural assessments provide early warning signs of declining health that translate to population and community level responses, and that vigour and resilience are highest at intermediate stress levels. For measuring the capacity of organisms to cope with additional disturbance (resistance or resilience), we have conducted laboratory and field experiments, in which bivalves and species assemblages along a metal contamination gradient (or pre-exposed to metals in the lab) were subjected to short-term secondary physiological stress (including heat, anoxia and organic carbon enrichment). Results of these stress-on stress experiments to date include evidence for lower resilience of chemical contaminant-exposed bivalves. However, resistance to some stressors (e.g. elevated temperature up to 35 °C) appears to be higher, surprisingly, in metal pre-exposed bivalves. We anticipate that the patterns and magnitude of responses of key species to a number of secondary stress challenges provide valuable diagnostic information to gauge the dynamic integrity of estuarine ecosystems.

Snail migration: Implications for experimental design

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The zonation of mobile species, such as grazing snails, may be influenced by migration patterns, which often are missed if the population is not sampled within the appropriate temporal scales (i.e., tidal cycles, diurnal periods, seasons). Aspects of community ecology, especially abundance, biodiversity, and habitat preferences, are better described when the mobility of different species or group of organisms also are investigated. The effect of migration on the density and size-frequency distribution of two dominant intertidal grazers were studied in New Zealand and the Fiji Islands. In New Zealand, Turbo smaragdus was investigated across four habitats (mangrove tree, pneumatophore, algal aggregation, and seagrass bed) during emersion and immersion periods at Matapouri Estuary, northern New Zealand. Marked-recaptured experiments indicate that snails migrate upward during high tide and downward during low tide. These snail movements appear to be related to improved feeding activity during tidal inundation within macroalgal aggregations in the pneumatophore and algal zones. In the Fiji Islands, the migration patters of Littoraria scabra were investigated within mangrove tree trunks and roots. Snail movement patterns were monitored through several tidal cycles. Results from these experiments indicate that snails move up and down the trees with the tide, and actively avoid submersion while feeding on micro-algae and filamentous algae on the tree surfaces.

While migrating, these snails maintain close affinity to their neighbors by following mucous trails, which facilitate aggregation behaviours.

Analysis of the New Zealand ballast water database: Where does our risk lie?

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Ballast water has been recognised as a vector for the transfer of organisms beyond their natural range, and some of these organisms have proved to be invasive in introduced environments. The high-profile impacts of ballast water mediated invasions, such as the zebra mussel (Dreissena polymorpha) in the Laurentain Great Lakes, have led to international action to try and mitigate the risks associated with ballast water discharges. Under the auspices of the International Maritime Organisation (IMO), international efforts to mitigate the risk posed by ballast water have seen the adoption of an international convention which includes an exchange standard with a transition to a treatment standard, whereby onboard treatment systems will be required to reduce the propagule load in ballast water. However, the current lack of effective treatment options means that implementation of the treatment standard is likely to be extended beyond 2009.

Exceedance curves for defining MHWS and future sea-level rise

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Exceedance curves also serve to illustrate the effect of sea-level rise on exceedance probabilities for a given level or berm height. A finding is that areas with a low tidal range will likely be impacted more than those with larger tidal ranges. The approach outlined is useful for engineering design and building awareness of what sea-level rise will mean for a particular locality. The techniques will be illustrated for the north-eastern coast of New Zealand based on tides derived from a New Zealand tidal model for sites at regular intervals and verified by tidal measurements. This application was used for an Environment Bay of Plenty project to provide a more consistent definition of MHWS to intersect with their LiDAR-based digital elevation model.

The control of carbon translocation in a sea anemone-dinoflagellate symbiosis from New Zealand

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Coral reefs are one of the earth's most diverse ecosystems. Much of this diversity is made possible by intracellular dinoflagellates of the genus Symbiodinium, zooxanthellae, which provide photosynthetic products for the coral animals in nutrient-poor waters. Zooxanthellae also maintain symbiotic relationships with other organisms, including sea anemones and giant clams. Carbon translocation from the zooxanthellae to the host is thought to be controlled by one or more chemicals present in the tissue of the host. Known as 'host release factor', (HRF), the compounds and molecules responsible are unknown. There have been no studies of HRF in New Zealand's marine symbioses, so we are

examining this phenomenon in the common New Zealand sea anemone Anthopleura aureoradiata. When zooxanthellae from A. aureoradiata were incubated in a tissue extract of this anemone there was no stimulation of labeled ^{14}C-photosynthate release by the zooxanthellae. This is in marked contrast to numerous studies with other comparable systems, as well as the behaviour of the zooxanthellae when still inside A. aureoradiata, where more than 30% of photosynthetically-fixed carbon was translocated to the host. The lack of an HRF response in vitro is being examined by: (1) PAM fluorometry, to test whether the lack of repsonse is associated with a loss of photosynthetic health; (2) incubating different clades of Symbiodinium in A. aureoradiata extract to test the generality of the response; and (3) altering the nutritional status of the zooxanthellae, as evidence from other systems shows that nitrogen-starved zooxanthellae respond more readily to HRF than nitrogen-sufficient zooxanthellae. The latest findings from these studies will be presented.

Visual observations at cold seep sites on the Hikurangi Margin, North Island, New Zealand

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The first direct observations of chemosynthetic assemblages in cold seep habitats along the east coast margin of the North Island were made during voyages by RV Tangaroa in November 2006 (TAN0616 NOAA-NIWA New Zeeps) and by RV Sonne in early 2007 (SO191 New Vents). Active seep sites were detected at several locations using a combination of historical data, acoustic detection of water-column gas flares, and photographic surveys of the seabed. High resolution digital video and still cameras enabled the spatial extent of the sites and the abundances of chemosynthetic megafauna to be determined, and subsequent physical sampling confirmed taxon identities and provided material for trophic analyses. We describe the main seep sites and their associated biota in terms of their spatial extent, activity, and the identities and abundances of the principal chemosynthetic taxa as determined from video and still images.

Marine ecosystem science, management and conservation in New Zealand: where is the connection?

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The science and management of marine ecosystems is often confounded by their complexity and by differing objectives among scientists, conservation managers and communities. A shared information base can help unify fragmented research efforts and advice from scientists and communities can help conservation managers to address a range of ecological and social objectives.

This poster presents examples of how scientific and other expert advice has assisted in the design and identification of marine protected areas and how these processes can be applied in New Zealand. We describe progress in the Hauraki Gulf region in mapping basic habitat surrogates to describe broadscale patterns in marine biodiversity and outline other ways in which knowledge about marine ecosystems can be incorporated into planning for marine conservation, sustainable use and understanding.

A new multi-stock, length-based stock assessment model for New Zealand rock lobsters (Jasus edwardsii)

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The exptended model allows simultaneous modelling of two or more stocks with a mixture of common and stock-specific parameters. All parameters except recruitment can be specified as common or stock-specific. The program allows a choice of likelihood functions for the various data sets, choice between finite and instantaneous fishing dynamics and two forms of selectivity curve. The time step is flexible and can vary during the period modelled. Lobster movement between stocks can be estimated; density-dependent growth can be modelled with estimated parameters; a stock-recruit relation can be estimated.

Evidence for hybridization in the endemic New Zealand brown alga Carpophyllum (Fucales)

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Hybridization can increase diversity, through the production of new species, or reduce diversity, by the coalescence of parental species, depending on the strength of selection on hybrids. The role of hybridization in marine macroalgae is poorly known. Carpophyllum has four recognized species. Morphological intermediates - interpreted as hybrids - have been reported between C. maschalocarpum and the other three species, but no molecular evidence for the hybrid origin of intermediates has been collected. Molecular data shows low variation between species, despite morphological differences. Mitochondrial and ITS sequences resolve C. plumosum and C. flexuosum as divergent groups, but C. angustifolium and C. maschalocarpum sequences produce multiple polyphyletic clades, suggesting incomplete lineage sorting or introgression. Putative hybrids of C. maschalocarpum and C. angustifolium occur in sites where these species co-exist. ITS sequences from morphological intermediates from East Cape and the Poor Knights confirms their hybrid status, as these specimens contain rDNA ribotypes from both parental species. ITS regions are inadequate for diagnosing hybridization in the Leigh area as several ribotypes are shared by the two parental species and heterozygotes might result from inter- or intra-specific crosses. ITS ribotyping can only confirm hybridisation in populations on the periphery of the range of these species, presumably because of local lineage sorting, founder effects, or both. Mitochondrial DNA suggests hybridization is symmetrical. Future work will address the phylogeographic structure of Carpophyllum populations.

Trophic study of Ross Sea Antarctic toothfish (Dissostichus mawsoni) using carbon and nitrogen stable isotopes.

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Antarctic toothfish (Dissostichus mawsoni) in the Ross Sea are diverse feeders, taking prey from a range of trophic levels. Current dietary information is based on stomach content analyses, however these data only give us insight into the latest prey catch, and provide no information on long-term

integrated diet. One tool which enables us to look at this is stable isotope analysis. Relative abundances of carbon and nitrogen isotopes in a consumer's protein reflect its diet and can be used to establish trophic position. Such information is critical to developing Ross Sea trophic models and to assessing the impact of the Antarctic toothfish fishery on associated species. We present data from 400 isotope analyses of Antarctic toothfish and potential prey species and show that there is a large range in isotope values: 3-4 ‰ for $d^{15}N$ (equating to one trophic level) and 4 ‰ for $d^{13}C$ (suggesting multiple primary sources of organic matter). We show that the diet of the Antarctic toothfish varies with location and with fish length and that some Antarctic toothfish occupy a trophic position in the Ross Sea food web equivalent to orca (Orcinus orca), sperm whales (Physeter macrocephalus) and Weddell seals (Leptonychotes weddellii). We attempt to assess the relative proportions of different food sources ingested by Antarctic toothfish using a multi-source mixing model *IsoSource*, discuss why these data do not conform to this model and in conclusion, present research plans for the future to address this issue.

Age and growth of juveniles of three species of flatfish in seagrass and non-seagrass habitats in two Otago inlets.

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Seagrass beds can play an important role as nursery areas for the successful development and growth of juveniles of many species of fish. Growth rates can influence survival during periods of predation pressure, favouring survival of faster growing individuals. This study examined the age and growth of three species of juvenile flatfish, Rhombosolea tapirina, Rhombosolea plebeia and Peltorhamphus latus in seagrass and non-seagrass habitats in two Otago inlets, Papanui and Puraukanui. Papanui Inlet is characterised by large patchy areas of seagrass and bare sediment, whereas Purakaunui Inlet contains no seagrass areas. Fish were aged by counting daily growth rings on sagittal otoliths. A laboratory validation experiment showed that R. tapirina otolith increments were deposited daily. Comparisons of size-at-age data between the two inlets and between seagrass and non-seagrass sites in Papanui Inlet will be presented. Comparison of growth rates among species will also be presented. Preliminary results indicate that juvenile R. plebeia have a higher growth rate than juvenile R. tapirina.

Divergent effects of two key species co-occurring in New Zealand marine soft-sediment habtitats.

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There is growing awareness that biodiversity contributes to ecosystem functioning and to the delivery of valued ecosystem goods and services. However, many of the "diversity" results can be traced back to strong single species effects. Here, we examine changes in habitat characteristics and ecosystem functioning brought about by manipulations of "key species" at a subtidal site in Mahurangi Harbour. Specifically, we created patches of large suspension feeding bivalves (Atrina zelandica) inside dense beds of large bioturbating urchins (Echinocardium cordatum). Atrina creates biodeposits which can smother microphytobenthos and enhance macrofauna in surrounding sediments, whereas bioturbation by Echinocardium can facilitate microphtye photosynthesis and disturb macrofauna. By sampling before and after the creation of Atrina patches, and by sampling at various distances from the Atrina patch edges, we documented interesting interactions between the two key species and effects on

various habitat characteristics. We conclude that, because the two key species have divergent effects on habitat characteristics and macrofaunal community composition, the best way to preserve biodiversity and a range of ecosystem functions in New Zealand coastal waters is to maintain habitat diversity (including dense patches of Atrina and dense beds of Echinocardium).

Colonisation of the Chatham Islands by intertidal organisms: Oceanographic connections

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We aim to determine the dispersal times for planktonic larvae between mainland New Zealand and the Subantarctic Islands, in order to test whether present-day oceanic circulation can explain observed genetic distributions of Cellana strigilis limpets which have a 3-10 day larval life. Satellite-derived measurements of sea level since 1992 are used to simulate potential larval trajectories. Distributions of these trajectories allow us to determine dispersal times between various islands.

Dispersal times between all islands, except between Snares Island and the main islands of New Zealand are much longer than Cellana strigilis larval lifetimes.

Present-day oceanic circulation patterns can explain the maintenance of western and eastern lineages of Cellana strigilis, but they cannot explain the observed homogeneity within each lineage. Simulations of paleo-currents are beyond the scope of this work, but lowered sea level during the last glacial maximum would have aided in Auckland to mainland New Zealand connections, but not between the other island groups.

Managing threats to Cephalorhynchus dolphins: lessons from comparing the New Zealand and the Chilean experiences.

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Hector's dolphin (Cephalorhynchus hectorii) and Chilean dolphin (C. eutropia) are congeneric species endemic to the inshore waters of New Zealand and Chile, respectively. Their coastal habits and small population sizes make them vulnerable to anthropogenic threats posed by entanglement in fishing gear, boat traffic, coastal run-offs and pollution, and aquaculture farming. Despite many apparent similarities in species biology and conservation threats large differences exist in legislative regulations, management approaches, public awareness and understanding of the two species. We compare the scientific information and management frameworks available to guide conservation actions in the respective countries and consider benefits of bilateral sharing of experiences. Unlike the longitudinally and regionally well-studied Hector's dolphins, Chilean dolphins are poorly known and information is lacking on many vital population aspects. Some systematic ecological studies of Chilean dolphins only began in 2001, allowing a variety of yet un-quantified threats to be identified. Rapidly expanding aquaculture farming activities (for salmon and mussels) in southern Chile appear to threaten small localized dolphin populations due to incidental entanglements in cage netting, displacement from important habitat and impacts on the coastal ecosystem. Dolphin bycatch in gillnets is also known to occur. Marine conservation in Chile is in its infancy, both with regard to a suitable management framework and implementation of conservation actions. The New Zealand experience could guide

Chile's steps towards a budding marine tourism industry and the inception of marine protected areas. The Chilean experience provides an experimental setting to evaluate effects of poorly controlled and rapidly expanding aquaculture activities.

The effect of antecedent conditions on rip channel development

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Rip channel systems are a common feature of nearshore system. They are often characterized by regular alongshore spacing. Field observations and computer simulations have focused on predicting the spacing and e-folding time of rip channels as a function of offshore hydrodynamics. Here, we show that the lack of predictability of rip channels is an inherent property of the system related to the high sensitivity to the bathymetry prior to pattern development. Sensitivity to the initial cross-shore profile appears to be as important as sensitivity to wave height. Because of this sensitivity, simple predictors of rip channel spacing or e-folding time have only limited success.

A meta-analytic review of the effects of seaweeds on temperate reef fishes

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Large brown macroalgae (seaweeds) are conspicuous components of temperate subtidal rocky reef ecosystems. The effects of large brown macroalgae on fishes are less well-understood than the effects of macroalgae on small mobile invertebrates, which are more intimately associated with macroalgae. Many rocky reef fishes recruit from the plankton to the structure of large brown macroalgae, whereas larger fishes often exhibit associations with either macroalgal-dominated or urchin-dominated ("barrens") areas. Our review of the published experimental evidence indicates that responses vary among fishes, and among size-classes within fish species. Relationships between effect size and latitude, manipulation area and duration were weak, and numerous possible artifacts were identified that future studies should avoid. The primary conclusion was that further field studies are required to clarify relationships between fish and seaweeds.

Equivalence tests for anova and Poisson models

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Tests of frequentist null hypotheses are almost ubiquitous in ecological journals, but the methodology is widely-criticised by statisticians. The main alternatives offered to date require the adoption of radically different statistical philosophies. Here we demonstrate extensions to an alternative - tests of equivalence hypotheses - that are novel in ecology, less computationally demanding than Bayesian and likelihood approaches, and are potentially widely applicable. For densities and sizes of blue cod,

Parapercis colias, in and near a New Zealand marine reserve, we test whether the differences in density and size between reserve and fished areas lie within an interval of practical indifference, at the start of the study and after eight years of protection. The tests of equivalence hypotheses that we offer allow practical significance to be incorporated into statistical calculations, and focus attention on whether differences are of real consequence, rather than whether sufficient data have been collected to attain statistical significance.

Sediment quality assessment: contaminant mobility and bioavailability

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The range of facilities for boat maintenance activities in New Zealand includes dry docks, hardstand yards, slipways, sealifts and travel lifts, floating docks, in-water cleaning by divers, tidal grids, or by beaching boats at high tide. However, a substantial proportion of facilities do not treat hull-washing wastewaters, but return both solid and liquid wastes to the sea. This is a concern not only for biosecurity reasons, but also because many components of antifouling paints are considered toxic to marine life. A previous study of seawater and sediment quality in the vicinity of boating facilities across New Zealand reported very high levels of antifouling agents in seawater and sediments near a small boatyard in the Marlborough Sounds, which has been in operation for about a century. Monitoring undertaken between 2004 to 2006 found a strong contamination gradient from the impacted zone to a reference site, but the correlation between contaminants and changes in benthic infauna composition were weak. Furthermore, body burdens of contaminants in wild mussel populations showed a gradient between sampling zones, but whether the bioavailable levels of contaminants had also changed remaines unclear. This present study summarises the main findings from the 2006 survey, and outlines the approaches undertaken to characterize the bioavailability of key contaminants using a food web model and also the use of transplanted mussels and passive samplers to monitor bioaccumulation of target contaminants.

Patterns of echinoderm distribution and rock-wall community structure in relation to low-salinity-layers in New Zealand fiords

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Low-salinity-layers (LSLs) in New Zealand fiords provide a refuge from stenohaline predators and grazers including omnivorous urchins (e.g., Evechinus chloroticus, Pseudochinus huttoni) and predatory seastars (e.g., Coscinasterias muricata), which in turn have been implicated in regulating the abundance and diversity of invertebrates inhabiting fiord rock walls. Areas covered in coralline algae and low in diversity are commonly observed within the depth strata frequented by E. chloroticus and C. muricata. With the exception of Patiriella spp., dominant seastars and urchins are restricted to rock wall habitat below the LSL. Data acquired from 8 years of photographic monitoring of the rock wall communities throughout Doubtful and Milford Sounds confirm that the vertical distribution of E. chloroticus and C. muricata is largely dictated by LSL thickness; hence these organisms are displaced

deeper in inner fiord regions. There also lies a tight correlation between spatial patterns of echinoderm distribution and species richness of sessile invertebrates inhabiting the rock wall. At the fiord heads, a deeper distribution of echinoderms coincides with a lower number of invertebrate species at depths between 10 and 20 m. The number of species at depths > 10 m is lowest at sites within inner Doubtful Sound, which corresponds with a particularly high abundance of P. huttoni at these sites. Construction of agent-based models coupled with numerical simulations of the LSL and *in situ* archival tagging of echinoderms is underway to more fully elucidate the mechanisms driving patterns in echinoderm distribution and rock-wall community structure in New Zealand fiords.

Small Mobile Invertebrates in Coastal Habitats… The hidden producers.

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A broad-scale survey of mobile epi- and infauna >0.5mm was conducted within 34 habitats common to the coasts of northeastern New Zealand between the high tide mark and 20m depth. Density, biomass and productivity of each community were estimated to ascertain the relative contributions and potential importance of each habitat type. Productivities differed by as much as 3 orders of magnitude, but turfing coralline algae and high-shore stranded macrophytes were consistently the most densely populated and productive habitats. At a broader level the subtidal rocky reef was most productive. The most abundant taxa were the gammarid amphipods and gastropods (numerically dominant in 85% of habitats sampled); whilst the former were the greatest contributors to overall productivity (mean 38.3%). Comparisons were also made between epi- and infaunal communities; epifaunal habitats contained the greatest animal density and biomass and were the most productive, although this tended to be concentrated in smaller size-classes than for infaunal communities. These animal communities have received relatively little attention, despite their importance in many ecological aspects such as being an important trophic link between primary producers and juvenile fishes. This is the first study to systematically estimate the productivity of small coastal invertebrates on such a broad scale and could provide valuable information for future coastal management schemes.

Ocean Acidification – What's All the Fuss About?

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One of the consequences of the oceanic uptake of carbon dioxide that has received little attention is acidification of the oceans. The burning of fossil fuels and other human activities has increased the concentration of carbon dioxide, a greenhouse gas, in the atmosphere. About half of the anthropogenic CO_2 emitted to the atmosphere has remained there, the other half has been taken up by the terrestrial and oceanic reservoirs. An increased oceanic CO_2 concentration results in a change in the carbonate speciation in the seawater, and a decrease in the oceanic pH. This in turn has implications for organisms which use calcium carbonate as a structural component. This review will present the chemistry behind the predicted effects of oceanic uptake, and will report some data from the NZ region.

The New Zealand EEZ and SW Pacific Ocean- How Big is the Sink for Atmospheric Carbon Dioxide?

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The South West Pacific Ocean is a dynamic area, containing several oceanic water masses, frontal areas and regions of deep water formation. The Southern Ocean is known to be a sink for atmospheric CO_2, however models do not reproduce the observations well, the processes determining the carbonate chemistry in this area are not yet well understood. Inverse models based on atmospheric CO_2 data estimate that the Southern Ocean sink is decreasing due to greater mixing of high carbonate deeper waters to the surface. Global pCO_2 and air-sea carbon flux climatologies are based on few measurements in the New Zealand region, and the data is skewed towards summer and spring timing. Data from several recent New Zealand cruises indicate that the net air-sea CO_2 flux in the SW Pacific Ocean and the NZ EEZ is less than has been previously estimated.

Remaining Unseen In a Pelagic Environment: The Conflict Between Camouflage and Feeding

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Trachurus novaezelandiae is a pelagic species that exhibits reflective camouflage. It has been observed that under some conditions T. novaezelandiae tilt upwards while searching for zooplankton. This behaviour gives them a line of sight just outside of Snell's window. In this area, light is refracted through transparent organisms, making them contrast against the dark under-surface of the water. In addition, each time prey is taken, these fish flare their operculum as a by-product of their suction feeding mechanism. Searching for prey outside Snell's window breaks the camouflage mechanism which is further disrupted by the flashes of reflected light that occur during feeding.

The photosynthetic health of Antarctic sea-ice algae in response to melting measured using Imaging Pulse Amplitude Modulated (IPAM) Fluorometry

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Antarctic sea-ice algae are exposed to dramatically different conditions as the ice melts. Our experiments duplicated the melting process, and involved the exposure of sea-ice to different irradiances (1-270 ◎mol photons m^{-2} s^{-1}), salinities (0-36ppt) and UVB levels (0-25% lamp output). Visualization of the algal response was carried out by Imaging Pulse Amplitude Modulated (IPAM) fluorometry. Ice algae responded to increasing levels of light with a reduction in photosynthetic yield, however once the ice had completely melted there was evidence of some recovery. Light also exacerbated the response when ice was melted in water of different salinities, while the effect of salinity itself was also marked. At the lowest salinity the ice algae were very severely stressed when exposed to low irradiances, and at mid and high irradiances the algae eventually gave no photosynthetic response. At intermediate salinities all algae were severely stressed, particularly at high irradiances; algae melted into full strength seawater in the dark were not stressed. Lastly, at 25% strength, UVB had the

immediate effect of depressing the photosynthetic yield regardless of the melting state. However, in the 5%-UVB and no-UVB (PAR only) treatments no effect was evident until melting was well advanced. At this point the 5%-treated ice algae responded negatively to UVB, more so that those exposed to PAR only; however, the 5%-treated algae recovered once the melting process was complete. Our results indicate that, as ice algae pass from the solid to the melted state, they are particularly vulnerable to environmental stressors.

The Banks Peninsula Marine Mammal Sanctuary 20 years on. What have we learned?

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The Banks Peninsula Marine Mammal Sanctuary, created to protect Hector's dolphins from entanglement in gillnets, is nearing its 20th birthday. In order to critically evaluate the Sanctuary's effectiveness, our research group has studied this population of Hector's dolphins intensively. Adult survival rates, calculated from photo-ID data, remain too low for population growth. The most likely reason for this is that the dolphins are more exposed to continuing gillnetting than previously thought. Three years of aerial surveys have shown that in summer, about 20% of the population is beyond the sanctuary's 4 nautical mile offshore limit. In winter this figure rises to 56%. New analyses of home range also suggest larger alongshore ranges than previously thought. Bycatch has not been quantified since 1997/98, but nearby gillnet effort is increasing, especially to the south. Acoustic monitoring shows that areas where amateur gillnetting is allowed in winter are used by dolphins. All population models so far constructed suggest that the Banks Peninsula population is declining. In summary, the sanctuary has reduced bycatch, but is too small to halt this population's decline, let alone facilitate recovery. Marine protected areas are obvious choices to mitigate bycatch, but they can act to shift the problem, rather than solve it. We offer some general pointers on MPA science and management.

Influence of turbulence on attachment and detachment of seaweed zygotes in turbulent flow

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A critical part of the attachment/detachment process occurs in the turbulent viscous boundary layer near the substrate. The turbulence regimes in the tank were therefore quantified using Particle Tracking Velocimetry. Simple modelling allowed us to interpret these experimental results in terms of relevant physical quantities. This experimental study of the flow can be used as well to set up a numerical model that will allow us to go further in a deeper understanding of the flow and interactions near and above substrates, in the types of turbulent conditions encountered by eggs or lavae of most benthic marine species.

Processes influencing intertidal barnacle populations in the Wellington region

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Marine intertidal communities are widely used as model systems for examining processes that influence population and community structure. This study documents natural patterns of abundance and distribution of barnacle species in the Wellington region and examines the role of settlement vs. post-settlement processes in structuring these populations. Surveys were conducted in 3 locations within the Wellington region (West Coast, South Coast, and Wellington Harbour) at high and low intertidal zones. We found significant differences in the overall density and species composition of barnacles among the three locations: Chamaesipho columna had the highest abundance in the Harbour, was moderately high on the West Coast, and occurred in very low density on the South Coast. Although overall barnacle cover was greatest in the Harbour, Chamaesipho brunnea was more abundant on the South Coast than in the Harbour. To examine the role of settlement, we monitored monthly larval settlement rates in the Harbour and on the South Coast. Additionally, we examined long-term colonization onto natural rock substrate in cleared and uncleared plots within existing barnacle patches. Peak settlement rates were more than three orders of magnitude greater in the Harbour than on the South Coast. After 1 year, barnacle colonization was also greatest in Wellington Harbour. Colonization was greater in cleared, low plots in the Harbour, and in uncleared high plots on the South Coast. The role of spatial variability in recruitment processes in influencing barnacle populations across this region will be discussed in context of other ongoing work on post-settlement mortality.

Long-term modelling of profile evolution on eroding alluvial fan coasts

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Coastal erosion is a topical issue at present highlighted both by intensifying development of coastal land and predictions of accelerating rates of global sea level rise. Additionally, in a New Zealand context long stretches of coast are fed by river sediment, so there is a need to understand potential impacts associated with practices such as river-damming for hydro-electric power generation. As a first step in addressing such issues we have developed a numerical geomorphic model that simulates several thousand years of beach, cliff and substrate profile evolution on a mixed sand and gravel shoreface. The second stage of work, currently in progress, is the development of a quasi-2D model that will include both cross- and along-shore components. Models of such long timescales are necessary to distinguish systemic trends from shorter-term effects. For instance, to what extent are current patterns of erosion dependent on initial Holocene shoreline configurations? In order to consider such scales we developed the model using an energetics approach in which process-form interactions are integrated over an annual time-step that includes a prevailing period of relatively benign swell and shorter intervals of storm waves. The paper will describe model development and preliminary runs based on the initial condition of a gently sloping alluvial fan. Particular attention will be focused on the role of abrasion of beach materials, critical thresholds that separate storm and normal conditions, and emergent properties of the model including beach volumes, rates of shoreline recession, and shore profile configurations.

Effects of temperature and egg size on early development in New Zealand echinoids

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Knowing the thermal limits for development in echinoderms provides an opportunity to study how predicted increases in sea surface temperatures (SST) might impact local echinoderm species. Both egg size and temperature influence development time in echinoderms. To determine how temperature affects development time, echinoid embryos were raised across a wide temperature range and the time to reach various developmental stages was measured. It was found that fertilization occurs even at temperatures where no further development takes place. Initially development time decreases with increasing temperature until a plateau has been reached, 1-3°C below the upper lethal temperature. To determine the influence of egg size on development, the blastomeres in the 2 cell and 4 cell stage of Fellaster zelandiae were separated and the resulting embryos raised to pluteus stage. Body size measurements were taken for different stages. Half and quarter sized embryos are expected to start off with roughly half or a quarter of the volume of the original egg. Takahashi and Okazaki (1979) showed that cell number in hatched half and quarter sized embryos also followed this pattern. However, our results show that body size of undersized embryos was larger than expected. Furthermore, half sized embryos developed to normal looking plutei, but quarter sized embryos were unable to form complete spicules or rods, and therefore no regular arm formation was seen. Our results indicate kina (Evechinus chloroticus) lethal thermal limits for development are very close to maximum summer SSTs, therefore, any increase in SSTs as predicted may pose serious complications for this species.

Temporal patterns in macrofaunal communities from four sandy beaches

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The factors influencing temporal variation in biological communities in general, and macrofaunal beach communities in particular, are not well understood. In order to characterise temporal variation in beach macrofaunal communities we surveyed biannually for three years at four similar beaches in northern New Zealand. Linear trends in community composition and seasonal effects were detected. Variations of up to 77% of individuals or 37% of taxa were recorded at the same beach between samplings. Temporal and spatial factors explained similar amounts of variation at these beaches (mid-shore beach:time = 15:13%, low-shore beach:time = 17:19%, PERMANOVA). For most taxa the beach factor significantly interacted with temporal factors. This interaction highlights the importance of local beach morphology and oceanography to beach communities. In order to be effective at detecting anthropogenic effects, it is recommended that beach monitoring examines species richness, monitors over multiple times and also monitor possible causative factors. More monitoring studies of biological communities in general and beach communities in particular, are needed in order to both effectively design monitoring programs to quantify anthropogenic effects and examine the relationship between environmental severity and temporal variation.

A threat to native biodiversity: Case study of Charybdis japonica in Auckland Harbour

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Populations of the invasive crab Charybdis japonica were first recognized in Waitemata Harbour in 2000, most likely arriving in ballast waters of an Asian merchant vessel. In 2002 and 2003, a NIWA survey found that C. japonica was well established at a number of sites in the Waitemata Harbour. C. japonica is a large and aggressive generalist predator and thus has the potential to impact negatively upon a variety of native benthic species. To understand the ecology of the invasive populations of C. japonica, I will answer the following questions: (1) What prey does C. japonica consume and prefer?, (2) Has the benthic community structure of the Waitemata changed since the arrival of C. japonica?, and (3) What is the impact of C. japonica experimentally transplanted into an estuary it has not yet invaded? These questions will be answered by (1) laboratory feeding assays, (2) literature reviews of surveys done by the ARC and Bruce Hayward's group over the past 10 years, and (3) a field inclusion experiment using male crabs only to eliminate the risk of establishing a reproductive population.

Large-scale tropical migrations, temperature preferences and diving behaviour of great white sharks (Carcharodon carcharias)

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Pop-up archival tags were attached to four white sharks (Carcharodon carcharias) at the Chatham Islands in April 2005 and two white sharks at Stewart Island in March 2007. One of the latter sharks was also tagged with a real-time satellite transmitting tag on the dorsal fin. The goals of our study were to understand the meso- and macro-scale movements, vertical behaviour, habitat use, and migratory patterns of white sharks. We are still waiting for the Stewart Island tags to pop up, but the Chatham Islands tags showed that some white sharks make long-distance northward movements of 1,000-3,000 km across the open ocean. Two sharks travelled to New Caledonia and Vanuatu and one to the Lousiville Seamounts. We suggest that white sharks may visit humpback whale wintering grounds to feed on carcasses and prey on newborn calves. Before migrating, all sharks spent nearly all of their time shallower than 100 m depth while patrolling near a seal colony over a period of 2-5 months. During oceanic migrations their behaviour changed dramatically, with most of their time spent in the top 1 m of water, punctuated by periodic deep dives to depths greater than 900 m. This vertical movement pattern, in combination with a migration from cool temperate waters to the tropics, results in the sharks experiencing a very wide range of ambient water temperatures. We discuss alternative hypotheses for the observed behavioural patterns.

The effects of fishing and protection on lobsters (Jasus edwardsii) on the East Coast

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Monitoring and research was conducted within and surrounding Te Tapuwae o Rongokako Marine Reserve, on the east coast of the North Island, since its establishment in 1999. The aim was to describe

the biological characteristics of spiny lobsters in the absence of fishing and to describe the effects of fishing and protection on lobster populations and the communities of which they are a component.

Diver and pot surveys showed that lobsters were significantly more abundant within the reserve than in the surrounding fishery and that the population was comprised of a larger proportion of legal-sized individuals. The rate of increase in abundance was higher than previously reported for any other New Zealand marine protected area. Higher female fecundity within the reserve is proposed to be primarily a result of increased availability of large males. Study of the movement patterns of tagged lobsters showed that cross-reserve-boundary movement of lobsters occurred but depended on the distribution of reef habitat.

The effects of fishing on lobsters were demonstrated through a reduced tail width to carapace length ratio of the fished population, a higher incidence of a bacterial infection associated with handling and a reduced growth rate of sublegal-sized male lobsters outside the reserve. In addition, a number of dietary and behavioural differences were recorded between lobsters from the reserve and those outside the reserve.

The findings have significant implications for fisheries management and for the design and management of marine protected areas. It was demonstrated that MPAs can not only contribute to the conservation of harvested species and the communities of which they are a component, but that the study of unfished areas can inform the management of fished populations.

Where does that sediment impacting on an estuary come from? – a new stable isotope technique for quantifying the provenance of sediment sources on a catchment scale

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Increasing sediment inputs into rivers, lakes, estuaries, and coastal habitats is a major threat to water quality around the world. Sediment can originate from many different sources within the catchment including diffuse and point sources. In estuaries and coastal habitats there may also be a component of oceanic sediment. Managing sediment impacts requires an identification of the source. While geochemical tracer techniques can distinguish sediment sources on a regional scale, they have difficulty at a single catchment scale. This paper presents a novel technique using compound specific isotopes to determine the provenance and apportionment of source material in sediment samples associated with a single catchment. The technique relies on the ability of source soils to hold specific organic compounds released by plants, and that different plants and plant groups produce the same organic compounds but with different $\delta^{13}C$ isotopic signatures. Provenance and apportionment use an array of end-members and a mixing model. The technique was tested with known mixtures of source soils and produced apportionments in close agreement with the expected compositions.

A case study, using this technique mapped the distribution of three main land-use source soils (pasture, native forest, and pine forest) across the river delta in a small estuary fringed with mangroves. Rather than being uniformly distributed, the results indicated that the source soil contributions varied markedly across the delta, raising concerns about the validity of taking single cores to characterise the sediments of an estuary.

Modelling organic matter decomposition in sediments: A new tool to assess environmental effects of aquaculture

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Studies on the environmental effects of shellfish farming have shown a variety of impact levels. The primary effect of mussel culture is the deposition of organic matter. The increased organic input can change the rates and relative importance of biogeochemical processes and nutrients released during the decomposition of organic matter in sediments can modify primary production in the water column. Many aspects of these changes are still not well understood; however, due to the rapid expansion of the aquaculture industry in New Zealand it is becoming increasingly important for us to improve our understanding of the associated effects on the sediment biogeochemistry. Numerical models of organic matter decomposition can provide information on processes in the sediment that cannot be obtained by measuring individual parameters. We used a Reactive Transport Model to examine processes related to the decomposition of organic matter in sediments affected by mussel farming in Wilson Bay, Firth of Thames. The model was verified using porewater pH, a parameter which is intimately liked to all major biogeochemical reaction processes in sediments. Initial model simulations successfully reproduced pH profiles in the surface sediments at the boundary of the mussel farming area. Comparisons of a model scenario simulating increased organic input as expected under a farm and measured pH profiles beneath a mussel farm show very similar trends, indicating that the model has the potential to simulate responses to increased organic deposition well. This scenario suggests that while at the farm boundary iron and manganese reduction play an important role, organic matter decomposition beneath the farm is dominated by sulphate reduction.

Localised patterns of connectivity for the invasive sea-squirt, Styela clava

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The Asian tunicate Styela clava is an unwanted invasive marine species that has spread throughout the northern hemisphere with detrimental effects on natural ecosystems and aquaculture industries. S. clava has recently established within two of New Zealand's main Harbours (Hauraki and Lyttelton) and has rapidly spread throughout the Hauraki Gulf and within the port of Lyttelton. Previous results from a Global phylogeographic study using the mitochondrial COI gene suggested limited vectoring of S. clava between Hauraki Gulf and Lyttelton populations. Here we explore this relationship further using 12 polymorphic microsatellite markers and a more extensive sampling regime within the Hauraki Gulf and Lyttelton areas. In the past year several new incursions have been observed in areas previously free of this tunicate. The microsatellite markers have also been used to more accurately assign a source population to these new incursions.

Quantifying potential rates of denitrification and nitrogen fixation in coastal sediment of Moreton Bay, Australia

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Potential rates of denitrification and nitrogen fixation were measured on temporal and spatial scales using the acetylene inhibition and acetylene reduction methods in coastal sediment of the subtropical, Moreton Bay region of southeast Queensland, Australia. Sediment samples were collected from estuarine sites located near and distal to wastewater treatment plant outfalls as well as several offshore sites to estimate the potential rates at which nitrogen could be removed by sedimentary denitrification and replenished by benthic nitrogen fixation. As expected, the highest denitrification rates (~1,951 μmol N m^{-2} h^{-1}) were recorded near wastewater treatment plant outfalls, however some sites near the outfalls had denitrification rates below the detection limit (<2 μmol N m^{-2} h^{-1}) suggesting that some environmental factor was inhibiting denitrification at these sites. Rates of nitrogen fixation were low relative to denitrification rates and ranged from below the detection limit (<0.2 μmol N m^{-2} h^{-1}) to 12.4 ± 4.2 μmol N m^{-2} h^{-1}. While rates of denitrification were significantly linearly correlated with dissolved inorganic nitrogen in the water column, and percentage organic carbon and total nitrogen in the sediment, further research is needed to identify the ecosystem scale controls of both denitrification and nitrogen fixation. Based on the results, it is proposed that denitrification is an important process limiting nitrogen availability for primary production in this coastal system that receives substantial nitrogen inputs from anthropogenic, exogenous sources.

Carl Linnaeus

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Swedish savant Carl Linnaeus (23 May 1707 – 10 January 1778) is rightly known as the "father of modern taxonomy". He laid the foundations for a utilitarian scheme of naming and classifying life, an approach that underlies the present-day Catalogue of Life and the concept of the Tree of Life because it was hierarchical and grouped organisms based on shared characteristics. In 1735, while in Holland to print and defend his doctoral thesis, he also published his new scheme of the classification of nature into three kingdoms — animal, plant, and mineral. Comprising only 11 pages, this was the first edition of the *Systema Naturae*. [The final, 13th edition of 1770 comprised 3000 pages in several volumes.] *Species Plantarum*, published 1753, serves as the official starting point for botanical names. The *Philosophia Botanica* (1751) laid down rules for classifying and naming organisms that would inform future taxonomic practice. The 10th edition of *Systema Naturae*, 1758, which serves as the official starting point for all animal names, saw whales moved from fishes to mammals. No essentialist, he perceived natural variation in nature and allowed for limited transmutation.

Linnaeus's contributions were many and varied. His 1746 *Fauna Svecica* was the most comprehensive faunal field guide of its kind for any country. He also laid a foundation for scientific ornithology. His combined botanical and medical interests resulted in the publication of volumes on medical plants, medicines, and pharmaceuticals. And his religious views encouraged him to think holistically about the interrelationships of the divine and the natural. In his 1749 *Oeconomia Naturae* (The economy of nature), he conceptualised nature as operating in equilibrium, inviting of detailed study, empirical observation, and experimentation; in this, Linnaeus has been labelled a protoecologist. At another level, Linnaeus actively supported the idea that a nation's welfare depended on science-

based administration. Accordingly, he promoted the creation of chairs in economics at Swedish universities.

After Linnaeus's death, his widow, following the instructions of her late husband, sold his collections (including many marine organisms), books, correspondence, and manuscripts. These were purchased by Englishman Sir James Edward Smith. In 1788, the Linnean Society was founded and, on Smith's death, the society bought the collections that today reside in London. Linnaeus had many students. Twenty-three became professors and some 20 took part in expeditions to most parts of the globe, including Daniel Solander, who accompanied Joseph Banks on Cook's first voyage to New Zealand.

Changing wave climate at the New Zealand coast

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Wave action is the dominant forcing process causing changes in erosion and accretion patterns along the New Zealand coastline. Any changes in wave conditions may alter the current pattern and rate of such coastal changes.

Numerical hindcasting, supported by a relatively limited historical measurement record, has previously been used to simulate the deep water wave climate in the oceans around New Zealand over decadal time scales, taking inputs from archived wind fields output from numerical weather analyses.

Wave action at the coast can also be investigated at high spatial resolution on a regional scale by numerical nearshore wave models such as SWAN. Direct simulation of the multi-decadal periods required for useful climate studies is, however, impractical. Instead, we introduce a scenario-based technique which allows high-resolution regional SWAN simulations to be combined with long-term records of environmental forcing functions, in the form of local wind records, and incident swell conditions from deep-water wave hindcasts, to produce long term simulations of wave conditions at the coast. This allows patterns of wave-driven nearshore processes, including longshore sediment transport, setup and runup to also be characterised.

This technique also allows the effects of global climate change on regional wave climate to be investigated. Changes in wind climate have an influence both directly, through the local wind forcing parameters, and indirectly, through the parameters representing arriving swell that had been generated by wind action over wide expanses of the surrounding oceans. This means that we must consider climate change at a range of geographic scales. At a New Zealand regional scale, the mean westerly wind component is predicted to increase. At a wider scale, the incidence and intensity of storms is expected to change. This is possibly more significant for wave climate, particularly the incidence of the more extreme events that can have strong effects on coastal morphology.

We present results for an application of this technique to the Bay of Plenty coast, including characterisation of spatial and temporal variation of longshore sediment transport, extreme wave height and runup potential in the context of both present-day climate and for a range of climate change scenarios.

Absence of evidence to evidence of absence – drivers, emerging issues and what the future may hold for biosecurity surveillance in NZ.

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Biosecurity surveillance is not an isolated activity but one that contributes to many areas within the biosecurity system, including official assurances for trade, risk analysis and import health standards, decision-making during responses and for pest management. The drivers affecting why, how and to what level we undertake surveillance have changed considerably. There are also new issues to contend with; globalisation has resulted in increased opportunities for spread of pests and diseases and environmental changes are resulting in changes to the host ranges and distribution. The Biosecurity Surveillance group are currently developing a surveillance strategy. This strategy includes reviewing the current state of surveillance in NZ and identifying an improved approach and principles to guide future surveillance activities.

Human impacts in estuaries as recorded by microfossils – a progress report on New Zealand studies.

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Estuaries are the most stressed of marine systems and often act as sinks for pollutants. Determining just how the current condition of estuarine ecosystems relate to a hypothetical pre-impact state is very difficult. While monitoring the concentration of trace metals, coliform bacteria and other pollutants are useful they do not document the well being of the soft-sediment biota. For remedial initiatives to be at all effective it is important to "see" what historic changes have occurred to the pre-impact communities. The only clues come from the hard-parts of a small portion of the original biota that are preserved in late Holocene sediment cores. However the macrofaunal record is at best patchy and not easily investigated using coring techniques.

For the past five years part of our research effort has focussed on the potential of microfossils (foraminifera, ostracods, palynomorphs) to document human impacts in New Zealand estuaries. We have investigated in detail historical and existing sewage disposal in the Manukau Harbour, the impact of stormwater run-off in the Waitemata Harbour, marine farming in Mahurangi Harbour and currently the effects of human assisted marine invaders (Spartina and Musculista). Other possible impacts such as dairy effluent, tip leachates, dockyards and marinas in coastal settings have also been explored.

Climate change and variability in the oceans around New Zealand

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This presentation will review information about recent and future climate change in the oceans around New Zealand. On a global scale, anthropogenic climate change is affecting the ocean in several ways: the upper ocean is warming, the salinity is changing (increasing in some areas and decreasing in others), the sea level is rising, and the absorption of CO_2 is changing the chemistry. These trends are expected to continue over at least the next century as global warming continues. In the New Zealand region, the ocean is affected by two great current systems: the warm Subtropical Gyre and the cold

Antarctic Circumpolar Current. It appears that these current systems have been affected, and will be further affected in future, by changes in the atmospheric circulation. The implications for oceanic and coastal environments around New Zealand are not clear.

What controlled the biological response in the Fe addition experiment SAGE.

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The SAGE Fe addition experiment was conducted in sub Antarctic waters to the south east of the South Island of New Zealand in the south-west section of the Bounty Trough (46.5 S 172.5 E) between March 17th and April 15th 2004 on board RV Tangaroa. Fe was added to the SF_6 labelled patch on 4 occasions throughout the 4 week experiment. The phytoplankton response over the course of the SAGE experiment was monitored in terms of photochemical efficiency (F_v/F_m), chlorophyll *a* concentration, primary productivity and species composition. In distinct contrast to previously iron enrichment experiments, there was an indication of the phytoplankton assemblage being relieved from iron stress but very little response in terms of enhancement of chlorophyll *a* or primary productivity. The SAGE patch contained small phytoplankton that showed variable fluorescence signals indicative of relief from iron stress, with F_v/F_m near physiological maximum (0.65). However, biologically, the phytoplankton assemblage only clearly responded approximately two weeks after Fe addition to the patch with a doubling of chlorophyll *a* and primary productivity, with no detectable increase in the efficiency of carbon fixation. The big question is what was the controlling factor for the biological response? The availability of macro nutrients? Grazing by zooplankton? The seed population of phytoplankton? Light limitation of phytoplankton growth? Physical dilution of the patch during storms? A combination of these factors?

Cumulative degradation in estuaries: The effect of habitat type and fragmentation on community resilience

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When changes in the frequency and extent of disturbance outstrip the recovery potential of resident communities, the selective removal of species contributes to habitat loss and fragmentation across landscapes. The degree to which habitat change is likely to influence community resilience will depend on metacommunity structure and connectivity. Thus ecological connectivity is central to understanding the potential for cumulative effects to impact upon diversity. The importance of these issues to coastal marine communities, where the prevailing concept of open communities composed of highly dispersive species is being challenged, indicates that these systems may be more sensitive to cumulative impacts than previously thought. We conducted a disturbance/recovery experiment across gradients of community type and environmental conditions to assess the roles of ecological connectivity and regional variations in community structure on the recovery of species richness, total abundance and community composition. After 394 days significant differences in recovery between sites were apparent. Statistical models explaining a high proportion of the variability ($R^2 > 0.92$) suggested that community recovery rates were controlled by a combination of physical and ecological features operating across spatial scales, affecting successional processes. The dynamic and complex interplay of ecological and environmental processes we observed driving patch recovery across the

estuarine landscape are integral to recovery from disturbances in heterogeneous environments. This link between succession/recovery, disturbance and heterogeneity confirms the utility of disturbance-recovery experiments as assays for cumulative change due to fragmentation and habitat change in estuaries.

Iron in the oceans and carbon uptake

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The iron hypothesis (Martin, 1990) proposed that (1) primary productivity in the southern ocean is iron limited and (2) increased iron availability in glacial periods could have contributed to the observed 100ppm carbon dioxide glacial/interglacial difference observed in the atmosphere trapped in ice. Testing the hypothesis led to a decade of in-situ mesoscale iron fertilisation experiments. The findings of 12 iron additional experiments was synthesized in a workshop and published recently by Boyd et al (2007). The experiments provided unequivocal support for (1) iron control of primary productivity in high-nutrient low-chlorophyll (HNLC) waters but (2) influence on carbon uptake from the atmosphere is less certain. The evidence suggests the efficiency of sequestration of phytoplankton carbon was low (<10%), with the biomass being largely recycled back to CO_2 in waters above the main thermocline. In addition, most recent modelling of glacial/interglacial ocean-atmosphere exchange suggests that iron fertilisation is one of a number of factors and might account for 1/5th of the glacial/interglacial CO_2 difference. In spite of the uncertainty, there is significant commercial interest in iron fertilisation for both productivity enhancement and CO_2 mitigation. This activity has led the SOLAS community to produce a position statement on large-scale iron fertilisation stating that "the current scientific evidence indicates that this will not significantly increase carbon transfer into the deep ocean or significantly lower atmospheric CO_2"

I get around: Dispersal by macroalgae

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Dispersal is a fundamental, yet poorly understood process in population dynamics. The scale and patterns of dispersal can determine connectivity, gene flow, replenishment and resilience of populations. Many marine algae are thought to have limited dispersal potential because there is no obligate planktonic stage, and usually little means of active transport for propagules. Successful colonisation requires several key processes: fertilization, dispersal to appropriate substrata, initial settlement and subsequent recruitment, which may be quite localised. Furthermore, earlier work has shown that it is difficult for fucoid algae to form viable populations unless gametes settle in high densities, to ensure males and females are in close proximity for fertilisation to occur. The limited dispersal of propagules may be enhanced by the movement of detached reproductive plants, but the effectiveness and viability of this over ecological time scales is virtually unknown. Although the potential importance of drifting reproductive plants as a long-distance dispersal mechanism is generally recognised, a key question is how long can drift algae remain reproductively viable. In a series of controlled experiments, using attached and detached plants, we examine the ability of drifting algae to remain reproductively viable, specifically habitat-forming brown algae. We show that drifting

Durvillaea antarctica and Hormosira banksii can mirror onshore populations and can release viable propagules, possibly for long periods after detachment. Furthermore, dioecious species have an ability to fertilise across considerable distances, especially when compared to kelps. This continuing work on early life-histories has considerable implications for the long-distance dispersal of these foundation species.

Sensitivity of coldwater coralline macroalgae to ocean acidification resulting from elevated carbon dioxide

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The oceans adsorption of anthropogenic CO_2 is predicted to rapidly reduce the pH of seawater to levels unprecedented for many millions of years. Acidification is likely to have severe consequences for calcifying organisms that are abundant and fulfil key roles in chemical, physical, and biological processes in today's oceans. Decreased pH makes calcification more difficult and ultimately causes existing calcium carbonate skeletons to dissolve. Evidence shows that many calcifying organisms are sensitive to changes in pH and carbonate saturation. These effects are predicted to occur first, perhaps within the next 50 years and be strongest in calcifiers from coldwater environments. However, data relating pH to calcification of cold-water organisms are lacking making predictions on the impacts of altered seawater chemistry on cold-water ecosystems difficult. Coralline macroalgae are important components of many marine habitats at all latitudes and precipitate a relatively soluble form of calcium carbonate. We exposed the widely distributed temperate coralline Arthrocardia corymbosa to pH levels of seawater today and that predicted for 2050, 2100 and 2300 in controlled conditions at 12°C. Over ten days evidence of significant dissolution was observed for thalli exposed to pH levels predicted for 2300. This suggests that corallines will be negatively affected by lower pH due to elevated CO_2 in the future. Further research is required to determine the potential for physiological acclimation and adaptation to lower pH by calcifying organisms before realistic predications of the sustainability of calcifying organisms in a high- CO_2 world can be made.

Natural currents: a pathway for the spread of marine NIS in Tasman and Golden Bays, New Zealand

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Many pathways have been identified for the spread of non-indigenous marine species (NIS). Such pathways can be classified as either *human-mediated* or *natural*. Human-mediated pathways include, among others, commercial shipping, aquaculture and fishing industries, the aquarium trade and recreational boating. Most human-mediated pathways are subject to some form of management; e.g. ship ballast water management plans, which help in the prevention and control of marine invasions. Natural pathways include, most significantly at least in terms of numbers, the dispersion of propagules and other life-cycle stages via currents, and to a lesser extent other natural mechanisms including the transfer of propagules via debris and other organisms, which may also be partly determined by currents. Natural pathways are a feature of all marine and estuarine systems, and direct management of them is generally unrealistic. With regard to NIS pathways in New Zealand, the focus of management agencies and researchers has been on ballast water and hull fouling. Although several

studies have been conducted on the dispersal via currents of the larvae of various commercially significant and native species such as abalone (Haliotis iris), the role of natural pathways in the spread of NIS is not well known. Located at the top of the South Island, New Zealand, Golden and Tasman Bays encompass marine and estuarine environments that are highly valued for their economic, environmental, social and cultural resources. As with most other regions in New Zealand, Tasman and Golden Bays have experienced a number of marine incursions (e.g. Undaria pinnatifida and Styela clava), which threaten these resources. It is therefore essential to design and implement biosecurity programmes that prevent future new invasions to the region, and to control the further spread of already established marine pests. For such management programmes to be successful, risk assessments must incorporate the potential dispersion patterns of natural pathways, especially currents, in addition to a knowledge of the human-mediated pathways. Knowledge on the hydrodynamics in Golden-Tasman Bays is relatively limited. The most recent study, by Cawthron, has generated a numerical model that simulates the hydrodynamic flows within this region. Based on this model, and using real atmospheric data (e.g. wind, temperature, precipitation) over a 13-years period, an hourly 2D current velocity profile was generated for Golden and Tasman Bays. This profile was used to simulate the dispersion of passive particles within the bays under different scenarios. The location of the release point of the particles was varied along the coastline and different patterns of dispersion were identified. Similarly, the effect of the life span of the particles in the final dispersion pattern was investigated. By assuming that NIS larvae would experience similar dispersion forces to the passive particles, the model is used to identify *donor sources* and *recipient areas* in Golden and Tasman Bays. This will enable managers to identify and prioritize NIS surveillance, eradication and control activities in the region. The approach can also be used to determine whether management of specific human mediated pathways in the region is likely to be cost-effective, and to prioritise research needs.

Seeking generality in the response of species abundances to multiple stressors

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While multiple stressors are considered to be general in ecological systems, describing and predicting their effects is still a major challenge, with ecologists seeking ways to generalise from studies on specific stressors and methods with strong ability to detect multiple stressors. In this study we analyse responses of the abundance of 46 macrofaunal taxa, common throughout a large harbour, to stressors representing habitat requirements (sediment particle size), food (organic content of sediment) and metal contamination (copper, zinc and lead). Using regression analysis, simple responses to either a single variable or variables acting additively were rarely observed. Rather, the response of most taxa was multiplicative, with stressors combining to enhance negative responses. Interestingly, some generality of response type was observed using stressor category and life-history traits. The results of this study suggest that regression analysis, together with well-designed, large-scale, field surveys, offer a good method for describing and predicting effects of multiple stressors.

Until the cows come home: restoration of spawning habitat of diadromous fishes

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New Zealand's diadromous Galaxiid fishes cross major ecosystems to complete their life cycle. The most common species, Galaxias maculatus, has a marine larval phase which then migrates into

freshwater to develop and later spawn. Spawning occurs almost exclusively in areas of streams that are tidally influenced. Within those stream areas, we have found that spawning adults show strong preferences for particular vegetation types occurring in the highest elevations of tidal reach. Local populations show strong fidelity to spawning areas they have used before. Surveys on the east and west coasts of the South Island have shown that the same spawning areas are used by successive spawning cohorts within and between years. Anthropogenic impacts through sedimentation, impoundment, stock grazing, infill and modification to riparian contours (elevation, slope) and vegetation severely impinge on this species' ability to complete its life cycle, effectively creating "sink" populations that contribute little to future stocks. Grazing by livestock can thin or remove vegetation while the physical disturbance of trampling can alter bank topography and bury eggs. Large-scale experiments that exclude livestock from degraded riparian areas have shown early promise in delineating effects of impacts and in mitigation and recovery. Early results show that spawning areas and egg production can be improved and extended rapidly when suitable conditions are restored. However, these effects occur within a natural regime of frequent environmental changes, such as flooding, which has lessons for spreading the risk and efforts in ameliorative efforts.

The effect of temperature on the tolerance of the clubbed tunicate, Styela clava (Herdman), to air exposure

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The effects of three different temperature regimes were tested on the survival of the clubbed tunicate Styela clava to air-drying. Styela clava is an invasive ascidian in New Zealand, and is a potential threat to the bivalve culture industry. Few studies have been undertaken on the control of this species, and fewer still on the effect of air-drying on the survival of S. clava. Individual S. clava were randomised into three treatment groups: constant 10°C, shade ambient (mean 20°C), and full sun ambient (mean 26°C). Humidity was consistently high for all treatment groups (78%-100%). The specimens were exposed to air for up to 120h, after which survival was tested. Air temperature was found to have a significant effect on the tolerance of S. clava to air-drying: the cooler the temperature, the longer the survival time. Time until death was correlated with body size and percent weight loss. Larger S. clava survived for longer out of seawater than smaller individuals.

What sets the upper thermal tolerance limit in marine ectotherms? Evidence for the role of heart mitochondria

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Determining what sets an organism's upper thermal tolerance limit has become a very important goal for physiologists given that global ocean temperatures are predicted to rise. Understanding what sets species' thermal limits, and how plastic these limits are, informs whether animals will be able to tolerate or adapt to climate change. The upper thermal tolerance limit in marine ectotherms appears to be set by oxygen supply to the cardiovascular system, yet the exact mechanism is not known. Oxygen supply is dependent on both heart pumping and energy supply, which in turn are dependent on heart mitochondria. To date studies suggest that mitochondria are not the limiting factor. However, these studies mainly focused on Antarctic species, and used mitochondria isolated from liver or skeletal

muscle. These mitochondria differ vastly from those of the heart. We used high resolution respirometry to re-examine the influence of temperature on heart mitochondria *in situ* using temperate New Zealand triplefin fishes. Triplefins form an excellent system, with similar diets, activity levels, and, contrasting habitats. We examined the temperature response of heart mitochondria in three triplefin species that differ in typical habitat temperatures. Our results show that heart mitochondrial function is impaired at high and ecologically relevant temperatures irrespective of oxygen supply. Thus, we have found a mechanism that in part may explain cardiovascular dysfunction at high temperatures. The three species appear to be living close to their upper thermal limits, yet the differences between species indicate that there is potential for adaptive response.

Under The Tunic - The Reproductive Periodicity of the Invasive Ascidian Styela clava in Auckland, New Zealand.

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Styela clava, a stalked ascidian from the northwest Pacific, was first identified in Auckland and New Zealand, in 2005 (though has likely been present in NZ for several years). MAF Biosecurity New Zealand, as part of their response to this incursion, commissioned Golder Kingett Mitchell to study the timing of reproduction and settlement of this species. This research focused on evaluating the seasonal patterns of gonad development and attempting to detect the presence of S. clava larvae and new recruits. From May 2006 to April 2007, adult individuals were collected from Bayswater Marina in Auckland at fortnightly intervals at the time of the first low tide following new and full moons. Sample processing of adult S. clava for determination of the reproductive cycle involved calculation of gonad indices, preparation and evaluation of gamete smears and histological staging of gonads. Larval settlement and presence in the water column were investigated concurrently during the warmer months. Analyses of gonads suggested that the species reproduces over an extended period in the Auckland region, beginning in the early spring and lasting through to late summer. While several ascidian larvae were detected throughout the study period, no S. clava larvae were found in the samples. Similarly, most settlement plates were covered in a dense layer of biofilm upon retrieval, but no S. clava juveniles were detected on the plates. The consequences of this extended reproductive period for management of this marine pest species are discussed.

Characterization and seasonal variation of seabird assemblage off Valparaiso (33° S, 71° W), central Chile.

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Chile is one of the countries with highest abundance of seabirds in the world, with al least 115 species registered. This abundance is due principally to the high productivity of Humboldt Current System (HCS) and the geographic position of the Chilean coast, representing an important breeding colony area. However the abundance and composition of seabird assemblages in central Chile have received scarce attention. Between July 2006 and April 2007 monthly surveys were conducted of seabirds occurring off Valparaiso (33° S, 71° W) central Chile. We evaluated whether the assemblages kept constant or show a seasonal variation. Seabirds were recorded from a boat extending the coast nearly 12

miles offshore in a 3 hour trip. All seabirds on the sea surface up to 150 m from the boat were counted directly using the "snapshot" method. We identified a total of 35 species of seabirds; 49 % belong to order Procellariiformes, 31% of Charadriiformes, 6% of Sphenisciformes and 5% of Pelecaniformes. We found a notorious seasonal variability for this assemblage, observing different patterns; winter visitors, summer visitors, transients and residents. The high presence of seabirds in this area could be related with an active upwelling zone (Punta Curaumilla). Our results suggest that this area is an important feeding zone. This project is funded by grant AR-03-05, Universidad Andres Bello.

Carpophyllum Hybrids: Competitively Superior, or Marginalised Intermediates?

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Hybridisation is a common process in the plant kingdom. Hybridisation occurs when the gametes of two species meet, fuse, and have compatible DNA to create hybrid offspring. This can create genotypes and phenotypes distinct from the parental species. There are also ecological factors which determine hybrid survival and persistence. Traditionally hybrids have been considered as generally less fit than either parental species. However, novel combinations of genes may result in greater fitness (heterosis). This greater fitness may be for the core conditions in a parental species range, for conditions on the margins of a parentals range, or for a novel intermediate environment. Much of the work done on hybrid ecology has focused on terrestrial plants, such as irises. Hybridisation also occurs in aquatic plants. Recent genetic work has revealed populations of a morphologically distinct Carpophyllum maschalocarpum X Carpophyllum angustifolium hybrid. These hybrids exist in the same general location as the parental species. At a smaller spatial scale the hybrid population appears to occupy habitat intermediate to the parental species. The distribution of these hybrids in relation to the potential parental species range may be highly informative. The distinct hybrid zone can give clues on parental dispersal capabilities, hybrid and parental fitness, and environmental conditions. This study will investigate whether the Carpophyllum hybrids are living within the parental species habitat, in marginal parental habitat, or in distinct habitats. In particular it will look at the distribution with regard to dispersal, wave disturbance and morphology.

Lessons from eighteen years of shellfish contaminant monitoring

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The Auckland Regional Council has conducted annual sampling of metal and organic contaminants in Manukau Harbour oysters since 1987. Mussel monitoring in the Waitemata Harbour, Tamaki Estuary and Manukau Harbour was also introduced to the programme in 1999/2000. Levels of organic contaminants in shellfish tissues are low by international standards, but clear differences were apparent between monitoring sites. Highest levels are obtained in shellfish collected from estuaries with industrial catchments (i.e. Mangere Inlet and Tamaki Estuary), but marked changes in the concentrations of organic contaminants have been observed through time. Levels of lindane, chlordane and dieldrin in Manukau oyster tissues declined significantly after these pesticides were deregistered in 1989-1990. However, recent pulses in DDT, chlordane, and PCB concentrations were observed in oysters and mussels from sites in Mangere Inlet. These pulses coincided with the decommissioning, and return to the sea, of treatment ponds at the Mangere Sewage Treatment Plant, and probably reflect

the remobilisation of contaminants that were previously bound in pond sediments. In contrast, temporal changes in metal concentrations do not seem to correlate well with landuse activity. Rather, cyclical fluctuations in the concentrations of copper and zinc appear to be partly driven by natural variation in weather patterns, and in particular, those associated with the Southern Oscillation Index.

Probiotic Bacteria for Hatchery Production of Greenshell™ Mussel

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Hatchery production of Greenshell™ mussel (GSM) larvae is being developed for New Zealand's NZ$180 million pa industry, yet larval batch losses due to bacterial disease present a problem. In order to minimize antibiotic use and the subsequent discharge into the aquatic environment, our research sought to identify bacteria from the hatchery environment that could be developed as probiotics for managing bacterial disease during the large scale production of GSM larvae.

The research program began by isolating and identifying two bacterial strains pathogenic to the larvae. This was achieved by challenging larvae with bacterial strains isolated from unhealthy animals. This phase was followed by an initial screening for probiotics active against the two isolated pathogens. A simple bioassay that included test subjects was developed in order to screen for potential probiotic strains. The bioassay offered an alternative method to the well-documented *in vitro* techniques and suggested that 43 of the 70 isolates screened were potentially beneficial to GSM larvae when challenged with a pathogen. Moreover, this bioassay demonstrated the advantage of using the host animal in the first stage of screening for probiotic bacteria. Identification using VITEK II short-listed the nonpathogenic isolates which were then identified by sequencing their 16S rDNA.

Research has now moved into the commercial hatchery environment. An infection model with the two pathogens has been established, and pilot studies have determined two potentially probiotic isolates to pursue in future full scale trials. Figures from the initial full scale trials conducted at the hatchery will be presented.

Latitudinal variation in the demography of a marine herbivorous fish: the New Zealand butterfish Odax pullus

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The overall diversity of herbivorous fishes declines with increasing latitude. The general consensus is that herbivores are less diverse in cold waters due to temperature constraints on digestion and assimilation of algal foods. However, New Zealand is home to a number of herbivorous fishes, including the butterfish Odax pullus which ranges as far south as the Antipodes Islands. We are examining the demography of Odax pullus including general life history characteristics such as longevity, size, growth rate, age at maturity, age at sex-change and physiological rate of ageing. To date results suggest that animals living in the south grow slower and live longer than their northern counterparts, yet the maximum size data are inconclusive, indicating that they are not necessarily

reaching a larger overall maximum size. Current work examines the relationship between growth, size-at-age and temperature and also the effect of temperature on the physiological rate of ageing. Preliminary results suggest that fishes living at cooler temperatures show less sign of physiological ageing than fish of the same chronological age in warmer waters. In the context of increasing sea surface temperatures and global warming, these preliminary results suggest that in warmer environments fish may grow and mature faster, but die younger. If this is confirmed and is a widespread pattern in fishes then it has profound implications for the management of our fisheries and the impact of global warming on marine systems.

Ocean Acidification - What's All the Fuss About? Part II: Potential biological impacts

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The oceans have offset the increase in atmospheric CO_2 by uptake of approximately 40% of anthropogenic emissions. The downside of this is an increase in the acidity of surface waters, as described in the companion talk by Currie *et al*.
Current estimates, based upon IPCC scenarios, suggest that the surface ocean pH at the end of the 21st century will be lower than it has been for at least the last half million years. This may significantly impact upon the biogeochemistry, ecology and productivity of the oceans. The focus of acidification research to date has primarily been upon calcifying organisms, including coralline algae, molluscs, echinoderms and planktonic calcifying groups, which will be affected by a reduction in carbonate availability. There is also emerging evidence of impacts of lower pH for non-calcifying groups, including changes in phytoplankton community structure and productivity, and reduced respiratory capacity in fish. The results of a workshop on Ocean Acidification workshop at the University of Otago (May 2008) will be presented, with a review of the susceptibility of different groups to acidification and consideration of potential impacts in New Zealand waters.

Nitrogen limitation and supply in the northern Tasman Sea

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The sub-tropical northern Tasman Sea is a typical oligotrophic region, characterised by low plankton biomass and very low nutrient concentrations. Two multi-disciplinary research voyages have examined the biology and biogeochemistry of this region to identify the controls on productivity. A sampling framework of water column profiling at a drifter buoy was employed for 12 days in March 2006 to monitor temporal changes, during which we experienced a Tropical storm and a surface bloom of the colonial cyanobacteria Trichodesmium. Nanomolar nutrient analysis and multi-factorial addition incubations confirmed that nitrogen was the nutrient that limits production in these waters. The relative importance of different nitrogen supply routes, including vertical diffusion, internal tides, dust supply and nitrogen fixation was examined. Stratification of the water column and rapid nutrient uptake imposed vertical segregation of these different nitrogen sources; the deep chlorophyll maximum effectively mopped up the vertical supply whereas primary production rates tracked nitrogen fixation

in surface waters. This suggests that the "classical" new nitrogen supply route across the nutricline does not maintain productivity in surface waters in this region, with implications for modelling productivity in oligotrophic waters.

Designing optimal marine protected area networks for the oceans around New Zealand

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The New Zealand Biodiversity Strategy specifies as one of its objectives the "protecting (of) 10% of New Zealand's marine environment by 2010 in view of establishing a network of representative protected marine areas." We demonstrate one approach for designing such a network for offshore waters, using reserve design software (Zonation) to analyse grid-based distribution data for 96 fish species. Analysis options include the differential weighting of species to allow greater protection for endemics, the taking account of varying degrees of mobility in different species, and balancing expected conservation returns against loss of fishing through cost:benefit analysis. Results indicate the conservation ranking for all grid cells in the EEZ, and the likely degree of conservation return as a function of the percentage area protected. Protection of the highest ranked 10% of waters with depths between 200 and 2000 m would on average protect 27.4% of the range of each species. Analysis of the Benthic Protection Areas proposed by the fishing industry and to be implemented during 2007 indicate that this network provide less than half of the biodiversity benefits expected from alternative, zero-cost configurations identified by our analysis.

Direct Measurements of Wind Induced Internal motions in lakes using an Acoustic Doppler Current Profiler.

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The internal flow field induced by surface wind stress in small lakes is weak with peak current speeds of only a few centimetres per second. In the past, baroclinic standing wave oscillations (internal seiche motions) have mostly been deduced from the vertical displacement of isotherms from temperature chain measurements because weak flows are not easily measured with rotor and propeller current meters. A 1.2MHz RDI workhorse ADCP was deployed with a thermistor chain in the small lake of Rostherne Mere, U.K (area 48.7 ha, mean depth of 15m, length 1.1km). An average velocity was recorded every 4 seconds, which, when averaged for 5 minutes, reduced the error to <1mm/s. Velocities were successfully measured to ~1cm/s, and internal seiche velocities were directly measured with peak velocities of 2-5cm/s. First and second vertical modes of baroclinic oscillation were identified through energy density spectral analysis. The periods of oscillation were consistent with estimates of the phase velocity based on a normal modes analysis. The period of observations was sufficient (84 days) to observe the decrease of the period of oscillation as stratification intensified during the summer months. The first vertical mode (V1h1) changed from 1hr 43min to 57mins, and the second vertical mode (V2h1) changed from 2hrs 30 min to 2hrs 20mins.

New discoveries from the deep: Preliminary results from the Ocean Survey 20/20 Chatham-Challenger Biodiversity and habitat mapping project

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Under the banner of Ocean Survey 20/20, *R.V. Tangaroa* completed three voyages to investigate seafloor habitats and benthic biodiversity of the Chatham Rise and Challenger Plateau 200–1200 m water depth in 2006-07. These surveys provide the first systematic, widespread sampling programme of deep-ocean soft sediment communities in the New Zealand region since pioneering work in the late 1960s and 1970s. The main aim of the work is to provide baseline information contributing to regional EEZ-wide marine environment classification.

Preliminary results suggest that benthic diversity on Chatham Rise and Challenger Plateau is of a similar order but with a slightly different species mix. Abundance (biomass) was higher on the Chatham Rise. There was widespread evidence of trawling on the Chatham Rise, although trawl disturbance in some areas was obscured by strong deep-sea currents.

Interesting findings from the Chatham Rise include a deep-water depression on south Chatham Rise filled with organic material; abundant brittle-stars below 1100 m water depth on SW and central area; large holothurians significant in deep water on the SE flanks. On the Challenger Plateau, important discoveries included unusual hexagonal features (Paleodictyon) at 1800 m water depth and rich sponge communities on rocky substrates on central parts of the plateau. Both surveys produced unprecedented, detailed imagery of benthic and near-bottom animal communities, including fish, and the exciting potential for the discovery of new records and new species in New Zealand's deep-sea world. Full data analyses will occur over the next 3 years.

Do juvenile fish dine under mangroves? The role of mangroves in fish feeding

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Many of New Zealand's mangrove forests have increased substantially in extent over the past 100 years, in response to increased sedimentation. This has led to intense societal debate as to their ecological value. It is often claimed that mangroves are important juvenile fish nurseries (as for tropical species) but no quantitative information has been available until recently. To address this, mangrove forests in eight Northern New Zealand estuaries were sampled with fine mesh fyke-nets across a spectrum of perceived environmental degradation (sedimentation and associated water turbidity).

Phylogeography of the giant kelp Macrocystis (Phaeophyceae) from Chile and New Zealand using a mitochondrial marker.

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The brown alga Macrocystis is the most widely distributed kelp in the world, with a distribution that spans the west coasts of North and South America and also includes Argentina, South Africa, Australia, New Zealand and most of the sub-Antarctic islands. This alga plays an important role in the marine environment by providing shelter and food for a wide range of flora and fauna. Macrocystis have a high dispersal potential due to rafting of fertile thalli, yet how the dispersal mechanisms affects populations is unexplored. In this study we examined the phylogeography of Macrocystis along the Chilean and New Zealand (NZ) coasts and some sub-Antarctic islands by investigating the distribution of haplotypes and exploring potential areas of genetic disjunction. Samples were collected in more than 50 sites and analyzed using a mitocondrial intergenic marker (atp8S spacer). Results indicate that 9 haplotypes were detected with low genetic variability between them. Only one haplotype is shared between both sides of the Pacific (central Chile and the Antipodes Islands) and appears to be the ancestral haplotype. Our data suggest that Macrocystis has colonized the southern hemisphere relatively recently through the introduction of a single haplotype, similar result was found by another work using rDNA internal transcribed spacer regions ITS. Scarcity of this haplotype in the west Pacific and the geographically localized distribution of the derived haplotypes indicate that connectivity across the ocean is restricted.

Taking stock: effects of climate variation and human impacts on the structure and functioning of New Zealand shelf ecosystems over the last millennium

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Predicting ecosystem dynamics in response to global warming, exploitation, invasive species or indeed deliberate management action requires both an appreciation of present patterns and processes and an understanding of ecological context. History matters in ecology, so context involves time, usually over periods much longer than the normal focus of ecological studies. The New Zealand marine ecosystem is driven by two great influences. The first is climate or environmental change by which variation in nutrients, temperature and current patterns influence the basic primary productivity that drives the ecosystem and influences the dynamics of every species. The second great influence is human impacts on the marine environment. These impacts include fisheries exploitation and associated bycatch but also embrace sedimentation of estuaries and shelf habitats, pollution, local increases in nutrient loading caused by run-off from urban and farmed landscapes and local elimination of seabird breeding colonies by the introduction of mammalian predators. While environmental variation has always affected the New Zealand marine ecosystem, human impacts first occurred in New Zealand only 750 years ago; very recently compared to the rest of the world. A new project funded by the Biodiversity Fund is attempting to draw together a large and scattered literature and datasets that will help to write the first comprehensive history of how climate variation and human arrival has altered New Zealand's shelf ecosystems over the last 1000 years. Progress to date, information gaps and opportunities for collaboration will be highlighted.

How do contaminants affect estuarine ecosystems?

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Because many towns and cities have been built near estuaries these ecosystems are subjected to a wide range of industrial and other contaminants including sewage. These result in elevated nutrients that can result in eutrophication and waste water discharges contains metals, halogenated hydrocarbons and oestrogen mimicking compounds. In estuaries the specific effects of these contaminants is difficult to assess and the effects on estuarine ecosystems is relatively unknown. In this presentation I present information on how selected contaminants (particularly trace metals) affect estuarine organisms and discuss whether these effects affect estuarine populations communities and the ecosystem. A particular focus will be on assessing whether contaminants affect the biodiversity and functional relationships in estuaries.

The phylogeography of the kelp Lessonia variegata (Laminariales) in New Zealand.

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The habitat forming, endemic, brown alga Lessonia variegata is widely distributed throughout the rocky reefs of the three main islands of New Zealand. Previous studies have revealed at least 4 clades within the L. variegata species complex. Our goal was a) to determine the relationships between these clades, b) to test the assumption that the distribution of the L. variegata lineages matches known patterns of species distribution based on contemporary current patterns and upwelling, and c) to determine the relationships of Lessonia sp. from around the world. To resolve the maternal lineage relationships we added an additional mitochondrial marker, the NADH dehydrogenase subunit 6 gene (nad6) to the previously markers: ATP 8-trnS-intergenic-spacer (atp8-sp), and trnW-trnI-intergenic-spacer (trnW-sp) in a combined dataset. To define the range and limits of maternal lineage distribution we used SSCP to quickly screen atp8-sp haplotypes in several populations across the L. variegata species range. Lessonia variegata shows an unexpected high level of genetic distinctness justifying the description of new species. The lineage distribution has shown areas of clear disjunction between populations and areas of increased connectivity. On the whole, and based on our samples, our distribution patterns reflect the expected pattern of algal distribution but gives evidence of range expansion. The global relationships reveal that the Chilean L. nigrescens is a sister group to all other Lessonia species suggesting multiple dispersal across the Pacific of this genus.

Effect of estuarine sediment conditions on seagrass growth responses

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New Zealand has only one species of seagrass, Zostera muelleri, which occurs predominantly in intertidal areas in estuaries throughout the country. However, as found worldwide for seagrasses, New

Zealand Zostera meadows have undergone declines within the last century. Globally, anthropogenic sediment and nutrient pollution of estuaries are considered to be major contributors to seagrass decline. Although considerable attention has been paid to the effects of reduced water clarity on seagrass growth that can result from this pollution, there has been limited study of the effects of estuarine sediment conditions.

We conducted a multi-estuary field survey and a microcosm experiment to investigate the potential for estuarine sediment conditions to affect the growth of Zostera. We surveyed 5 sites in three contrasting harbours (Raglan, Tauranga and Whangapoua) and measured Zostera biomass, cover and photosynthetic potential along with a range of sediment properties. For the microcosm experiment we compared the biomass and photosynthetic potential of seagrass plants grown on sediments from historical (decline) sites versus existing sites in Tauranga Harbour.

In the estuary survey, higher Zostera cover was linked to higher sediment water and lower organic contents which explained 52% of variation while higher Zostera biomass was linked to lower sediment redox potential and total phosphorus concentrations which explained 22% of variation. Harbour-specific seagrass-sediment relationships were more significant with up to 82% of plant variation explained. Zostera biomass was significantly higher in Whangapoua relative to the other two harbours and may be linked to the two- to four-fold lower catchment sediment yields delivered to this harbour. In the microcosm experiment Zostera biomass was significantly higher on existing sediments providing evidence that sediments from historical sites were less favourable for seagrass growth. Overall, our results suggest that changes in estuarine sediment conditions may affect seagrass growth and play a role in seagrass decline.

Bivalve decline in Doubtful Sound has reduced the flux of marine organic matter to higher trophic levels

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As many of the world's ecosystems experience diversity declines, it is pertinent to increase understanding of the ecological implications for ecosystem functioning. It is becoming apparent that the loss of key species can disproportionately alter community energetics. In Fiordland, New Zealand, the clams Austrovenus stutchburyi and Paphies australis form extensive beds on delta habitats, however in Doubtful Sound, freshwater inputs from a hydroelectric power station (250-510 m^3s^{-1}) have decreased the salinity of shallow waters (<2 psu), making the local deltas uninhabitable for these species. Clam populations in inner Doubtful Sound are 29 times smaller than those of neighbouring Bradshaw Sound (a fjord not directly affected by the power station). The objective of this study was to determine if the decline of these filter feeders had implications for the supply of pelagic organic matter to the wider delta community. $d^{15}N$ and $d^{13}C$ values of generalist predatory fish including Notolabrus celidotus and Hemerocoetes monopterygius provided an integration of relative organic source use by the invertebrate communities. Fish from the bivalve-poor inner Doubtful Sound deltas had consistently lighter $d^{15}N$ and $d^{13}C$ than those from bivalve-rich deltas (e.g. N. celidotus (mean ‰ (± SE)) inner Doubtful Sound: $d^{15}N$ 9.4 (0.25), $d^{13}C$ –20.5 (0.26); Bradshaw Sound: $d^{15}N$ 11.3 (0.24), $d^{13}C$ –17.9 (0.24)). Findings were consistent with bivalve-poor communities having reduced flux of new production from phytoplankton and macroalgae, and an increased reliance on poor-quality food items including terrestrial forest litter. This study provides an example of a decoupling of the benthic-pelagic link in Doubtful Sound, as a direct result of the decline of filter feeding clams.

Fish Taxa and Functional Group Responses to Ra'ui (traditional marine managed areas) in Rarotonga

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Managers often wish to know the effects of marine protected areas (MPAs) on metrics such as fish and invertebrate abundance, size, and diversity, and much of the published work to date suggests that MPAs often lead to increases in these metrics. However, many putative 'MPA effects' may be confounded by factors such as substrate type and habitat complexity; MPAs are often sited in unique or comparatively pristine locations. Consequently, some of the empirical evidence that demonstrates effects of MPAs may be equivocal. Our previous work focusing on one reef fish species, Ctenochaetus striatus (Maito, striped bristletooth), demonstrated that substrate heterogeneity in the lagoon of Rarotonga influenced perceived effects of Ra'ui (traditional marine managed areas). Here, we further explore spatial patterns of abundance for a number of fish taxa and functional groups within the lagoon of Rarotonga, Cook Islands. We quantify patterns of abundance in relation to Ra'ui and associated environmental features that may vary systematically among Ra'ui and/or between Ra'ui and paired control areas. Weighted response ratios, calculated from 'substrate-adjusted' densities, are used to evaluate island-wide putative effects of Ra'ui (all sites pooled). Island-wide, the effects of Ra'ui appear to be equivocal. However, among sites, fish taxa and functional group responses to protection varied, suggesting that a range of ecological processes play a role in determining spatial patterns of abundance and distribution of fish at individual sites. In-depth study is required to elucidate what these processes are in the context of marine protected area assessment.

Nuisance Sediment - Getting a Grip at Te Mâhia

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Anthropogenic activities exert pressures on the sustaining capacity of marine ecosystems, causing the destruction of vital coastal habitat, loss of marine biodiversity, and the deterioration of near-shore water quality. Fine muddy sediment, clouding the water column and at times draping the near-shore seabed, is a perennial nuisance at Te Mâhia (East Coast, New Zealand), not only degrading the rocky reef habitat but also inhibiting the gathering of kai moana by the local community. This project was conducted to elucidate the source (s) of fine muddy sediment to the near-shore marine environment and, building on multi-beam mapping use side-scan sonar to describe the underwater rocky reef habitat immediately adjacent to the coastline to examine possible effects of sedimentation.

Marine recreation and coastal ecosystems

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Recreational usage of coastal ecosystems by humans, including recreational fishing and diving, continues to increase in line with an increasing human population. The recreational snapper (Pagrus auratus) fishery in the inner Hauraki Gulf may contribute 25–30% of the total ~1000 t recreational catch for SNA1 (North Cape to East Cape), with 300–400 small boats fishing each day on any given weekend or holiday during the summer fishing season (weather permitting), and ranging up to 600–700 in the

high period. We are assessing the interactions between this fishery and its underpinning marine ecosystem, with the goal of maintaining both in a healthy and productive state. We have divided the inner Hauraki Gulf up into eleven spatial strata, encompassing different levels of fishing effort, and within each are measuring fishing effort and catch (aerial over-flights, and boat ramp interviews); actual snapper abundance on the seafloor (night-time dropped underwater video (DUV) counts of sleeping snapper) and associated habitat associations (e.g. biogenic habitats such as sponges, horse mussels, rhodoliths (maerl) and ascidians); and snapper movement dynamics, both within and between strata (6,300 snapper tagged in 2006/07 summer). The central area (Motiuhe, Sergeant's, and Rakino channels) has also been intensively habitat mapped using high-resolution multi-beam sonar and digital side-scan sonar. Collectively, these data are being used to build snapper-habitat models, including seasonal movement dynamics, and to quantify how the recreational fishery interacts with (and potentially modifies) such relationships, and potentially, wider ecosystem functioning. In this talk we give an overview of the project, and some of its findings to date.

Recovery and resilience along intertidal gradients: Making wrong predictions for the right reasons

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Varying stresses affect community composition and are particularly evident along intertidal gradients. Complex interactions, including facilitative relationships involving foundation species determine where organisms can and actually do live. Habitat-forming intertidal algae vary from the mid- to low intertidal zones and provide shade, moisture and additional vertical structure that facilitate the growth and survival of many understorey species. In two separate large-scale removal studies using Hormosira banksii and Durvillaea antarctica, we examined the relationship between these species, diversity and disturbance within two intertidal zones. In both studies, species composition and abundance were measured in large canopy clearances (3x3m and 2x2m) of H. banksii and D. antarctica. Some disturbance models (self-replacement, highly localised dispersal) predict reasonable recovery for H. banksii in the mid zone (relatively high physical stress) and fast recovery for D. antarctica in the low zone. Neither of these predictions held true. We found that H. banksii treatments had recovered to only 29% of control levels two years after the initial removal, with full recovery still not evident in all areas after four years. Against predictions, D. antarctica treatments recovered to only 4% of their original cover after one and a half years, despite Durvillaea surrounding the treatments and having massive reproductive output. The recovery of D. antarctica at one site was partially affected by the arrival of Undaria pinnatifida, which recruited quickly and in greater numbers than D. antarctica. Our research shows the importance of long term studies of recovery and resilience in these systems that have high natural disturbance levels and are increasingly overlain with human impacts and the arrival of new species.

Genetics of the Actin Gene in the Red Algal Genus Stylonema (Stylonematophyceae)

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Diversity within the morphologically simple red algae has been underappreciated until recently. Phylogenetic results, using mostly plastid genes, have shown that several diverse and ancient lineages comprise this morphologically simple group. Many of these groups are believed to lack sex and to be

haploid, e.g. Stylonematales. The scope of phylogenetic markers was recently complemented by the ubiquitous actin gene. Its investigation in Stylonema alsidii (Hoef-Emden et al 2005), a world-wide marine species, has shown that it contains a single copy of the actin gene. However, only one isolate was used, and a proper understanding of this gene in Stylonema is still not established. Direct sequencing of the actin gene from various S. alsidii samples often showed a mixed signal with several peaks in third codon positions, suggesting multiple copies of the actin gene in these isolates. This study will: (1) test isolates of S. alsidii to see if multiple copies of the actin gene are found; and (2) enhance general knowledge of the actin gene in Stylonema. Cloned partial actin genes will be analysed to determine if multiple copies of the gene are present in isolates. These results have several implications: either a gene duplication has occurred within S. alsidii between the isolate previously used and our isolates, suggesting a recent duplication event; or our isolates are diploid (two alleles of actin) overturning the belief that all these organisms are haploid and not sexual.

International action on biofouling. Measures to reduce the spread of invasive marine species

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In 2004 an International Maritime Organization diplomatic conference endorsed a convention for the management of ship's ballast water and sediments. This was a major step forward in slowing the spread of marine invasives. But this was just the first step. The other primary pathway for marine invasive species – biofouling – has yet to be addressed at an international level. There is a growing body of evidence that biofouling is responsible for as much if not more of the marine invasive incursions worldwide. Many countries are starting to recognise this issue through risk assessment studies and are starting to look at developing treatment options and New Zealand has been a leader in this area. As with all invasive species issues, particularly those in the marine environment, a single country can not effectively act alone. There is a need for international action that addresses the critical need for: guidelines for antifouling application, treatment options for different niche areas on vessels, and standardised records and certifications for antifouling systems. Biofouling will not be addressed with a 'one size fits all' measure so any international measures will need to be practical and effective for the wide range of vessel types that present a risk. In response to these issues New Zealand, cosponsored by the UK, Australia and the IUCN was successful in getting biofouling on the IMO agenda. The presentation will provide an overview of progress on international action as well as outlining some of the current findings on biofouling risks, and some promising treatment options.

Lobsters spill into marine reserves

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Protection from fishing, through establishment of marine reserves, can result in rapid increases in abundance, size, and biomass of exploited species, leading to the global application of marine reserves as a conservation tool. In addition, reserves can enhance fisheries productivity in adjacent, non-reserve areas through spill-over of larvae, juveniles and adults. Spillover from reserves has spawned a large number of studies targeting a range of species and ecosystems, and has been critical in promoting the benefits of marine reserves and gaining support from local stakeholders. There is no record, however, of "spill-in effects", whereby mobile animals disturbed outside of reserve boundaries rapidly migrate into marine reserves. This study provides direct field evidence across multiple spatial scales (10s meters

to kilometers) that mobile animals (e.g., Caribbean spiny lobster, Panulirus argus) rapidly spill-in to marine reserves in a density-dependent manner in response to disturbance by predators (recreational sport divers). Spill-in explains the sometimes rapid build-up of animals in reserves, and alters our paradigm of the function of marine reserves by shifting our attention away from testing spill-over effects, to developing and testing new hypotheses for the role that animal behavior and communities of organisms inhabiting reserves may play in the disproportionate attraction of larval through adult stages of dispersing and mobile organisms. In addition, spill-in will contribute to understanding how mobile organisms inhabiting both marine and terrestrial systems, such as those that form flocks, schools, herds, troops, or packs, respond to the interplay between human disturbance and reserves intended to protect them.

Spatial autocorrelation: Bane or bonus

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Spatial autocorrelation is a general phenomenon within ecological studies. However, considerable confusion exists about how to analyze spatially autocorrelated data. Two completely different arguments about autocorrelated data are commonly reported:

1. It decreases the true power of a test. The reported type I error rate or confidence interval (CI) needs to be increased to account for this.

2. It can be ignored. The reported CI and hypothesis tests will give correct type I error rates.

This paper will discuss the mechanism that acts to separate these doctrines. We will identify those situations in which classical analytical methods are inadequate (and why), and we will show that in those circumstances where classical methods are valid, autocorrelation is actually a bonus - providing an opportunity for ecologists to *improve* the precision and power of their analyses.

Resilience in a changing world: differential fitness responses to additional stressors by the cockle Austrovenus stutchburyi.

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As part of a broader programme aimed at identifying indicators of resilience, resistance and vigour in impacted estuarine communities, we have undertaken field experiments along a contamination gradient to examine the hypothesis that resilience (the ability to recover from perturbations) is influenced by the genetic identity of individuals within a population. We chose several sites in Auckland's Waitemata Harbour (Tamaki and Hobson estuaries), along with Te Matuku Marine Reserve on Waiheke Island. Tamaki and Hobson estuaries are known to be contaminated with a number of urban contaminants, including heavy metals, with Hobson recording higher sediment metal levels than Tamaki. In contrast, Te Matuku records low contamination levels. At each site we exposed cockles (Austrovenus stutchburyi) to anoxic conditions for 24 hours and determined a range of fitness measures in individual animals (including respiration, reburial, feeding and excretion rates) before treatment, immediately following retrieval of animals from treatment plots and 2 hours after exposure to assess recovery. In this presentation, preliminary results focusing on fitness measure responses will

be presented. The results of this study will increase our understanding of the role of pre-adaptation and genetic variability more generally as determinants in the overall functioning of ecosystems.

Life-history trade-offs in whelks: does variability among sites in adult conditions affect offspring size, number or performance?

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Whelks are an interesting and useful model system in which to investigate life-history trade-offs. They lay benthic egg capsules that hatch crawl-away juveniles, with species-specific strategies ranging from having a single relatively large hatchling per capsule (e.g. Cominella virgata) to multiple, smaller hatchlings per capsule either without intracapsular feeding (e.g. Cominella maculosa) or with it (e.g. Haustrum species). We collected whelk egg capsules from sites in the Wellington region across which adult growth and food availability varies, to examine whether site-level differences in adult conditions translate to reproductive trade-offs in capsule volume, hatchling size, hatchling number, and early juvenile growth.

Maximum variation in hatchling size was 2-fold for C. virgata, C. maculosa and H. haustorium. In general, there was greater variability in hatchling size at smaller scales (i.e. within capsules, among clutches), and no significant difference in mean hatching size among sites. For species with multiple hatchlings per capsule, hatchling number varied by up to 7- 8.5 fold among capsules, with only clutch identity significant, and not site. The strength of trade-offs between size and numbers of hatchlings within a capsule varied by clutch and species. Although mean hatchling size was not different among sites, for C. virgata and C. maculosa early juvenile growth was, for the first 2-4 weeks after hatching. Additionally, there was also site-level variability in egg capsule volume. These results suggest that site-level conditions may affect whelk offspring, but not necessarily via direct effects on hatchling size or number, and that allocation by individual whelks may be more important.

3-Dimensional Observations of Shoaling Internal Waves in Shallow Coastal Waters

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Recent field programs on the New England Shelf have shown summer time water column structure is strongly influenced by localised air-sea interaction, tides and coastal upwelling. Furthermore, mooring and remote sensing data has illustrated how non-linear internal wave groups propagating onto the shallow inner shelf undergo a polarity reversal from waves of depression to waves of elevation. This present work identifies several groups of shoaling internal waves in a time series data set collected during summer 2001 from a 'concept' 3-dimensional mooring array. We discuss the the unique measurements that capture waveforms and localised mixing caused by shear instabilities in shoaling internal waves. A scaling analysis suggests mixing associated with the instabilities is potentially orders of magnitude greater than that provided by the localised effects of wind and tidal stirring.

Hoplostethus taxonomy: rough science and a sawbelly in the NZ EEZ

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The results of a taxonomic review of the fish genus Hoplostethus Cuvier, 1829 (Trachichthyidae) in New Zealand waters are presented. Out of six nominal species, three valid species are recognised, all of importance as commercial target species or by-catch. One (giant sawbelly) is a new endemic species currently without a scientific name; two (orange roughy; silver roughy) are globally widespread in temperate waters and have acquired a plethora of scientific names (synonyms). All three have previously been misidentified, confused with similar species, and generally poorly diagnosed during their history. Selected taxonomic problems are presented and are largely resolved by the powerful combination of morphological and molecular techniques. Research supported by FRST contract C01X0502.

Icebergs and the oceanography of McMurdo Sound, Antarctica.

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McMurdo Sound, Antarctica, is a unique location for the study of ice-ocean interaction. It is located between the Ross Sea and the ocean cavity under the Ross and McMurdo Ice Shelves, and has many types of ice within its confines. Recently the opportunity for an additional experiment presented itself when a large tabular iceberg grounded north of the sound for ~3 years, and another moved through the area over ~8 months.

We collected current meter and CTD data during the height of the icebergs' combined effect, and again after both had moved away from the area. The icebergs had a significant impact on the local oceanography and the potential to impact on bottom water processes in both the Ross Sea and under the Ross Ice Shelf. Our data have captured this perturbation and subsequent recovery of the McMurdo Sound system toward its historical norm.

Predicting between-estuary connectivity based on population genetics of the cockle Austrovenus stutchburyi.

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Understanding patterns of larval dispersal is critical for identifying populations vulnerable to extinction due to low rates of external recruitment, identifying genetically appropriate populations for restocking or reseeding degraded habitats, and designing networks of marine protected areas. Potential large-scale geographic barriers to dispersal have been identified in genetic studies of connectivity between marine invertebrate populations in New Zealand. At finer scales, estuaries provide an

opportunity to study the mechanisms that influence gene flow between populations, as they are spatially discrete habitat units with hydrographic barriers that limit dispersal. Estuarine endemic species are therefore more likely to exhibit genetic differentiation than similar coastal species. Here, we examine inter-estuary dispersal and population connectivity of the common cockle Austrovenus stutchburyi, a suspension feeding bivalve occurring throughout New Zealand in sheltered harbours and estuaries. We present preliminary results from mtDNA Cytochrome Oxidase I sequencing at two east and one west coast sites. No haplotypes were shared between coasts whereas east coast samples consisted of one main haplotype found at both sites, and a number of unique haplotypes. These results suggest that gene flow between east and west coasts may be limited, and demonstrate the suitability of our methodology for studying population connectivity. Future genetic analysis of populations from additional sites throughout NZ will test our hypotheses of connectivity at local (within estuary), regional, and national scales.

Linkages between catchment land-use and assimilation of terrestrial inputs

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Catchment land-use practices can significantly affect nutrient and organic matter runoff to coastal ecosystems. This study examines the assimilation of terrestrial matter in coastal food webs using 30 stations nested within six study areas that are influenced by agriculture, urban and pristine forested catchments on South Island, New Zealand. By contrasting stable isotopic gradients (carbon) in primary producers (macroalgae, seagrass), filter feeders (cockles, mussels) and consumers (fish) across ecosystems and along freshwater-marine interfaces, we discuss the spatial and temporal variance in the assimilation of terrestrial matter in marine food webs. The isotopic results will be used to model the relative contribution of terrestrial matter to marine organisms, which combined with geographic information systems (GIS) data on land-use in the respective catchments, provides information on the linkages between watershed land-use and terrestrial inputs to coastal ecosystems.

The meroplankton community of the northern Ross Sea: a preliminary comparison with the McMurdo Sound region

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As part of the Latitudinal Gradient Project (LGP) the coastal meroplankton community is being studied along the coast of Victoria Land, in the Ross Sea, Antarctica. In this preliminary analysis the meroplankton community from Cape Hallett (72°S) is compared to that from two previously sampled sites in the southwestern Ross Sea; at Cape Roberts and in McMurdo Sound (ca 77°S). Non-metric multi-dimensional scaling (MDS), a hierarchical cluster analysis and permutational MANOVA in combination show that the meroplankton composition differs significantly between the three sites. Although this preliminary analysis includes only one northern Ross Sea site, the results suggest that there are differences in meroplankton composition along the Victoria Land coast. Several larval types, including annelid trochophores, unidentified annelid larva, echinospira, barnacle nauplius, asteroid, echinoid, and ophiuroid larvae were absent or rare in the southwestern Ross Sea but found abundantly at Cape Hallett. Detailed analysis of the meroplankton community at Cape Hallett and further examination of changes in the meroplankton community along the Victoria Land Coast will continue in future years of the LGP.

Recruitment and connectivity in a reef fish metapopulation: It's the journey that matters most.

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Recruitment variability shapes local population dynamics for most reef organisms. One important source of variability in recruitment is post-settlement survival, which can be both strong and selective on phenotypic variation. Moreover, selective mortality can alter patterns of connectivity among local populations, provided selection operates on phenotypic traits associated with particular source populations. We examined sources of variation in mortality occurring shortly after settlement, estimated from reciprocal transplant manipulations of the common triplefin, Forsterygion lapillum. Post-settlement mortality was selective and correlated with a suite of phenotypic traits that together comprise a composite measure of "larval quality". We used otolith microchemistry (from LA-ICPMS) to identify and characterize three distinct putative source populations and two distinct dispersal syndromes and asked whether dispersal history and/or source population identity accounted for heterogeneity in larval quality. Our analyses indicate that dispersal history and not source population identity explained much of the observed variation in larval quality, and hence patterns of post-settlement mortality. From these analyses we infer the importance of ocean matrix effects (pelagic environmental heterogeneity) as driver of both local- and metapopulation dynamics in marine systems. We conclude with a description of our ongoing Marsden-funded research targeting "matrix effects".

The worm snail that ate the reef

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The dynamics and restoration of corals are of critical concern given their ecological importance and the deleterious impacts caused by disease and anthropogenic activities. Previous research has focused on the possible effects of nutrients, algae and disturbance. Vermetid gastropods, which are sessile and feed via an extensive mucus net, are poorly studied members of the coral reef community, yet also may have important effects on corals. We examined the possible effects of vermetids on coral growth and survival in a field study in a lagoon of Moorea, French Polynesia. Vermetids were either left at ambient densities or removed from small (~3m^2) patch reefs. Coral nubbins were collected, weighed (using the buoyant mass technique), and outplanted to these patch reefs. Growth was assessed after ~7 weeks and survival after ~8 months. Eight experiments were conducted using four different species of coral (Pocillopora, Montipora, Porites lobata, and Porites rus). Growth and survival were both greater offshore than inshore, although effects of vermetids were similar in both regions. Effects of vermetids were strongly deleterious but varied among coral taxa. Vermetids reduced the growth of coral by as much as 90% (Pocillopora) and by as little as 30% (Montipora). Survival was reduced from >98% in the "removals" to 79% (P. rus), 70% (P. lobata), and 45% (Pocillopora). These dramatic short-term effects can have dramatic consequences for coral regeneration and dynamics. We projected changes in coral community composition resulting from observed effects of vermetids and found that the effects rival those documented from other factors.

Sedimentary nitrogen uptake and assimilation in the temperate zooxanthellate sea anemone; Anthopleura aureoradiata

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Anthopleura aureoradiata, a temperate anemone with endosymbiotic dinoflagellates ("zooxanthellae") is commonly found buried under surface sediments of mudflats around New Zealand. This habit would have traditionally been thought to have had a negative impact on anemone growth and productivity through decreased light levels and reduced planktonic feeding. However, recent research with tropical corals suggests that some corals may benefit nutritionally from surface sediments accumulated on their surfaces. It was therefore hypothesised that the sediment that surrounds A. aureoradiata is a major source of nitrogen for the anemone. The uptake of nitrogen from the sediment was measured using the stable isotopic tracer ^{15}N. ^{15}N-labelled sediment was provided to A. aureoradiata at low (5 g dry weight) and high sediment (20 g dw) loads for 6 hours and ingestion was detected for both host and zooxanthellar fractions. While there was no difference in isotopic enrichment with sediment load in the host tissue (low 0.881 ± 0.020, high 0.821 ± 0.052 atom % ^{15}N), a difference was found in the zooxanthella fraction (low 1.128 ± 0.064, high 0.927 ± 0.05). Meanwhile, no measurable change in atom % ^{15}N was found in the sediment used in the feeding chambers, presumably because uptake is small compared to the overall availability of N. These results suggest that sedimentary N-uptake does occur in A. aureoradiata, and that it may play an important nutritional role. Studies using ^{14}C to assess nitrogen status (via NH_4^+ enhancement of dark carbon fixation) in anemones incubated with/without sediment will also be discussed.

Seasonal composition and variation in the abundance of petrels, shearwaters and albatrosses off Valparaiso, central Chile

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Between July 2006 and April 2007 we conducted monthly counts of petrels, shearwaters and albatrosses (Procellariiformes) occurring off Valparaiso in central Chile (33ºS; 71ºW). Seabirds were recorded from a boat using transect counts, extending from the coast to nearly 12 miles offshore. During the 3-hour trip, all Procelliiforms on the water surface up to 150 m from the boat were counted directly while flying birds were counted using the "snapshot" method. We identified a total of 17 Procellariiform species including four albatrosses (Salvin`s, Buller`s, Northern Royal and Black-browed), three shearwaters (Sooty, Pink-footed and Buller`s), six petrels (Southern and Northern Giant, Westland, White-chinned, Cape and Juan Fernandez), Peruvian Diving-petrel, Wilson`s Storm-petrel, Thin-billed Prion and Southern Fulmar. Among the albatrosses, Black-browed and Salvin`s were regularly present from July until February, while Buller`s and Northern Royal were detected only in the summer months. White-chinned petrels were regular during winter and spring, but became scarce the rest of the period; Westland petrels were sighted only in August and February. The Cape Petrel, Southern Fulmar and Thin-billed Prion were present in the area exclusively during winter (July through September). Sooty shearwaters were present throughout the whole period of study, with a spectacular irruption in October when we counted 5,600 birds; Pink-footed shearwaters were present only in spring and summer (October through March). We discuss these patterns in relation to the bird`s migration habits and the location of their breeding colonies. This project is funded by grant AR-03-05, Universidad Andres Bello.

Developing formulated diets for spiny lobsters – Could digestive physiology be the key?

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There is a strong worldwide interest in the development of aquaculture for spiny lobsters. In addition to a seed lobster supply, the most significant bottleneck has been developing a cost-effective and nutritionally-adequate formulated diet for spiny lobsters. The poor performance of spiny lobster juveniles on formulated diets in comparison to fresh food has thought to be due to nutritional deficiencies and/or poor feed intake. The digestive physiology of spiny lobsters is poorly understood and may provide an alternative explanation for the poor results obtained from artificial diets.

This hypothesis was tested by characterizing aspects of the feeding (i.e., food consumption, food intake rate, appetite revival) and digestive physiology (i.e., foregut capacity, gut emptying rates, blood glucose, digestive enzymes' activity and post-prandial fluctuations) of Jasus edwardsii juveniles when fed a dry formulated diet and fresh mussel.

It was found that foregut capacity and slow rates of appetite revival restrict food consumption to the low levels currently observed for this species. The appetite of mussel-fed lobsters, measured as the amount of food eaten after a satiation meal, returned linearly to a maximum level (i.e. foregut capacity) after 12h. This directly corresponded with the linear foregut emptying rate. However, appetite revival in lobsters fed the formulated diet was slower (24-48h), despite a similar foregut emptying rate.

Hyperglycaemia and delays in enzyme recycling were examined to determine if these could explain the slow appetite revival. The results are discussed in the light of future research on diet development for spiny lobsters.

Effectiveness of proposed options for managing Hector's dolphin bycatch

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New Zealand's endemic Hector's dolphins overlap with gillnet and trawl fisheries throughout their geographic range. The catch rate in commercial gillnets has been estimated using independent observers. No quantitative estimates are available for bycatch in recreational gillnets or trawl fisheries. The catch rate (per dolphin, per km of gillnet, per year) in commercial gillnets was used in a population viability analysis to estimate past and future population sizes. Total population size today (7,873, CV 0.16) was estimated at 27% of population size in 1970 (29,316, CV 0.16), before a major expansion of commercial gillnetting. The species matches IUCN criteria for Endangered. The North Island subspecies matches criteria for Critically Endangered. Current management, which includes two protected areas, is not sufficient to halt population declines. Hector's dolphin populations are predicted to continue declining to 5,475 (CV 0.20) by 2050. Creating four strategically placed protected areas would allow population recovery towards 1970 levels, with an estimated 47% probability of reaching 50% of 1970 population size by 2050 (proportion of 5000 model runs in which final population size was at or above this reference level). Reducing fisheries mortality to levels approaching zero shows the strongest promise of meeting national and international guidelines for managing dolphin bycatch, with a 59% probability of reaching 50% of 1970 population size by 2050. The Department of Conservation and Ministry of Fisheries are developing a Threat Management Plan for Hector's dolphin. The likely effectiveness of the management options in this plan will be discussed.

The importance of macroalgal nursery habitats for recruitment of temperate reef fish

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Many marine organisms have complex life cycles and undergo a series of habitat shifts through ontogeny. Such habitat shifts may be due to requirements for different food resources associated with growth or changes in predation risk associated with size. Despite the intuitive appeal and widespread use of the term 'nursery habitat', a clear and meaningful (i.e., mechanistic) definition of ecological nurseries has remained elusive. We ran large scale subtidal manipulation experiments in the Wellington region, using the common triplefin (Forsterygion lapillum) as a model species, to determine how the 'quantity and quality' of settlers differs between different macroalgae species. This and future work will help me to develop a better conceptual model for the nursery habitat concept.

Appraisal of molecular detection methodologies for identifying and enumerating aquatic species

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Methods for the detection of marine species in aquatic environments require formats in which it is desirable to quantify as well as efficiently and accurately identify these pests. A method showing promise in this area is the sandwich hybridisation assay (SHA). One constraint in developing this method (particularly for species that are not easily accessed) is that the target RNA in preserved specimens degrades over time. We describe how target rRNA can be preserved by treatment with "RNAlater" for a variety of potential pests for New Zealand, including invertebrate larvae of the northern Pacific seastar, Asterias amurensis and toxic dinoflagellates. We report on the development of SHA probes for A. amurensis, with the view to developing an array system for detection. Finally we present quantitative data for both SHA and qPCR for the toxic dinoflagellates, Alexandrium and Karenia spp., enumerating at the cell rather than nucleic acid level.

The air-sea interface and climate

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The interface between the atmosphere and ocean plays a crucial role in controlling the exchange of gases which are of significant climatic importance, such as carbon dioxide. It is estimated that globally, the oceans take up almost half of the anthropogenic CO_2 emissions. This global exchange is ultimately governed by small-scale microphysical processes at the interface. On the regional scale, we usually rely upon parameterisation of gas transfer velocity against some simply measured parameter such as wind speed, to determine the rate of gas exchange. During the SAGE experiment we determined the parameterisation using a dual tracer experiment, comparing the relative evasion rates of a pair of inert gas tracers. Parallel developments are taking place in laboratory and modelling studies which are able to more directly examine the microscale processes. Significant insights into the interface processes have been obtained by exploiting the parallels between gas exchange and heat exchange. In particular infrared imaging is able to display the disruption and renewal of the thermal boundary layer, and shows that microscale wave breaking may be one of the most important factors in heat and gas transfer.

In order to address these small scale processes, we have modelled basic interfacial processes using the numerical model, Gerris. This gives insight into exchange at the droplet and small-scale wave scale.

Appling integrated multi-trophic coculture to increase aquaculture productivity and value in existing water space

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What is Integrated Multi-trophic Coculture (IMTC)? The growing of complementary feeding groups in close proximity for the benefit of the cultured species, the environment, the economy and society. NIWA is working with the aquaculture farming industry to assist the sector to reach its goal of $1 billion in export revenue by 2025 through species and product diversification. Our research is supported through the International Opportunity Investment Fund (IIOF - FRST) and aims to develop and implement methods for the cost-effective, sea-based culturing of multiple species that are ecologically complementary. In such co-culture, the bio-production of one species can be utilised by other species as a food source. Within a farmed area, for example, waste from mussels could be used by sea cucumber, while seaweeds on mussel lines could be used to feed a cultured grazer species. IMTC is an ecologically-based practice for the aquaculture sector that aims to maintain wider ecosystem health and achieve an optimum ecological balance. IMTC yields two clear economic benefits for the aquaculture sector. Firstly, it is an attractive pathway for diversifying the industry into higher-value species. Secondly, the maximisation of natural food utilisation, coupled with the minimisation of environmental impact, endows the sector with a significant international marketing opportunity, since the market is increasingly demanding products with low environmental impact (and such products command higher premiums). IMTC provides a pathway for New Zealand to capitalise on the global demand for seafood and on the opportunity to increase export earnings through introducing high-value species where we have established networks and market profiles. Our research to date is highlighted and the application of IMTC to existing culture space in New Zealand coastal waters is discussed.

Biophysics in Coastal and Ocean Boundary-layers

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Biological entities have a range of characteristic spatial and temporal scales governing their life histories. These entities develop in environments that also have their own characteristic spatial and temporal scales. Success is controlled by the interplay of these scales. This talk will explore this interaction with emphasis on the range of scales that exist in boundary-generated flows in a variety of situations. Examples from recent research activity will be presented include waves on rocky reefs, flow in mussel farms, headland generated eddies, tides over submarine ridges, oceanic surface layers etc. The work seeks a basis for understanding the actual biophysical interactions underlying many "research outcomes" relating to coastal and oceanic productivity, biodiversity and aquaculture.

Modelling long-term coastal evolution

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We are developing a numerical model that is capable of predicting coastal morphological change in response to long-term variations in environmental forcing parameters such as sea level, wave climate and sediment supply to the coast.

Land-use changes, climate change and sea level rise are processes that are acting now, but whose long-term impacts on the coastline are unknown. Observable response times to these changes are generally on the order of 10 to 100 years, but may be up to 10,000 years in the case of sea level change. Around 80% of our population lives near the coast, with many resources built on soft-sediment geology that will respond rapidly to changes in these environmental parameters. Our model aims to predict the coastal response at timescales of decades or longer, to facilitate sound environmental management decisions for the future.

The model utilises conceptual rules to characterise sediment transport to the coast, combined with a random-walk transport scheme that enable it to rapidly process morphological evolution at time-steps of order 20-years. At present the model generates realistic river-delta development in response to variation in sediment supply and sea-level change that take place over several hundred thousand years. An alongshore wave-driven transport module is also included, and the model predicts the shoreline response to wave climate, such as spit formation and growth at river mouths, on timescales of decades to centuries.

New species and new records of fishes from the Ross Sea and Ross Dependency

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Since 1998 Te Papa has received by-catch fishes from the annual toothfish fishery in CCAMLR Area 88 of the Antarctic, mostly from MFish Scientific Observers. Based on this developing collection, plus the specimens collected during the benthic 2004 BioRoss survey, and published accounts, we record over 120 fish species from the region. This list includes at least 14 putative new species in seven families and 27 new records in 20 families. Ten new species and 15 new records were taken from the western Ross Sea (below 70° S) between 85 and 1878 m depth. Four new species and 12 new records were taken outside the Ross Sea in the Ross Dependency (60° S to 70° S), between 377 and 2267 m depth. An overview is given of selected new species and records, including some of the taxonomic problems. Initial examination of many of these has highlighted the need for generic revision to resolve their identification.

Mangrove-habitat expansion and tidal-flat evolution: triggers, feedbacks and controls

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Mangroves have colonised 11 km^2 of intertidal flat in the southern Firth of Thames over the last 50 years, which has resulted in large-scale environmental changes. Seedlings colonise intertidal flats down

to mean sea level (MSL), which reflects tolerance to submersion and wave exposure. Mangrove-habitat expansion and tidal-flat evolution is reconstructed using dated cores (^{210}Pb, ^{137}Cs), historical records and field observations to explore interactions between sediment processes and mangrove ecology. The original silt–sand substrate was transformed by the delivery of millions of m^3 of mud following catchment deforestation (1850s–1920s). Mudflat occurs above +0.2 m MSL, with sediment accumulation rates (SAR) averaging 20 mm yr^{-1} since the 1920s. Mangrove colonisation was delayed until surface elevation reached +0.5 m MSL in the mid-1950s. SAR of 50–100 mm yr^{-1} in the old-growth forest rapidly built a mud platform close to the upper limit of the tide. Episodic seedling recruitment on the wave-exposed mudflat occurs at decadal intervals and is controlled by wind climate. There is evidence of storm-related erosion and mangrove-forest disturbance. In the old-growth forest, SARs have averaged <10 mm yr^{-1} since the 1970s. Sedimentation gradients within the forest built a basin that has only recently infilled and colonised by mangroves. The forest today at +1.7 m MSL is near the upper limit of the tide and is infrequently inundated. Thus, feedbacks between surface elevation, tidal inundation and sedimentation exert strong controls. The fate of the mangrove forest will depend on the response of surface elevations to sea-level rise.

Macroalgal productivity: Single species and community productivity in the intertidal zone

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Macroalgae are the dominant primary-producers in costal New Zealand. They play a vital role not only in carbon fixation, and also provide habitat and nutrients to myriad associated species. There is considerable debate in the ecological literature about the relationship between diversity and various forms of "ecosystem function", often citing productivity but usually not measuring it. Where particular habitat-forming species are involved, species identity can be of primary importance in such relationships. This can be further highlighted in shallow coastal areas of southern New Zealand, where much of the benthic biomass on rocky reefs is divested in intertidal large brown algal stands, from the upper limits of Hormosira banksii to the very low zone dominated by huge bull kelp, Durvillaea antarctica. Macroalgal productivity has been poorly explored in New Zealand and the relative contributions of species are not well understood. The aim of this research is to quantify macroalgal productivity (under lab and natural conditions), and to understand the functional roles of macroalgal species. Maximum species productivity (fucoid species) range from 0.5 mg Carbon Fixed $gDWT^{-1}$ h^{-1} (Hormosira banksii) to 1.2 mg Carbon Fixed $gDWT^{-1}$ h^{-1} (Carpophyllum maschalocarpum). Productivity of fucoid species appears to be related to tidal position, with low shore species being much more productive than high shore species. Unlike the single species irradiance-productivity relationships (which show saturation) community productivity is linear with irradiance. Analysis of community dynamics may give insight into functional roles of species and their underlying importance could potentially uncover species essential to ecosystem functioning.

Buoyant Sticky Mucus: The Dispersal and Attachment of Fucoid Algae in a Turbulent Environment

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A major obstacle for marine species is the transition phase between the release of propagules by reproductive adults and successful settlement. For coastal species, this process generally occurs in highly turbulent waters on topographically complex shores. We are examining the density of mucus and eggs released by reproductive fucoid algae to model potential dispersal curves, and to delineate the mechanisms that are important at sub-millimetre to metre scales in turbulent waters. Egg sizes and mass densities of three fucoid species were determined using buoyancy chambers and particle tracking velocimetry. Mass densities ranged from 1.14 g/cm^3 for Cystophora torulosa to 1.67 g/cm^3 for 30µm Durvillaea antarctica eggs. Our research is exploring initial buoyancy and its effects on dispersal potential because the nature (density) and longevity of the mucus in which the eggs are released is known to vary between species and because it appears to play a major role in small scale dispersal. Fertilised propagules of fucoid algae that reach the substratum must attach and remain attached throughout their ontogeny of development. We have measured and modelled detachment of propagules at different stages and compared these to biologically inert particles through a series of flume experiments. We found 100% of recently settled Hormosira banksii propagules (1hr) were detached by velocities of c. 1m/sec, while D. antarctica settled for the same length of time required much greater velocities (4x) for >80% detachment. These data are applied to models to predict successful establishment of these habitat-forming species across gradients of wave action.

Blueskin Bay Gyre deflection: Expanding on current knowledge.

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Previous research has established the hydrological and oceanographic features of the waters off the Otago coast, including the presence of a persistent gyre system in the lee of the Otago Peninsula. To date no work has been done however, to better understand these hydrological patterns at a finer scale. The research discribed here concentrates on the hydrology at the deflection point of the Blueskin Bay Gyre, off-shore of Cape Saunders.

In south-westerly wind conditions, south of Cape Saunders a stratified low salinity body of neritic water is present from 3-4km to the shore at Allans Beach, with the Southland Current water travelling northeast along the coast off-shore of the 50m isobath. Within Wickliffe Bay, north of Cape Saunders and the deflection of the gyre, lies a well mixed body of neritic water.

In North-easterly wind conditions, south of the Cape, the waters show strong thermohaline stratification with neritic waters at the surface to 10 – 15m depth, below which lies the waters of the Southland Current. North of the Cape 3km from shore, within Wickliffe Bay the Southland Current is present to within 5m of the surface; inshore of the 20m isobath. Off shore, in surface waters less than 10m, low saline neritic water is present. The presence of this body of neritic water off-shore of the oceanic Southland Current waters is a possible indicator of a down stream eddy.

Using findings from previous research and the results of this survey a more detailed understanding of local hydrological conditions will be discussed.

The 'Underyielding' of Nutrient Fluxes from a Marine Benthic Community: Cause and Effect

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The relationship between biodiversity and ecosystem-processes remains a paradigm in ecology today. Here we present the results of a benthic mesocosm experiment that investigated the effects of three marine bioturbators (Nereis virens, Callianassa subterranea and Upogebia deltaura) on the flux of nutrients across the sediment-water interface. The experiment was orthogonal in design, producing 7 species treatments (three single species treatments, three pair combinations and a multi-species treatment with all bioturbators) with an additional control to determine the background levels of nutrient fluxes. Bioturbator treatments were introduced to 30cm diameter sediment cores and held in a mesocosm facility for 60 days, prior to the determination of nutrient fluxes. Following nutrient measurements, polyester resin was added to the burrows of each treatment which solidified, creating physical structures from which burrow surface-area and volume were measured.

Treatments that contained more than one species typically generated less burrow surface area than expected based on the single species treatments (underyeilding). Nutrient fluxes from treatments containing multiple species were also less than expected based on the single species treatments. The similar response of burrow surface-area and nutrient flux suggested a mechanistic linkage; with the former a probable determinant of the latter. This indicated that the 'underyielding' of burrow surface-area was the likely cause of lower than expected nutrient fluxes. Further investigation uncovered that poor performance in diverse treatments was predominantly caused by Upogebia deltaura. This species consistently failed to construct large burrow structures when in combination with other species.

Settlement cueing and spatial dynamics in the New Zealand half crab, Petrolisthes elongates.

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Specific substratum selection due to chemical settlement cues or surface properties may lead to aggregated (gregarious) settlement and can determine recruitment patterns. Both larval supply and the often patchily distributed availability of suitable microhabitats have a strong impact on the spatial variation in abundance of species. This is especially true for small invertebrates, such as crabs, living among cobbles on intertidal boulder fields.

The results from choice chamber experiments provide strong evidence that adults of P. elongatus release a chemical settlement cue, presumably a pheromone, that attracts conspecific larvae. This evidence is supported by significantly different numbers of recruits in cobble-filled baskets deployed in the natural habitat that contained either 30 P. elongatus adults or were empty (i.e. excluding migrating adults but allowing settlement): There was 4-fold greater settlement into baskets with adults. This attraction effect is density-dependent and results in gregariousness and patchiness of settlement on a small scale (tens of centimeters).

Further, I assessed the heterogeneity of rock-size distribution as well as the patchiness of abundance of P. elongatus on four different spatial scales, ranging from centimeters to kilometres, using 0.5m x 0.5m quadrats in a nested design including three sample sites in the Wellington region.

The examination of gregariousness and aggregation leads to broader considerations concerning trade-offs between aggregation and density dependence.

Shifting the baseline back: documenting community perceptions of marine resources and application to marine conservation, a case study in Fiji.

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We have documented the shifting baseline phenomenon in the marine ecosystem and amongst different age groups at Kubulau, a geographically distinct community in Fiji. This community is the owner / manager of its fishing grounds, which have undergone gradual changes in ecological intactness through increased fishing pressure over time. We observed there had been a shift from a relatively healthy to a severely degraded ecosystem, followed by a recovery in marine resources as a result of establishment of the Namena MPA more than 10 years ago. We use the results from this study to demonstrate the usefulness of socioeconomic surveys in communities and to indicate the state of the marine resources available in each community. The results also show the importance of the older fishers' traditional knowledge and memory of the reef and resources from the years past to help set targets for restoring reef fish and invertebrate populations. The study was also used as a motivational tool for the community for the conservation of their marine resources. The approaches used in this study are important tools for assisting with conservation efforts in Fiji.

Snapper use of an estuary – the Mahurangi Harbour

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Snapper (Pagrus auratus) is New Zealand's most important coastal finfish species, supporting large commercial and recreational fisheries around the east and west coasts of northern New Zealand. Within the Mahurangi Harbour (north-eastern NZ), three methods have been employed to quantify spatial and seasonal patterns of distribution and abundance of snapper, and their habitat associations.

Maternal investment, trade-offs in reproductive allocation and carry over effects of nutrition in whelks

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A growing body of evidence highlights the role that maternal effects play in determining the fitness of subsequent generations and in shaping community structure. In this study the relative influence of maternal and juvenile nutrition on growth and survival are compared. Three species of intertidal whelks (Haustrum scobina, Cominella virgata and Cominella maculosa) were collected from harbour and south coast shores of the Wellington region and subjected to high and low food treatments over a

25 week period. Over this period whelks reproduced and laid egg capsules which were measured, counted and saved until hatchlings were obtained.

Capsule volumes differed between low and high food treatments in each species. Maternal nutrition influenced the growth of H. scobina and C. virgata hatchlings, but not the growth of C. maculosa hatchlings. No difference in hatchling survival was detected between hatchlings born from low and high food adults.

Taken together these results add weight to the body of evidence highlighting the importance of adult nutrition on reproductive allocation and on the early life of hatchlings. The degree of persistence of maternal effects into the next generation is species specific and may be more important than juvenile nutrition in the first weeks of life of some species. Differences in maternal influence between species are likely to be alternative strategies used to balance the advantage of high fecundity with the benefits of producing higher quality larger offspring.

Effects of recreational diving at the Poor Knights Islands Marine Reserve.

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Marine ecotourism is a large and valuable industry in New Zealand. As this industry continues to expand, increasing pressures will be exerted not only on the flora and fauna so valued by tourists, but also on the wider marine ecosystem. Ecotourism at the Poor Knights Islands Marine Reserve consists predominantly of boating and recreational diving, and it is the aim of this study to determine the effect (if any) of these activities on benthic reef communities. Video and still camera surveys were conducted to map biological habitats and quantify abundances of benthic taxa. These were carried out at a total of 80 sites around the island chain, at depths of 0–70 m. Multivariate techniques will be used to model the abundances of potentially vulnerable organisms as a function of environmental variables (depth, slope, aspect, wave exposure, etc.) and recreational diving intensity. Preliminary data will be presented on the types of habitats and taxa recorded, along with the ongoing objectives of the research programme. Ultimately this project will help provide knowledge to develop new management tools to conserve ecosystem integrity, natural heritage values and sustainable human usage of marine ecosystems.

Using science to develop an acceptable limit for NZ fisheries bycatch of seabirds

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The Ministry of Fisheries launched its Strategy for Managing the Environmental Effects of Fishing (SMEEF) in 2005. This strategy set out how MFish proposed to meet its environmental obligations under the Fisheries Act and other international obligations. The SMEEF proposed the development of a set of standards for defining acceptable limits on the effect that fishing may have on the aquatic environment, including the effects of fishing on seabirds.
Seabirds are known to be caught as incidental bycatch in many of New Zealand fisheries, by several different fishing methods; trawling, bottom and surface longlining and setnetting (gillnetting).
The Fisheries Act states that "associated or dependent species should be maintained above a level that ensures their long term viability". Therefore when developing the seabird standard we needed to consider scientific knowledge gained from population and reproductive studies, at-sea observation of fishing operations and estimations of total incidental seabird bycatch levels, in order to determine

appropriate levels of fishing related mortality. This presentation will follow the scientific basis for developing the standard for the incidental capture of seabirds in New Zealand waters.
The actual levels proposed for the seabird standard are under review by MFish managers and will be publicly consulted on in the near future.

Ecosystem-based management in the tropical South Pacific - initial results from a case study in Fiji
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The scope of the project is at the seascape level and incorporates the adjacent watersheds. The project focuses on two *qoliqolis* (fisheries management areas) and adjacent watersheds on Vanua Levu. Fish resources from the *qoliqolis* are an important source of sustenance and income for the local communities, but some land-use practices at the sites, such as logging, widespread land clearance and sugar-cane farming, may adversely affect the marine ecosystems through sedimentation and nutrient enrichment from runoff.
Thus far, initiatives at both sites include: establishment of MPAs through close collaboration and consultation with the local communities; active management committees; draft management plans and fish wardens who have been trained to enforce the MPAs and *qoliqoli* rules. Marine biophysical and socio-economic surveys were undertaken at both sites and a biological monitoring program begun at one site to investigate effectiveness of MPAs. Watershed conservation has begun through development of a management plan for a forest reserve at one site, which increased awareness of the importance of good water quality and watershed conservation. New information on the watersheds of both sites has been obtained through freshwater fish surveys and a preliminary watershed runoff model has been developed that demonstrated the potential impact of sediment and nutrient runoff on the marine habitats of both sites.

Scavenging pressure: a measurable ecosystem service correlated with estuarine health
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The EHI is essentially an index of water quality. Although water quality is important, it is only one driver of estuarine health. There are other drivers, such as fishing and invasive species, which may not directly relate to water quality. Fishing pressure may explain the reduction in scavenging rate within "healthier" rivers. Measuring water quality is wise but, because we do not completely understand estuarine health, we need to gauge management actions against our best measure of estuarine health. We can improve our measurement of estuarine health by including direct measures of higher order ecosystem processes.

The taxonomic status and phylogenetics of blue mussels (genus Mytilus Mytilidae; Bivalvia) in NZ: a new molecular marker determines the mitochondrial DNA lineage of M. galloprovincialis Lmk.

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Taxonomic interpretations of molecular variation within the blue mussel genus Mytilus define a sibling species complex that includes Mytilus edulis, M. galloprovincialis, and M. trossulus. These species are differentiated using nuclear DNA markers. Interpretations of mitochondrial DNA have been used to infer the phylogeographic histories of intraspecific lineages. Southern hemisphere populations of M. galloprovincialis represent distinct lineages. Following a suspected Pleistocene trans-Atlantic migration, southern hemisphere lineages diverged 1-2 million years ago. Further study of M. galloprovincialis is warranted due to the paucity of published molecular investigations. This study utilized naturally occurring blue mussels in NZ examined with regards to taxonomic status and phylogenetic relationships with other lineages of M. galloprovincialis . A new RFLP molecular marker was developed to differentiate between M. edulis from the northern hemisphere and M. galloprovincialis from the northern and southern hemispheres. M. galloprovincialis is the only species identified within mainland NZ using a nuclear DNA marker. The blue mussel population on Auckland Island consisted of pure M. galloprovincialis and hybrid M. edulis/M. galloprovincialis individuals. Mitochondrial DNA and RFLP genotyping both indicate that mussels from several NZ locations have alien M. galloprovincialis northern hemisphere lineage genotypes. This finding suggests alien blue mussels have been introduced to, and now co-exist with, native NZ mussel populations. The presence of alien genetic lineages of M. galloprovincialis in NZ has implications for biosecurity mandates, conservation interests, and aquaculture guidelines.

Coral disease prevalence and associated environmental variables at a remote Pacific atoll

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Coral diseases are an ever increasing threat to coral reefs. This is clearly a concern for conservation and management of these systems and their reef associated organisms. Little research has looked at the wider ecological impacts of coral disease and virtually nothing is known about baseline levels of disease in the remote Pacific. Work was conducted over a six week period during the months of June and July of 2007 at Palmyra Atoll located in the central Pacific. Transects were run haphazardly at key sites established for long term monitoring around the atoll at both inner reef and fore reef locations. This initial baseline survey was aimed at quantifying, in detail, coral community structure, environmental variables and pathology assemblage data for each site. Environmental variables measured were salinity, turbidity, chlorophyll concentration and temperature. Work is also in progress to determine sedimentation levels for each key site within the inner reef locations. This presentation will discuss the initial base line findings of characterising coral community structure within the inner reef and fore reef locations and the potential diseases identified at Palmyra Atoll. Ultimately the data from this initial baseline survey will be used to create a multivariate regression model using forward selection to determine correlations between three separate matrices: coral community structure, pathology assemblage data and environmental variables. Key patterns will then be targeted for further investigation and repeated over two seasons in 2008.

Scallop biology and fisheries in northern New Zealand

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Scallops (Pecten novaezelandiae) are an important component of many soft-sediment marine communities around New Zealand. They are patchily distributed in a variety of semi-estuarine and coastal habitats from low tide to around 60 m deep, but are more common in depths of 10–30 m. Scallops grow rapidly, have high mortality, high fecundity, and exhibit variable recruitment. Such a life history results in large fluctuations in abundance, and reliance on relatively few year classes.

Scallops support regionally important fisheries off the northeast coast of the North Island. Commercial fishing using dredges has been conducted in this region since the late 1960s, and a wide variety of effort controls and daily catch limits have been imposed in the past. The two fisheries (Coromandel and Northland) have been limited by explicit seasonal catch limits since the early to late 1990s, and some additional controls remain on minimum legal size, dredge size, fishing hours, and non-fishing days. Non-commercial (recreational and customary) fishers usually take scallops by scuba diving or snorkelling, although some use recreational dredges. Non-commercial fishing occurs mainly in enclosed bays and harbours, many of which are closed to commercial fishing.

Management of the northern scallop fisheries is based on a Current Annual Yield (CAY) harvest strategy, which requires annual pre-season surveys to estimate start-of-season biomass. This approach provides flexibility by enabling management to respond to the observed variability in scallop abundance. However, there remains some degree of uncertainty in important aspects of the stock assessment, and the underlying processes that drive variations in scallop abundance are still poorly understood. This paper reviews biological and fisheries information for scallops in northern New Zealand, and outlines future research directions that could advance our knowledge of scallop population dynamics.

Plasticity in diet of two echinoderms across an ecotone: evidence for microbial recycling of forest litter and bottom-up forcing of population structure

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Many coastal marine populations persist across gradients in benthic productivity. In the New Zealand fjords there is a sharp gradient in available biomass between the wave-washed outer coast, dominated by kelps, and the quiescent inner fjords where estuarine seaweeds and terrestrial inputs predominate. We found significant variation in abundance of macroalgal groups, the grazer Evechinus chloroticus and the detritivore Stichopus mollis, and in $\delta^{15}N$ and $\delta^{13}C$ of the macroalgae and consumers among five study sites across this gradient. Analysis of $\delta^{15}N$ and $\delta^{13}C$ from tissue of the two consumers relative to the primary carbon source pools with a mass balance model indicated that diet was primarily influenced by composition and quality of macroalgal food, except at the inner most sites where there was evidence for terrestrial inputs. These results demonstrate that it is important to resolve relative abundance of food sources and specific isotopic variation to resolve spatial patterns in diet from stable isotope analysis across environmental gradients. Isotopic analysis of stomach contents of E. chloroticus from the inner-most sites provided strong evidence that terrestrial detritus was being assimilated via microbial recycling ($\delta^{15}N$ –5 ‰ and $\delta^{13}C$ –37 ‰). Differences in $\delta^{13}C$ of stomach contents versus those of tissues provided a basis to measure assimilation. There was a strong correlation between this proxy for assimilation with growth parameters among study regions across the ecotone. This analysis

indicates a strong bottom-up influence on vital rates of E. chloroticus within the fjord, with links to source-sink structure of the population.

Has oyster dredging affected biodiversity in Foveaux Strait? Evidence from changes in bryozoan assemblages over forty years

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Bryozoans once dominated large areas of sea floor in Foveaux Strait, forming an important element of epifaunal reefs. The reefs provided habitat for a diverse fauna, including Bluff oysters and blue cod. Concern exists that dredging for oysters has removed or modified extensive areas of epifauna and that this disturbance may have resulted in the localised extinction of reef-associated species.

A cocktail of urban influx in estuaries: hangovers for biota?

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Estuaries are under pressure due to increased urbanisation of coastal environments. A cocktail of stressors flows from urbanised catchments to receiving estuaries via stormwater runoff and stream flow, reducing the health of estuaries. Early detection of reductions in estuarine health allows mitigation of the effects before they become irreversible. We measured the $\delta^{15}N$ and hepatosomatic index (HI) of the crab Australoplax tridentata to assess whether the nutrient sources and body condition of crabs were affected by urban influx. These responses were measured around 3 urban influx sites within Coombabah Lake, located on Queensland's rapidly urbanising Gold Coast. We predicted that crab $\delta^{15}N$ would be more elevated at 0 m than at 250 m from the urban influx sites and that crab HI would differ between 0 and 250 m from urban influx. Crab $\delta^{15}N$ showed a pulsed response at both distances from urban influx that was positively correlated with rainfall (r = 0.90, p = 0.007, for both distances). Crab $\delta^{15}N$ was most elevated at an urban influx site adjacent to the Coombabah Wastewater Treatment Plant (CWTP) with values > 6 ‰. At this influx site, crab body condition varied more through time at 0 m (Coefficient of variation: 28.4 ± 6.0 %) than at 250 m away (Coefficient of variation: 4.0 ± 1.7%). The enrichment of crab $\delta^{15}N$ following rainfall indicates that nutrient sources within Coombabah Lake are impacted by the delivery of urban N via storm runoff. The constant elevation of crab $\delta^{15}N$ at the influx site next to the CWTP suggests that this is a significant source of anthropogenic N to the estuary. Increased fluctuations in crab body condition at this site indicate that these N sources, together with other ingredients of the urban cocktail, are having a localised impact on the biotic health of the estuary.

Abstracts for Poster Presentations

The current distribution and abundance of Omobranchus anolius, the introduced Australian Blenny, throughout the Waitemata Harbour and inner Hauraki Gulf

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Introduced marine species could pose serious threats to natural biological diversity. One such relatively recent introduction, the Australian oyster blenny Omobranchus anolius, was first reported from the Hauraki Gulf in 2003, and at this time was considered to have a limited geographic distribution. Subsequent surveys at 36 sites in Waitemata Harbour and Tamaki River estuary in 2006 reveal that the distribution of this species has increased. Consistent with earlier reports, the strong association between this blenny and that of the similarly invasive Pacific Oyster (Crassostrea gigas) is confirmed. O. anolius was found co-existing with two other fish species, Acanthoclinus fuscus and Grahamina sp., suggesting it may not exclude native fish from available habitat. The potential effect of O. anolius on native biodiversity appears to be minimal given that this species is presently known only from otherwise extensively modified environment.

Report on the stomach contents of long-finned pilot whales stranded on the Ruakaka Coast, New Zealand.

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New data are reported on the diet of the long-finned pilot whale, Globicephala melas, based on stomach contents recovered from whales involved in a mass stranding on Ruakaka Beach, northeastern New Zealand, in November 2006. For nine whales for which identifiable stomach contents were recovered, three that stranded on 10 November and six that stranded on 11 November, prey remains comprise exclusively cephalopod beaks attributed to five species of squid. The stomachs of five whales were completely empty, whereas the stomachs of a further two whales contained presently unidentifiable upper beaks only. No whale appears to have been satiated immediately prior to stranding, given that no stomachs contained more than five lower beaks, and the maximum biomass of prey recently consumed by any one whale is calculated to be less than 5kg. Squid prey are all recognized to be oceanic species found from 50 to 1000 metres, although more common towards the deeper end of this range. These data both complement and contrast with the only other information available for this species reported from stomach contents of whales stranded on Farewell Spit, South Island in December 2005.

Systematics of the squid family Onychoteuthidae Gray, 1849

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Onychoteuthid ('hooked') squids have been reported from every ocean but the Arctic. Ranging in size from120mm to 4m total length at maturity, these squid often comprise major portions of the local diets of apex predators including fish, seabirds, and marine mammals. However, the family Onychoteuthidae is systematically unstable, with 64 nominal species, 13–15 of which are generally considered valid. The type species, Onychoteuthis banksii Lichtenstein, 1818, is known to be a cosmopolitan complex encompassing a number of taxa. Several genera are known only from certain life stages and may prove synonymous with other known taxa. Many type specimens are lost or damaged beyond recognition, and few descriptions provide sufficient morphological detail to permit confident identification or even reasonable comparison. This PhD will therefore provide a comprehensive review of the family, examining type material wherever possible, re-assessing all nominal taxa and describing and illustrating all valid species according to modern systematic standards.

Faunal Assemblages and Sediment Characteristics of Hydrocarbon Seeps in the Hikurangi Margin, Eastern North Island, New Zealand – preliminary results.

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Hydrocarbon seeps host chemosynthesis-based ecosystems in the deep sea fuelled by methane fluxes. A recent joint German-New Zealand cruise to the Hikurangi Margin subduction zone, offshore eastern North Island, enabled mapping and sampling of seep fluids, sediments and biota. Box core data (biological, sedimentological) are currently being analysed to determine faunal composition and the physical and chemical properties of the sediments among seep sites. Stratigraphic logs, grain size analysis and X-radiographs of core samples indicate the background sediments (sand, sandy mud, mud) are variably infused with methane-derived carbonates, some of which have cemented and entombed invertebrate shelly taxa (e.g., vesicomyid, solemyid and lucinacean bivalves). Bioturbation is pervasive and originates from a relatively abundant vermiform biota. Historical methane fluxes likely varied, as at least one core showed a clear vertical transition in sediment and community components. It is expected that results from these analyses will enhance our knowledge on present and ancient macrofaunal assemblages and their interactions with sediment characteristics of seep sites, especially for New Zealand.

Marine ecosystem science, management and conservation in New Zealand: where is the connection?

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The science and management of marine ecosystems is often confounded by their complexity and by differing objectives among scientists, conservation managers and communities. A shared information base can help unify fragmented research efforts and advice from scientists and communities can help conservation managers to address a range of ecological and social objectives.

This poster presents examples of how scientific and other expert advice has assisted in the design and identification of marine protected areas and how these processes can be applied in New Zealand. We describe progress in the Hauraki Gulf region in mapping basic habitat surrogates to describe broadscale patterns in marine biodiversity and outline other ways in which knowledge about marine ecosystems can be incorporated into planning for marine conservation, sustainable use and understanding.

The appropriateness of beach burial of cetaceans in beach sediments: an environmental appraisal

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Since January 2007 the Department of Conservation has buried two ship-struck Bryde's whales above high water at Station Bay, Motutapu Island, Hauraki Gulf. No environmental impact appraisal was undertaken on the receiving environment prior to burial. Accordingly, it is unknown whether Station Bay is an appropriate location on Motutapu Island to bury these cetaceans, and whether the maritime and marine biodiversity of this bay will be affected by the substantial organic input associated with decomposition of approximately 40 tons of decomposing cetacean.

Preliminary inventories of marine and maritime fauna and flora at Station Bay are presented. Given the presence of several sparsely distributed species throughout Hauraki, Station Bay might not be the most appropriate burial site for cetacean species. This poster further describes research planned for 2008 to provide the Department of Conservation with information on the nature and extent of physical, biological and chemical effects of cetacean burial on dune and intertidal flora and fauna in areas of recurring cetacean strandings throughout the greater Auckland region.

Isolation and Identification of Thraustochytrids from New Zealand Estuarine Habitats

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Thraustochytrids were isolated from estuarine habitats in the Whangapoua Harbour, New Zealand. Estuarine samples were pine pollen baited and stored at 17ºC for 2 weeks, then subsequently plated onto agar plates and stored at 17 ºC for a further two weeks under a continuous light regime. Individual colonies were axenically sub-cultured and purified using standard microbiological techniques. On the basis of 18S and CO1 DNA gene typing and comparative phylogenetic analysis, we determined the isolates to be closely related to Thraustochytrium and Schyzochytrium, members of the phylum Labyrinthulomycota (Kingdom Chromista). The isolates are currently being investigated for their biotechnological potential.

The role of Tucetona laticostata (Mollusca: Bivalvia) as a determinant of benthic-invertebrate community structure throughout Hauraki Gulf

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The large dog cockle, Tucetona laticostata (formerly Glycymeris laticostata), was once abundant in channel environments throughout Hauraki Gulf. Since the 1930's the distribution of this species

appears to have decreased, most likely as a consequence of channel deepening, dredging and spoil disposal. The large and robust valves of T. laticostata remain articulated for many years, and their shell accumulations provide a persistent refuge for myriad invertebrates. Where extensive deposits of their valves occur invertebrate diversity appears to be elevated relative to adjacent areas where their shells no longer persist.

Extensive beds of T. laticostata occur off and around Otata Island, one of a series of islands in the 'Noises group' in Hauraki Gulf. The distribution and abundance of T. laticostata and associated benthic invertebrate communities was surveyed in this region using SCUBA, SCUBA-collected core and vessel-collected Van-Veen grab samples. Preliminary data reporting spatial and temporal variations in benthic invertebrate communities in the region are described, as are actual and potential anthropogenic threats to these areas.

Baseline survey for non-indigenous marine species at Stewart Island (Rakiura).

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The introduction of non-indigenous marine species (NIMS) threatens New Zealand's indigenous biodiversity and natural resources. Knowledge of New Zealand's marine biodiversity and NIMS already established in our waters, however, is relatively poor. Effective management of marine biosecurity is difficult without good baseline information from which high risk species and vectors can be identified. To improve New Zealand's biosecurity capability, MAF-Biosecurity New Zealand commissioned a number of baseline surveys in ports, marinas and relatively pristine regions around New Zealand. In September 2006, Golder Associates (NZ) Ltd and the Australian National Centre for Marine & Coastal Conservation (NCMCC) undertook baseline surveys about Stewart Island, adopting widely accepted sampling protocols developed by the Australian Centre for Research on Introduced Marine Pests (CRIMP). Preliminary analysis of the species detected during the survey indicate the presence of several non-indigenous and cryptogenic species including the Asian kelp Undaria pinnatifida, the red seaweed Champia affinis and the bryozoan Watersipora subtorquata. Several other potential non-indigenous species were collected for taxonomic identification by the Marine Invasives Taxonomic Service, the results of which are as yet to be received. Non-indigenous species introductions to Stewart Island will be discussed in relation to European settlement and human endeavour throughout Stewart Island's history. Special mention will be made of the role early European whalers and sealers played in NIMS introductions, and how more recent developments to the island's economy have created other means whereby NIMS may be introduced.

Impact of black swans and other stressors on New Zealand seagrass

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Seagrass (Zostera muelleri) is a marine angiosperm that forms extensive intertidal meadows in many New Zealand estuaries.These beds are an important habitat and food source for benthic invertebrates, juvenile fish and birds yet in many locations their abundance is declining (e.g. aerial coverage in Tauranga Harbour was reduced by 34 % between 1956-1996). Deteriorating water quality (i.e. elevated

turbidity and nutrient concentrations) are reasons cited for this decline. Further stress on seagrass beds maybe caused by black swan (Cygnus atratus Latham) grazing. Black swans were first introduced from Australia in 1863, nowadays, in Tauranga Harbour large numbers (> 200 birds) have been observed feeding on seagrass at a single location. In this poster I will present an outline of my PhD research and preliminary observations of swan grazing behaviour. The main goal of my thesis is to quantify swan grazing pressure on seagrass beds and then determine how this disturbance interacts with other stressors (light limitation, elevated nutrient concentrations) to affect seagrass productivity. I will use a combination of field surveys, gut content analysis and behavioural observations to quantify the amount of seagrass biomass consumed by swans. In the second part of the study I will select sites along a gradient of environmental stressors then simulate the disturbance caused by swans to determine the interactive affects of stressors on seagrass productivity. Initial field observations of swan behaviour suggest they eat during high tide periods which would make cropping blades easier. Visual analysis of stomach contents of swans from Tauranga Harbour suggest they are strictly herbivorous and eat predominantly Zostera, but stable isotope analyses is required to confirm this. Ultimately this study will improve our knowledge of black swan behaviour and the influence it has on seagrass beds.

Trophic structure and biomass modelling of coastal ecosystems in central New Zealand and central Chile with respect to bottom-up and top-down management schemes.

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In New Zealand, the Ministry of Fisheries is responsible for the management and regulation of coastal fisheries, while the Department of Conservation manages the network of marine reserves (MRs). While MRs provide positive impacts for abundance and average individual size of many fish and shellfish species, (Cole et al. 2000) they are not considered by the Department of Conservation or the Ministry of Fisheries in their management schemes.

Chile has a markedly different system in place through the use of management areas (MAs) and *caletas*, groups of individuals comprised of fishermen and community members responsible for the stewardship of a specific region. *Caletas* consult with ecologists, tourist developers, government managers, and the Navy in order to make decisions about coastal resource use (Meltzoff *et al*. 2002).

Observational field data from protected and unprotected sites in central New Zealand and MAs in central Chile describing abundance, size/biomass, and habitat type for key species of fish, shellfish, and kelp is currently being collected. These data are combined with historical fisheries data to create a database describing resource use and current biological community structure. Interviews with local fishermen, community members, and ecologists will provide local knowledge of community structure changes thru time. This data will be employed to model ecological relationships describing trophic interactions and biomass flow using STELLA and Ecopath software.

Predictive modelling scenarios will be conducted to alter amount of area protected, resource-harvesting levels, seasonal variation, spillover effects, and migration rates to determine impacts for species distributions and community structure.

On the hydrodynamic properties of an ocean wave energy converter

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New Zealand's potential for marine energy generation is immense. Environmental considerations accentuate the need for solutions and technology advances are increasing the feasibility of cost effectively converting marine energy to electricity. Researchers all over the world are working to find the optimal prototype ocean wave energy converter (OWEC). In 2004, Industrial Research Limited, the National Institute of Water & Atmospheric Research, and Power Projects launched a New Zealand Wave Energy Technology (WET-NZ) Research and Development Programme to develop a wave energy conversion device.

In order to design an optimal device, engineers must understand with confidence the dynamics of OWECs. The primary objective of this present study which includes experimental work conducted in the IRL 2.36x0.43x0.75m wave tank, is to determine the effects of the water on the heaving, surging and pitching motion of a spar buoy. Using similarity laws, engineers can theoretically predict larger scale performance from the behaviour of a small scale model, based on the experimentally measured hydrodynamic coefficients. These parameters strongly affect the dynamic performance of their OWEC.

The second phase of the study consists of using these experimentally determined hydrodynamic coefficients as parameters in a numerical model of the OWEC, represented by rigid coupled bodies. The results of various computational simulations will be compared to real sea trials and wave tank experimental results. If they closely match each other, it means that the WET-NZ engineers can predict the dynamics of larger commercial scale OWECs, and estimate their annual power production.

Exploring options for the sustainable management of the Firth of Thames Ramsar site

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The intertidal Ramsar wetland in the southern Firth of Thames is a site of international importance for migratory and New Zealand shorebirds. The site is exposed to influences from terrestrial sources (such as e.g. nutrient and sediment runoff) as well as from marine sources (e.g. fishing, marine farming). To ensure the sustainable management of the site, a project involving all relevant management agencies, and seeking input from the community and tangata whenua, was initiated. A semi-quantitiative risk analysis was carried out for the site using a relative risk model. The results show sedimentation to be the biggest threat to the site, followed by contaminants. The main source of sedimentation was thought to be existing sediment reservoirs in the Firth, rather than current terrestrial inputs. The habitats most at risk was the intertidal flats of the Ramsar site, and the species most at risk were those using the intertidal area (shellfish, marine worms, and some fish species). The results from the risk analysis were used to identify priority actions to reduce key risks to the Ramsar site. This was achieved through identifying what can be done to minimise each of the risks included in the model, and who should do it. Actions not covered by existing work programmes were prioritised, as were any information needs identified, and recommendations provided to all agencies involved.

Asymmetric Priority Effects in Two Reef Fishes

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Due to seasonally regenerating habitats, or pulsed arrival of young-of-year, some communities undergo repeated periods of development. The sequence of species arrivals into these communities may reflect interspecific differences in life-history traits, which may be adaptive to the environments or communities into which they are entering. Here, we asked if previously identified competitive interactions between Thalassoma quinquevittatum and T. hardwicke juveniles are dependent on priority of arrival of juveniles of these species into the community. We achieved this by simulating settlement pulses to manipulate the order and timing of arrival of each species onto experimental patch reefs. Results indicated that both species experienced lower survival when they arrived later than their congener. When both species arrived simultaneously, survival of T. hardwicke was comparable to treatments where T. quinquevittatum arrived earlier, while survival of T. quinquevittatum was comparable to treatments where T. hardwicke was absent. This study highlights complex effects on the intensity and outcomes of interspecific competition between these two species, suggesting that asymmetric priority effects may be important in mediating competitive interactions between, and promoting coexistence of these species. These results are likely indicative of real ecological effects due to the pulsed arrival of T. hardwicke and T. quinquevittatum young-of-year during the settlement season. If one species arrives early in the settlement season, it may negatively affect the recruitment success of the second species.

Solar Powered Sea Anemones

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Symbioses between Anthozoa (e.g. corals & sea anemones) and dinoflagellates (zooxanthellae) are ubiquitous in tropical reef waters, where the zooxanthellae provide photosynthetically-fixed carbon to their host and support its survival in a nutrient-poor environment. Such symbioses are also found in temperate waters, though the nutritional advantage of harbouring algal symbionts in a low-light, high-nutrient environment is unclear. Here, we are determining the potential for zooxanthellae in Anthopleura aureoradiata, a common sea anemone of NZ inter-tidal mudflats and rocky shores to support the metabolism of their host, and hence its growth and reproductive demands. We have used standard respirometry techniques to measure rates of photosynthesis and respiration, and establish the CZAR (the "contribution of zooxanthellae to animal respiration") over the ambient diurnal light-cycle. Environmental data were collected on both overcast and clear-skied days in summer and winter field conditions to further model the CZAR. Future laboratory research will be undertaken to determine how the manipulation of temperature, salinity, light and heterotrophic feeding rates impact on the daily CZAR.

The effect of a long-line mussel farm on currents in Golden Bay

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Observations of flow through a long-line mussel farm in Golden Bay reveal that the farm acts on average to decelerate the flow through the farm, while acting to accelerate the flow around the farm. The flow reductions within the farm can be up to 70% of that upstream of the farm, with significant implications for the biological response within the farm. A non-linear, shallow water hydrodynamic model verifies well against the observations, revealing patterns of flow acceleration and deceleration not only in the mean, but over the tidal cycle. In this particular case, the flow in the farm is found to be mainly two-dimensional, so that the shallow water model remains relevant for assessing the impacts of future farm developments. Although the detailed flows through the farm are likely to more complex than can be revealed by the present study, the parameterisation of the net farm drag in terms of a bottom stress seems to capture many of the observed features of the large scale flow.

IMBER: Integrated Marine Biogeochemistry and Ecosystem Research

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Human activities are rapidly altering Earth System processes that directly and indirectly influence society. Informed decisions require an understanding of which parts of the Earth System are most sensitive to change, and the nature and extent of anticipated impacts of global change. In response to this need, the new IGBP-SCOR Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project has been formed, to focusing on ocean biogeochemical cycles, ecosystems and there interactions. The IMBER goal is to; investigate the sensitivity of marine biogeochemical cycles and ecosystems to global change, on time scales ranging from years to decades. To achieve this, the IMBER Science Plan and Implementation Strategy is structured around four major research themes. Theme 1 focuses on identifying and characterising interactions of the key biogeochemical and ecosystem processes that will be impacted by global change. Central to IMBER goal, Theme 2 will develop a predictive understanding of how marine biogeochemical cycles and ecosystems respond to complex forcings, such as large-scale climatic variations, changing physical dynamics, carbon cycle chemistry and nutrient fluxes, and the impacts of harvesting. Theme 3 investigates the roles of ocean biogeochemistry and ecosystems in impacting the larger Earth System through direct and indirect feedbacks. Finally, Theme 4 integrates natural and social sciences, drawing on information from the previous three themes to investigate key interactions with the human system and the options for mitigating or adapting to the impacts of global change on marine biogeochemical cycles and ecosystems.

The Scientific Committee for Oceanic Research

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The Scientific Committee on Oceanic Research (SCOR) was formed in 1957 by the International Council for Science (ICSU) to encourage an interdisciplinary approach to scientific questions about the ocean. Since its formation, SCOR has promoted international cooperation in planning and conducting

oceanographic research, and solving methodological and conceptual problems that hinder research. Scientists from thirty-five nations are members of SCOR. Approximately 250 scientists participate in SCOR working groups, committees, and panels on a voluntary basis at any given time. Working groups are formed of not more than 10 members to deliberate on a narrowly focused topic and develop a publication for the primary scientific literature in 4 years or less. Working groups cover the full range of ocean science topics and proposals for new working groups are considered annually. SCOR has been instrumental in planning and coordinating large-scale ocean research projects for long-term, complex activities, starting with the International Indian Ocean Expedition and continuing through the projects currently sponsored by SCOR. Virtually all major international ocean research projects are associated with SCOR in some way. Another major area of SCOR activity in the past 50 years has been ocean carbon research. One of SCOR's first working groups was WG 2 on Carbon Dioxide in the Ocean, formed in 1960. More recently, SCOR has led in focusing scientific attention on the issue of ocean acidification. SCOR is active in helping develop capacity in developing countries for ocean science, through travel grants and involvement of developing country scientists on all SCOR groups.

Towards assessing spatial and temporal changes in community bioturbation rate

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The rate of biogenic sediment mixing (bioturbation) by benthic macrofauna is a function of the types, sizes and relative densities of animals inhabiting a site. For example, a site dominated by large-sized, deep-dwelling, highly mobile macrofauna will have a greater bioturbation rate than a depauperate site occupied by small, sedentary, surface-associated taxa. We developed a per capita bioturbation index by ranking different species of New Zealand macrofauna in relation to three general categories: size, mobility, and behavioural/feeding guild. Bioturbation potential for a single "average" individual of a given species was calculated by multiplying its three category ranks together. These species-specific values were then applied to a site in accordance with the types of species present and their relative abundances. The index was useful during a defaunation experiment at three sites in Mahurangi Harbour (it correlated well with oxygen and nutrient fluxes that are thought to be influenced by the bioturbation of marine soft-sediments) and has many other potential applications.

Spatial and temporal habitat usage of sharks in Manukau Harbour

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Neither the population structure nor the spatial and temporal presence of sharks in Manukau Harbour has been previously researched. This poster presents preliminary data on the diversity, abundance, sex ratio and size of sharks caught in Manukau Harbour by rod and reel over 40 days (188 fishing hours) spread between June 2006 and April 2007. Shark species and abundance varied considerably during this time, with 5 species and 231 individuals landed, and a further two species identified; 43 individuals were tagged with external, individually numbered plastic tags and released. One tagged Broadnosed Sevengill shark was recaptured in the South Taranaki Bight.

A proposal and implementation plan for a marine reserve network for the North-East Islands of New Zealand

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Our aim was to design a marine reserve network along the North-Eastern Island chain (Whakarua Moutere) of the North Island, New Zealand in order to support the World Heritage Proposal for this area.

This research reviews the principles for the design of marine reserve networks and New Zealand's existing marine management tools and policies. The application and implementation processes of other marine reserves were also used as examples to identify areas which have contributed to their success or failure. In conjunction with the principles and objectives of marine reserve network design, the guidelines of the New Zealand Maine Protected Area Policy and Implementation Plan (2005) were used as focus areas of research. The oceanographic processes, ecosystems and biodiversity of the North-East Islands were evaluated, as well as the social issues concerning this region.

The results of this research have identified and prioritised areas for marine protection and have recommended an optimal and feasible design of a marine reserve network. The research also suggests solutions to mitigate opposition from stakeholders, and future monitoring plans once the North-East islands reserve network is implemented.

Marine reserves are an extremely effective and comprehensive management tool for the protection of marine ecosystems, and our study highlighted the requirement for marine reserves in the North-East Islands region. This poster is presented in the hope that these recommendations will be used for future marine conservation efforts in New Zealand.

Paua go with the flow - mostly! The effect of water velocity on behaviuor and oxygen consumption of Haliotis iris.

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In the wild, paua live in areas with good water flow, and many of the systems used for paua culture attempt to simulate such conditions. In culture, paua are known to move around in response to water flow, light levels, and food availability. We posed the question "How does the water flow affect the oxygen consumption and behaviour of the paua?"

Using a replicated raceway system (and eliminating any effect of light by running the experiments in the dark), we monitored the behaviour of three size groups of paua under different water flow rates, with and without food, and we measured the dissolved oxygen depletion in the water as an indicator of the oxygen consumption of the paua.

Paua behaviour in the raceways varied with their size and the presence or absence of food. Small (~ 25 mm) paua in water velocities of 0.05-0.1 m/s showed a marked and fast migration downstream, with up to 70% moving to the outlet end of the raceway within 24 hours. At low water velocities (< 0.05 m/s) the initial downstream movement was slower but by 24 h was more pronounced, with up to 85% moving to the outlet end. In treatments that were not fed there was a faster and greater

movement of the paua downstream. In those that were fed there was a proportion (~ 30%) that moved to the upstream end. The larger paua (both ~ 50 mm and ~ 75 mm) also showed some migration downstream but i t was generally much slower and to a lesser extent, particularly in the presence of food.

The oxygen consumption of the paua in the raceways increased with increasing water velocity up to 0.1m/s. Above this velocity there was a levelling off or reduction in oxygen consumption. Oxygen consumption rates also varied with the size of the paua tested. Between water velocities of 0.05-0.1 m/s the oxygen consumption rates of small (~ 25 mm) paua averaged 160 mg/kg/h, mid sized (~ 50 mm) paua averaged 110 mg/kg/h, and large (~ 75 mm) paua averaged 80 mg/kg/h.

So in a paua farming system the behaviour of the paua is influenced by the availability of food and oxygen, but they will generally go with the flow.

Paua do it better in the dark! The effect of photoperiod on growth and behaviour of Haliotis iris

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In the wild, juvenile paua normally feed between dusk and dawn, but the influence of photoperiod on feeding behaviour and growth of these animals in culture was unknown.

We have investigated the effect of photoperiod on the growth and survival of juvenile paua in a culture situation over a 3 month period. We tested the effect of four photoperiod regimes on three size groups of paua. Growth and survival of the small (~ 18 mm) paua was better in total darkness than in any of the other light treatments. At the growth rates recorded in this study, 10 mm paua would grow to 45 mm in 9 months under 24 hours darkness, but would take an average of 11 months for that growth under the three photoperiod regimes with light (ie dark:light 18:6, 12:12, 6:18). Mortalities of the small paua in the 24 hours dark treatment were 80% lower than in tanks in the light treatments.

The medium and large sized animals showed no significant differences in growth or survival under the different photoperiods. However, their behaviour did change under the different photoperiod regimes. The longer the light period, the more mobile the paua were during the dark period, actively looking for food. With shorter light periods they became less mobile, only moving occasionally to get food.

Paua exposed to light periods exhibited signs of stress, fleeing to the corners and up the walls of the tank each time the lights came on. It appears that paua held in the dark have more time to eat, and therefore to grow, and do not suffer light induced stress.

The squid genus Histioteuthis (Cephalopoda: Histioteuthidae) in New Zealand waters

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Hitherto unreported collections of squids of the family Histioteuthidae from New Zealand waters were examined, revealing novel information on the diversity, bathymetric and geographic distribution of species in our waters. Ontogenetic and sexually variable characters and character states, that are of systematic value for differentiating otherwise similar species, are also reported for the first time. Histioteuthids are extensively preyed on locally by cetaceans, pinnipeds, seabirds and fish. Their indigestible hard remains (beaks) can occur in hundreds to thousands in stomachs of predators, particularly cetaceans, and can be used to reconstruct the diets of these predators. To enable greater

accuracy in species and biomass determination, both upper and lower beaks of some species are illustrated in detail for the first time, as are novel species-specific biomass regression equations based on lower beak rostral length.

Long term kina roe enhancement - how long is long enough?

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The effects of roe enhancement on gonad growth and colour, survival and reproductive development in Evechinus chloroticus were tested in a 27-week experiment. Animals were collected and held at 14°C and 12:12 h light/dark and fed *ad libitum* a formulated moist feed. The urchins were sampled at the beginning of the experiment and every three weeks after for 27 weeks. The results showed that the maximum GI value of roe enhanced E. chloroticus is likely to be reached within 12 weeks and the most economic roe enhancement period is likely to be 9 weeks to optimise returns for minimal holding costs. There were no effects on survival from long term roe enhancement and changes in lightness of the gonads of urchins held in the trial occurred as a result of the urchins feeding on the artificial diet rather than being exposed to long term enhancement. The experimental conditions effected the reproductive development of E. chloroticus during the experiment. Although the gonads of the experimental urchins progressed through the reproductive stages at a similar rate to those taken from the wild source population at the same times, the former were less advanced after 12 weeks and more advanced after 27 weeks. The 27 week result is possibly due to the early initiation of the photoperiod cue for gametogenesis during the experiment. The experimental results indicate that the cue for gametogenesis occurs in the wild population in mid September at the latest. The results from this study indicate that food availability is the strongest driver of gonad enhancement (increase in gonad size) in E. chloroticus but that other environmental factors have an influence on both gonad size and the gametogenic cycle of this species.

Historic trawl data and recent information infers temporal change in the occurrence of squid in the diet of orange roughy (Hoplostethus atlanticus Collett) in New Zealand

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A review of historical trawl data for orange roughy on Chatham Rise and Challenger Plateau, New Zealand, between the years 1984 and 1996 infers a shift in this species' diet, with a progressive decline in the percentage occurrence of squid. On Chatham Rise, this decline appears to be compensated for by increases in the percentage occurrence of fish and crustaceans in orange roughy diet, whereas on Challenger Plateau, decreases in all of squid, fish and crustaceans are apparent. New orange roughy dietary data for 2004 from Chatham Rise is consistent with earlier data series, with further declines in the percentage occurrence of squid apparent. Reduction in squid as a dietary component for orange roughy could be attributed to declines in the abundance of squid as a consequence of fisheries activity.

Evaluation of reserve selection based on inshore demersal fish species

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Recent advances in data mining and conservation prioritization have been used in the analysis of 56 demersal fish species distributions throughout New Zealand inshore waters to a depth of 200m. Species distributions were identified from an analysis of the Ministry of Fisheries inshore trawl database. Zonation, a recently developed, spatial conservation planning software was used to select marine protected areas under scenarios that included prioritization of endemic species, dispersal and the inclusion of existing marine protected areas (MPAs). Neighbour constraints were also included to produce a solution more practical to implement and subsequently manage for the creation of MPAs. These constraints identified a much more tightly aggregated group of cells for protection rather than the fragmentation of cells that occurred when such constraints were not applied. Results indicate that setting aside 10% of the inshore region of New Zealand's EEZ to a depth of 200m would protect, on average, 24% (without neighbour constraints) and 18% (with constraints) of the range of each of the 56 species analysed. Increasing the area protected to 20% would increase average species protection to 41% (without constraints) and 34% (with constraints). Similarly, for the protection of solely New Zealand endemic species, 10% of the inshore region protected resulted in average protection of 28% (without constraints) and 33% (with constraints) of endemic species ranges.

Population connectivity of New Zealand shelf amphipod species using DNA sequences

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At present little is known about amphipod population connectivity and gene flow across shelf ecosystems, especially in the Southern Hemisphere. Amphipods lack a larval dispersal stage and as such are notorious for their propensity to form genetically distinct populations. This makes them an ideal model group for studying the process of speciation. Amphipods like all peracarids have a brood pouch and lack a larval distribution stage. More than 400 species are known from New Zealand and they can be found in most habitats.

The aim of this research is to determine levels of gene flow for amphipod species within and between two study sites off New Zealand using molecular techniques. The Chatham Rise represents the convergence of Sub-Antarctic and Sub-Tropical water masses and is a physically heterogeneous habitat with many potential dispersal barriers. In contrast, the Challenger Plateau is a vast and largely homogenous area of soft sediment. It is therefore hypothesised that amphipod populations over similar geographic scales will exhibit greater genetic structuring on Chatham Rise than on Challenger Plateau.

Epibenthic amphipod species were collected from the New Zealand continental shelf during April (Chatham Rise) and May/June (Challenger Plateau) of 2007 in collaboration with the Oceans 2020 biodiversity research project. Specimens were captured from between 60 and 1800 metres water depth using an epibenthic sled designed to sample from 0 – 1.16m above the benthos. Population breaks will be linked to past and present dispersal barriers.

Microbial diversity in antarctic sea ice

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Sea ice forms around the continent of Antarctica, varying in extent over the seasons. As it develops it becomes inhabited by microbial communities, which contribute 25-30% of the total Southern Ocean primary productivity. However, little is known about the sea ice micro-organisms that generate this biomass. Sea ice is generally believed to contain chemo-heterotrophic bacteria that contribute to the microbial food web by secondary production. We have determined the identity of the bacterial components of the sea ice ecosystem using molecular biology techniques and obtained an initial profiling of the communities by Restriction Fragment Length Polymorphism (RFLP). Some of the organisms detected have been reported in literature, while others have not. To date, the most dominant bacterial species present in the sea ice belong to the Alpha- and Gamma-Proteobacteria divisions, as well as organisms from the *Cytophaga-Flavobacterium-Bacteroides* (CFB) division. We also have preliminary physiological and molecular evidence for light-responding prokaryotic cells in sea ice. The molecular evidence suggests that proteorhodopsin(PR)-containing bacteria *Roseobacter* and Polaribacter may be present in sea ice. In addition, there is support for the notion that cyanobacteria could also present. Neither PR-containing bacteria nor cyanobacteria have been shown to contribute to primary productivity in sea ice before. The future research goals are to confirm the presence of phototrophic prokaryotes and to establish their biodiversity in antarctic sea ice, along a latitudinal gradient in the Ross Sea.

Identification and characterization of subcuticular bacteria in New Zealand echinoderms.

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Sub-cuticular bacteria (SCB) are symbionts found in all classes of echinoderms. Their existence has been known for over thirty years, however few attempts have been made to identify SCB or determine what role they play in the symbiotic relationship. Previous work has suggested that SCB belong to the alpha subdivision of the proteobacteria, and proposed functions of these bacteria include nutrition and antimicrobial protection for their echinoderm hosts. The current research aims to identify and characterize the SCB of several New Zealand echinoderm species using molecular techniques based on the 16S ribosomal RNA gene. Preliminary results, based on the cushion star Patiriella sp. and the sea cucumber Stichopus mollis will be presented. These results suggest that SCB belong to both the alpha and gamma subdivisions of the proteobacteria. Future research directions will also be described. These include extending the range of the study to include other local echinoderm species, and the use of fluorescent in situ hybridisation (FISH) probes to determine the exact location of SCB within the host. Taken together, these methods will allow definitive identification of the bacteria and may shed some light on the role these organisms play in the physiology of their hosts.

Ocean Survey 20/20 International Polar Year Census of Antarctic Marine Life Voyage to the Ross Sea region, 2008

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A New Zealand led voyage that will contribute to the international, circum-polar vessel-based Census of Antarctic Marine Life (CAML) survey of Antarctic marine biodiversity during International Polar Year (IPY), will sample marine life from the shallows to the abyss in the Ross Sea region as part of New Zealand's contribution to IPY.

NIWA's ice-strengthened research vessel *Tangaroa* will carry up to 26 marine scientists to Antarctic waters for seven weeks in February-March 2008 to sample multiple biological and physical components of the marine ecosystem. The Ross Sea Region is one of the more pristine marine ecosystems around Antarctica. Biodiversity and hydrographic research to date have shown that the area is topographically and biologically diverse, with evidence of high planktonic productivity and a significant toothfish population.

The survey will significantly extend baseline data on a wide range of biological components from microbial organisms to fish and top predators down to 4000 m depth, across different terrains and geographical gradients. The research will also inform ecosystem models required for fisheries management by CCAMLR. Benchmark data for modelling the effects of climate change such as ocean warming and acidification in the Ross Sea Region will be collected as well as data for environmental classification and bio-regionalisation schemes.

Under the banner of New Zealand's Ocean Survey 20/20 Programme, the voyage will be a collaborative effort by government agencies and New Zealand's Antarctic marine science community. International science participation and outreach to the public of New Zealand are also important objectives of the survey.

Symbiodinium cell surface glycan diversity and culture homogenity

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Symbiodinium sp. dinoflagellates are the symbiotic partner in many cnidarian hosted mutualistic relationships. These Symbiodinium show a degree of specificity for particular hosts with a limited range of symbiont types being found in association with a given host. This specificity may be partially determined through cell surface glycan-lectin interactions during the initiation of the symbiosis. The diversity of glycans present on the Symbiodinium cell surface was investigated through the use of sugar-specific fluorescently labelled lectin probes and flow cytometry. Preliminary data indicate that the 4 lectin probes utilised exhibit differential levels of binding to the cell surfaces of the 4 Symbiodinium cultures examined, suggesting variation in cell surface glycan diversity and concentration between Symbiodinium types. Since cultured Symbiodinium have been utilised in these studies, investigation of the genetic homogenity of these cultures is of utmost importance in ensuring that the data collected are representative of specific Symbiodinium types.

Resilience to disturbance in a marine benthic landscape

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As human and natural disturbances modify coastal marine systems, it is important to understand how marine landscapes (and their structure-forming species) respond to different spatial and temporal rates of disturbance. We model a mosaic patch landscape to illustrate how disturbance and dispersal interact to determine community dynamics in a biogenically-structured benthic community. We simulate recovery from disturbance of three typical marine benthic communities characterised by different structurally dominant species. We vary the spatial extent and frequency of disturbance events which reduce the community to a pioneer state, assuming that communities age through a series of successional stages toward a mature community composed of biogenic structure. Disturbance frequencies include realistic combinations of spatial and temporal extent, from small, frequent disturbances like ray pits, to large infrequent disturbances like hurricanes. The relative importance of dispersal processes is demonstrated by allowing colonisation of disturbed habitats only if patches are within a certain dispersal distance from a patch containing structured habitat, and by varying the minimum age for a patch to serve as a source of colonists. The model indicates functional extinction of mature community stages under many combinations of temporal and spatial frequencies of disturbance. The range of feasible combinations of disturbance that result in non-homogeneous communities also decreased non-linearly as the size of the colonist neighborhood decreased and as the minimum age of source patches increased. The relative tolerance of disturbance regime differed substantially between the three archetypal communities, with the least resilience to disturbance occurring in highly structured biogenic reef communities.

Biodiversity at the Balleny Islands

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In 2006, the Ministry of Fisheries commissioned two biodiversity research projects in the Ross Sea region in Antarctica. Scientists on board the R.Y. *Tiama* carried out an onshore and subtidal census of marine life at the Balleny Islands while those on board R.V. *Tangaroa* sampled plankton, benthic biota, filmed the seabed and recorded bird and marine mammal densities opportunistically in the Ross Sea Region. At the Balleny Islands, shallow water transects surveyed by *Tiama* were continued at greater depths by *Tangaroa* allowing us to develop ecological profiles. The projects have shown that the Balleny Islands are a hotspot for biodiversity and that they serve as an important breeding outpost for Antarctic seabirds and marine mammals. This data will be used by New Zealand to further support a Marine Protected Area proposal around the Islands. Future work may include the collection of similar data from Scott Island where preliminary observations suggest a more impoverished ecology compared with the Balleny Islands. The results will also be compared with the coastal environment of the western Ross sea ICECUBE project. A repeat census of penguin colonies and marine mammals at the Balleny Islands may be required.

Sediment Macrobenthos of Ulva Island/ Te Wharawhara Marine Reserve, Stewart Island, New Zealand

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The Ulva Island/ Te Wharawhara Marine Reserve was established in 2004 in Paterson Inlet, Stewart Island. Since the establishment of the reserve, there have been subtidal surveys of giant kelp (Macrocystis pyrifera) and exploited species such as kina (Evechinus chloroticus), paua (Haliotis iris), rock lobster (Jasus edwardsii), blue cod (Parapercis colias), blue moki (Latridopsis ciliaris), and trumpeter (Latris lineata), but there is limited information on benthic infauna. Early studies of soft sediment fauna in Paterson Inlet offer some observational information of soft-bottom assemblages, for example annelids, molluscs, ascidians and brachiopods. The aim of the present study is to provide an assessment of infaunal assemblages both within and outside the marine reserve including environmental factors that may be influencing the assemblage composition. Results from this study will provide baseline information on the biodiversity of soft sediment infauna in Paterson Inlet and within the marine reserve. These data will allow for comparisons to be made to early information before the establishment of the marine reserve and against which soft-bottom community changes can be assessed in the future.

Involving coastal stakeholders in marine conservation management.

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Involving coastal stakeholders in marine conservation management can lead to a better understanding of the relationships among marine ecosystems and coastal communties and increased public support and commitment for marine conservation strategies. We use case studies from the Great Barrier Reef Marine Park, Byron Bay Marine Park, the Integrated Kaipara Harbour Management Group and elsewhere to demonstrate the benefits of community participation in the identification and co-management of marine protected areas. Some of the benefits include transparency and fairness in process, increased compliance, reduced conflict, shared knowledge and a sense of ownership.This poster outlines a range of techniques to incorporate public perceptions and expert knowledge into the development and management of marine reserves and other conservation strategies. Th ese include spatially referenced user surveys, interactive geographic information systems, advisory groups, decision support systems, facilitated interviews, workshops, field trips, public events, memorandum of understanding, environmental education and hui. Although participatory processes initially demand more resources and effort, in the long run, they increase the likelihood that marine protection will be approved and effectively implemented and enforced.

Problems storing and querying taxonomic and ecological data? Not any longer! Introducing… ECOBASE.

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Problems storing and querying taxonomic and ecological data? Not any longer! Introducing… ECOBASE.

McMurtry, M. J. and Cameron, M. J. Many organisations have large taxonomic and ecological datasets in various formats, with limited consistency.

The Auckland Regional Council has recently commissioned iQuest to build an SQL database "EcoBase", a secure repository for our marine and freshwater ecological data. The database is flexible and adaptable, built with ISO accreditation in mind.

EcoBase improves our workflow, and the quality, accessibility, interpretation and manipulation of our data with fantastic features, including:

1. easy interface: a user-friendly 'explorer' style interface

2. easy importing: csv import, with customisable templates

3. validation: 2-stage import system, with data validation at each step

4. taxa: a 'taxonomic tree', with the ability to handle taxonomic info where organisms are identified to differing taxonomic levels

5. site / sampling info: a variety of sampling strategies are ok

6. parameters: an extensive parameter / variables list; it's simple to add a parameter to your monitoring

7. access: flexible administration rights / no-go areas

8. background info: digital media can be added: photos, video, maps, even csv files that have been successfully imported

9. querying: elegant querying and reporting on taxonomy and variables, summary info and graphs

10. web reporting: public web interface providing summary info / dataset download

EcoBase is a powerful tool that provides quality ecological data management functionality, applicable to a wide range of public and private organisations.

How do the introduced macroalgae Undaria and Colpomenia influence native rocky intertidal communities and does increased nutrient richness play a role in the distribution of these introduced algae?

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The introduction of non-native species into the marine environment is considered a major threat to marine ecosystems as it may have enormous effects on biodiversity, productivity, habitat structure and

fisheries. The spread of non-indigenous species has increased enormously world-wide the last few decades, and rates are still increasing.

Disturbed habitats seem to be more susceptible to invasions, and because human actions are responsible for a large degree of disturbance in many habitats, it appears that the success of invasions may be mediated by anthropogenic effects.

A major consequence of increasing human populations in coastal regions, and with this increased anthropogenic disturbance, is the alteration of nutrient regimes in aquatic environments. Small increases in nutrient supply can lead to an increase of algal biomass and a decrease in macroalgal diversity, and hence this process may affect how introduced algal species behave in new systems.

I will investigate if the introduced seaweed species Undaria pinnatifida and Colpomenia bullosa affect patterns of competition and community composition in rocky intertidal communities. Also, to investigate whether increased nutrient concentrations in coastal seawater facilitates the distribution of these introduced algae, I will employ a regime of artificial nutrient additions in rocky intertidal environments around the Wellington coast.

Investigation of the effects of increasing nutrient concentrations on key species of intertidal ecosystems and possible cascading effects through trophic levels will give insight in the consequences of our anthropogenic impacts on the rocky intertidal zone and can help to set up appropriate environmental management and conservation strategies.

Biogenic Sediment Controls on Ebb-Tidal Delta Stability.

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Mair Bank is a large ebb-tidal delta located at the entrance to Whangarei Harbour. The physical presence of Mair Bank is active in the transformation of wave energy by dissipating ocean swell and mitigating erosion at Marsden Point. Marsden Point is an area of national commercial importance because of the Oil Refinery and nearby Deep-water Shipping Port. Densities of pipi (Paphies australis) occur up to 1000 per m^2 at this site and are exploited as both a commercial and recreational resource (providing 99% of NZ's TACC).

Bank stability has been linked to the distinct cap of shell material. This cap largely consists of pipi shells and is thought to maintain stability by armouring underlying sandy sediments. No quantitative studies have been conducted to determine the overall stability of Mair Bank; however, anecdotal information has suggested its morphology has changed over time.

This study investigates the inherent linkage between biological communities and the geomorphic setting in which they inhabit. Furthermore, it proposes the generation of a temperate carbonate sediment budget as an original way of assessing ebb-delta stability. Biological, hydrodynamic, geomorphological and sedimentological information will be combined to generate the budget for Mair Bank.

The Role of Burrowing Crabs as 'Ecosystem Engineers' for the Maintenance of Coastal Processes

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In New Zealand, burrowing crab species comprise an important component of the intertidal and coastal benthos. These burrow-building, mobile deposit-feeders occur in high densities and in a diverse range of habitats. Therefore, the impact of these 'ecosystem engineers', via the physical modification of their environment, is predicted to be significant. The action of bioturbation (biological perturbation) in the presence of many benthic species is well known to have effects on both the physical and chemical environment of sediments. Commonly benthic species are known to increase the depth at which oxidative processes take place, suppress the redox potential discontinuity boundary of sediments, enable greater movement of organic matter and increase permeability and chemical exchange at the sediment-water interface.

This poster highlights current and future work exploring the role of New Zealand's burrowing crabs Helice crassa (Dana 1852) and Macrophthalmus hirtipes (Jaquinot 1853) in estuarine nutrient cycling at both local and system scales. Future work will investigate the key interactions between each crab species and the environment, examining if species activity and behavioural traits modify the rate of nutrient exchange. Potential nutrient responses in relation to density and sediment-type will also be discussed.

The invasive red seaweed Grateloupia turuturu in New Zealand

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In 2007 the invasive seaweed Grateloupia turuturu was reported in New Zealand for the first time after the identity of several cryptic bladed red seaweeds collected in Wellington Harbour was confirmed using a combination of anatomical and molecular analyses. Subsequent to this discovery various sites around Wellington harbour and south coast were surveyed in spring (November) and resurveyed in summer (February/March). As a result of preliminary results from the spring survey, additional sites in Wellington were also surveyed during summer. Grateloupia turuturu was detected in both seasons in a broader range of habitats than expected, including moderately-exposed rocky intertidal areas. The presence of large populations of G. turuturu adjacent to the Interislander ferry terminals, as well as Seaview and Chaffers marinas is of concern, and surveys in other New Zealand ports are warranted. Ecological and seasonal observations of the populations in Wellington are also needed in order to establish the phenology of this introduced species in central New Zealand.

Ulva in New Zealand: molecular tools reveal biodiversity and introduced species

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The genetic diversity of the green algal genus Ulva sensu lato in the New Zealand region was surveyed using the *rbc*L gene, examining 581 samples from a wide geographical range. Twenty-four genetically distinct taxa belonging to three genera were discovered in New Zealand waters. A number of the species identified in this study can be distinguished through a combination of growth form, morphological, ecological and distributional characters. However there remain considerable problems in distinguishing a number of other species by morphological characters alone. Based on information such as distribution in New Zealand (percentage of samples occurring in highly modified environments and/or areas with much boat traffic) as well as the genetic similarity of New Zealand samples to material from overseas, we concluded that at least 5 species have been introduced to the New Zealand region. The genus Umbraulva is recorded for the first time for the New Zealand region (and for the Southern Hemisphere) and 4 species are able to be distinguished. One of these we consider to be introduced to the region and the other three species appear to be new and undescribed indigenous taxa. Subantarctic samples provide the first evidence of the existence of the genus Gemina since its description in 1952; sequence data confirm that it is distinct from Ulva and Umbraulva.

Rhodoliths in New Zealand

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Rhodolith beds – areas of free-living coralline algae – are of global ecological importance as biogenic reefs and biodiversity hotspots, but have been little studied in New Zealand. Elsewhere in the world rhodoliths have been identified as key habitat formers and a variety of marine protection mechanisms have been imposed to protect rhodolith beds. During recent (2002-2008) research to document coralline algal diversity in central and northern New Zealand, we have discovered rhodolith beds additional to those reported previously; we also continue to receive reports of (and samples from) beds outside our current northern New Zealand study region (e.g. Foveaux Strait). Here we discuss the identity and distribution of rhodolith species from New Zealand rhodolith beds.

Managing Kaimoana Resources at Te Mâhia

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Kaimoana provides cultural, spiritual and physical sustenance and identity for coastal Mâori. Kaimoana not only sustains the way of life of the individual, but also maintains tribal mana and standing as manifested in manaaki, shared with manuhiri. Kaimoana has long been a part of the diet of coastal Mâori, as well as being an important resource for trading with inland tribes. Tangata whenua and local communities from Te Mâhia are concerned over the current state of their local kaimoana resources. There is mounting evidence of a decline in the lobster fishery, and anecdotal evidence suggesting that other culturally, ecologically, economically and socially important reef species (i.e. kina,

karengo and paua) are also declining. Coastal development, from farming, forestry or housing, and the associated effects of sedimentation and increased nutrient input, may be exacerbating the situation.

The Mâhia Coastal Marine Strategy (MCMS) provides guidelines for research throughout Te Mâhia rohe. Tangata whenua have been conducting a monitoring program of the near-shore marine environment, and together with NIWA have used multi-beam and side-scan sonar to map areas of this environment in order to understand and manage kiamoana resources.

Local Application of Biodiversity Informatics: Implications to Resource Management in New Zealand

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Computer and statistical techniques for analysing and managing information (informatics) are emerging as valuable tools for management and conservation of biodiversity. Considerable biodiversity data are synthesised in databases at global and national levels (FishBase, Catalogue of Life, OBIS; and NABIS, South-western Pacific Regional OBIS, respectively); however**,** the suitability of these databases for management of biodiversity appears to decrease progressively from global to local scales. Accordingly, biodiversity databases should be developed to meet the immediate needs of resource managers operating at finer (local) scales**.** One such local database (for the Auckland area) is reported herein.

Biodiversity database requirements were first determined according to advice from environmental consultants and regional councils. Existing biodiversity data, (such as species lists) and available spatial, temporal and ecological information (such as synonyms, common names, known anthropogenic threats to, and the conservation and invasive status of taxa)**,** were then assembled from sources such as consultants' reports and peer-reviewed literature, into a database format using Microsoft Access. These data were augmented with novel data on the diversity, distribution and abundance of species ascertained from surveys of 29 sites (18 intertidal hard and 9 soft shores, and 2 subtidal soft shores) around Auckland.

This database presently provides the most useful tool for appraising the biodiversity and relative conservation requirements of shores around Auckland. Coming months will see further inclusion of novel data from subtidal surveys throughout Hauraki Gulf, and critical assessment of existing data sets to reveal gaps, trends and other marine biodiversity facets, customised to local-area needs.

Stress resistance in an extreme environment: Lessons learnt from a temperate symbiotic sea anemone

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Coral bleaching, the loss of symbiotic dinoflagellates (zooxanthellae) or their photosynthetic pigments in response to environmental stress, is of huge global concern. In contrast to tropical corals, which are highly sensitive to fluctuations in environmental parameters such as temperature, light and salinity, zooxanthellate invertebrates in temperate waters rarely bleach despite highly variable conditions. Here we are testing the effects of combined salinity-light-thermal stress on the temperate sea anemone

Anthopleura aureoradiata, and measuring photosynthetic health and symbiosis stability. We are employing pulse amplitude modulated (PAM) fluorometry, a powerful yet simple and non-invasive tool, for measuring various aspects of photosynthesis through chlorophyll fluorescence. In the field, the effects of fluctuating environmental factors on A. aureoradiata are being evaluated using Diving PAM. In the lab, anemones are being exposed to varying levels of salinity (10-60 ppt), temperature (5-35 °C), and light (10-1000 μmol photons/m^2/sec) and photosynthetic health is being measured with Imaging PAM. Because A. aureoradiata resides on shallow mudflats and in rock pools, it is exposed to considerable environmental fluctuations. Since it has never been seen to bleach in the field, we hypothesize that the resistance of A. aureoradiata to changes in salinity and other environmental variables is a function of the robust photophysiology of its zooxanthellae. It is expected that photophysiological stress, specifically zooxanthellar expulsion and loss of photosynthetic capacity, will only occur at extreme levels of salinity, temperature, and light. Preliminary results from initial field and laboratory trials will be presented.

Mysid habitat and diversity throughout the Auckland Region: implications for conservation

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Four species of mysid have been identified from and are described for estuarine environments in Manukau Harbour and along the Auckland East Coast: the sometimes sympatric Tenagomysis novaezealandiae and T. chiltoni; and the non-sympatric, possibly new congener, Tenagomysis sp.; and the considerably scarcer and patchily distributed Gastrococus sp. 1. Keys are provided to facilitate differentiation of these often-confused and overlooked taxa. Mysid abundance is low at nearly all habitats surveyed to date, with the notable exceptions of Kakamatua in Manukau Harbour and Big Manly Bay in Hauraki Gulf. Aspects of species' population dynamics are described, as is their role in estuarine food chains.

Antarctic Microalgae: Physiological responses to environmental change

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Sea ice communities show considerable physiological responses to changes in environmental conditions. As sea ice algal communities play a very significant role in primary production in the Southern Ocean and are an important source of fixed carbon in this habitat, it is important to understand how these organisms adapt to the high variability of Antarctica. In today's context of global warming and ever changing environmental conditions, the adaptability and physiology of antarctic organisms becomes highly significant due to their relative physical and evolutionary isolation.

This study will examine the effects of environmental parameters such as UV radiation, light, salinity and temperature on the physiology of antarctic microalgae, including effects on photosynthesis and osmotic balance. The effects of varying levels of these parameters will be studied immediately after field collection. Biochemical and physiological functioning will be monitored using techniques such as Pulse Amplitude Modulation fluorometry and by monitoring the production of mycosporine-like amino acids , antioxidants and heat shock proteins in response to environmental stress. Other samples will be taken to assess morphological changes and functioning using TEM. Alcohol preserved samples

will be returned to NZ for analysis of changes in species composition, biomass and possible DNA analysis.

Samples will be taken from 3 field sites: Terra Nova Bay (74^0S), Cape Evans (78^0S) and the Vestfold Hills at Davis Base (65^0S). The latter have been chosen because of the presence of small lakes of varying salinity and temperature that will be used to study the effect of salinity on photosynthesis.

Modelling mussel farms

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A generic ecological model is developed for estimating the effects of mussel cultivation and potential culture production in sheltered coastal waters. The model describes the dynamics of a simple food web, growth of mussels and nutrient cycling. The design of the model is closely tied to the temporal and spatial scales which are important in determining the sustainable production level for a particular embayment. The pelagic ecosystem, mussel energetics, population dynamics and hydrodynamics are coupled to allow fully dynamic predictions on the effects of the cultivation density. The model was applied to Beatrix Bay, one of the intensive culture embayments in the Marlborough Sounds, New Zealand. It is shown that the model could successfully capture main features of the observed system behaviours including nutrients, phytoplankton and mussel growth. Although high fluxes of water into the bay suppress some signals of nutrient and carbon cycling in the system, the model simulations demonstrated that the mussel cultivation can have considerably effects on the ecosystem of the bay (including food depletion and nutrient cycling). One of the most obvious effects is the nutrient enhancement through mussel excretion at low cultivation densities, which promotes primary production particularly during N-limitation period of summer. The sensitivity analysis has identified some uncertain parameters and knowledge gaps. This would help direct further experimentations for improvements of the model. The modelling exercise has established a primary predictive tool for managing mussel aquaculture of a coastal embayment to estimate relationships between the stock level and the growth rate of mussels, and the potentially achievable harvest and stocking density.

Snapper Movement Dynamics in the inner Hauraki Gulf and beyond.

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Snapper (*Pagrus auratus*) are an important and iconic recreational fishery, with approximately 25-30% of the total SNA1 catch being taken from the inner Hauraki Gulf. We are running a large snapper tagging programme to quantify movement dynamics in this region, within a larger project looking at the interactions between recreational fishing and marine ecosystems. This tagging work includes testing a hypothesis that inner Hauraki Gulf fishing 'hotspots' may represent 'sinks' for snapper movement, with higher innate habitat values than surrounding areas ('sources'), resulting in a directional flow of snapper as fish are removed by fishing. Approximately 6300 tagged snapper were released across the inner Hauraki Gulf in November/December 2006, and February 2007. One hundred and forty tags have been returned as of July 2007, from both recreational fishers, and the commercial sector (trawl, Danish seine, long-line, set-nets).

Uptake of marine biotoxins by crabs and the potential for human intoxication

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Ostreopsis siamensis occurs in New Zealand's sub-tropical waters and produces potent palytoxin-related toxins. Blooms have been linked to sea urchin (Evechinus chloroticus) mortalities in Northland in recent years, and the micro-alga's geographic range now extends to Wellington. Fractionation of active extracts, guided by a haemolytic neutralisation assay for palytoxin, and extensive acute toxicological studies of these extracts using small mammals, confirm toxicity by intraperitoneal injection of the active fraction, but minimal toxicity by gavage.

Paddle crabs (Ovalipes catharus) were fed O. siamensis contaminated Greenshell™ mussels (Perna canaliculus) and toxin was detected in the digestive organs but not the edible flesh. Trials to determine saxitoxin uptake by Charybdis japonica in Japan (Oikawa et al. 2007) and dinophysistoxins and pectenotoxins by Cancer pagurus in Norway (Torgesen et al. 2007) also resulted in toxin being limited to digestive organs, however, if these are considered a delicacy as they are in Japan, toxin contaminated crabs pose a potential human health risk. We will also be investigating uptake of saxitoxins by O. catharus.

Artificial seagrass units as experimental units for examining juvenile fish habitat dynamics

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Seagrass (especially subtidal) meadows and other biogenic habitats in northern New Zealand estuaries provide disproportionately important juvenile fish habitat (e.g. for snapper, trevally, spotties and parore). Artificial Seagrass Units (ASU's) provide a potentially valuable method for experimentally manipulating seagrass patch and landscape configurations, without the logistical/ethical issues associated with manipulating natural seagrass. To assess their value, we ran a small scale experiment in Whangapoura Harbour, Coromandel, using plastic plant ASU's of three sizes (0.25 m^2, 0.5 m^2, 1 m^2), along with controls (bare frame, and bare sediment plots) (replication = 4, randomised plot design). We deployed these in late December, just prior to the main fish recruitment season, and sampled them for fish in January and February. Almost one thousand fish were recovered from 5.5 m^2 of ASU habitat and the controls in January (February not yet available), with 97% of these fish being ASU associated. This assemblage was dominated by triple-fins and spotties, with lower numbers of clingfish, leatherjackets, and snapper. All three ASU sizes supported fish, but the smallest units (0.25 m^2) had the smallest associated species pool, with species diversity increasing with patch size. Elevated fish abundances on the ASU's represented both (presumably) direct settlement from the plankton, and an 'artificial reef' effect drawing in larger fish from the surrounding habitats. Both processes strongly suggest an important advantage is gained by these species using the ASU's relative to the surrounding bare substrates.

Seasonal blooms of Lyngbya majuscula: natural cycle or not?

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Lyngbya majuscula, a cyanobacterium, has been found in tropical and subtropical locations worldwide. It has been recorded from Auckland's Hauraki Gulf since at least 1955. In the summer of 1999/2000 a large bloom throughout the Hauraki Gulf brought Lyngbya to the public's attention with numerous newspaper articles and letters. In particular, blooms of L. majuscula at Omana Beach, and surrounding areas (Beachlands-Maraetai) resulted in complaints about the distinctly unpleasant odour of decomposing wash-ups on the beach and prompted removal efforts. Since then, 'blooms' to nuisance level, requiring clean up, have occurred at Omana in 2001, 2003 and 2005. In 2003 monthly monitoring of L. majuscula on Omana reef was initiated to examine spatial and temporal trends in distribution. L. majuscula was generally more abundant during late summer and autumn, but increased abundance during this season was variable among years. Analysis of abiotic variables suggested that growth of L. majuscula is supported by warm conditions with relatively low wind speeds. Variability in the magnitude and timing of L. majuscula abundance peaks among years and months suggests limited ability to predict blooms. Overseas, Lyngbya has been used as an indicator of environmental health. Further research into the relationship between environmental variables, in particular nutrients, and L. majuscula growth is required to pin-point the drivers of blooms and the potential for L. majuscula to be used as an indicator in Auckland. Information gained from monitoring has been useful for exploring spatial and temporal patterns in L. majuscula abundance and its relationship with key climatic variables.

Capturing the "best digital features" of our fishes

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Capture of high quality colour digital images of 'fresh' fish specimens in the lab is of critical importance to support taxonomic research, species description and accurate identification. As part of the FRST-funded "Biosystematics of NZ EEZ Fishes" project, the Te Papa Fish Team has developed a specialised digital photographic laboratory. This system enables images of specimens to be quickly captured, reviewed and re-taken if necessary to enable capture of top quality images with accurate colour fidelity. The system is versatile, using a range of lenses, permitting photography of a large size range of specimens, from small (40 mm) triplefins to large (900 mm long) skates. In addition, this system has proven valuable at sea, where it was instrumental in capturing colour patterns and morphological characters of 580 fish species in 4 weeks on the NORFANZ voyage in 2003. Setup, use and operation of the system, together with images of fresh fishes, are illustrated.

Nutrient dynamics in the southern basin of Tauranga Harbour

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Nutrient availability is a key component of coastal ecosystem dynamics. In shallow coastal ecosystems (e.g. estuaries), the total primary production is related to availability of nutrients in the water column. Massive nutrient loading from urbanised areas and runoff can increase nutrient loading leading to eutrophication in estuaries. In estuaries, processes are strongly controlled by the tide. For example, tide can transport invertebrates, provide food for sessile invertebrates and flush nutrients from estuaries. On a time scale of hours, the incoming tide brings new nutrients in from the shelf, and the outgoing tide brings nutrients from the land to the ocean. This sensitive balance between the incoming and outgoing nutrient content can control the ultimate role that estuaries play as a nutrient sink or source. This role will depend on variations from estuary to estuary in morphology, tide magnitude and freshwater inputs along with seasonal changes to these factors. The aim of this study is to understand tidal variability in influencing nutrient dynamics in two contrasting sub-estuaries. A study of nutrient and phytoplankton dynamics will be conducted over complete tidal cycles in the southern basin of Tauranga Harbour to assess the short-term variability in these parameters. A coupled 3-D hydrodynamic-ecological model (ELCOM-CAEDYM) will be used to trace sources and pathways of new and recycled nutrients. These will ultimate be validated with field measurements. However, at this stage the importance of relative processes in control tidal variations in nutrient and phytoplankton concentrations will be studied with a series of exploratory model runs.

The Growth and Survival of Haliotis iris Using Different Protein Level Formulated Diets and Two water Temperatures

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Six different protein levels (1.27, 9.83, 21.87, 29.90, 36.97, and 41.59%) within artificial diets were fed to juvenile abalone for 120days under ambient and five-degree higher temperature culturing systems. Abalone survival was 100% when fed protein levels of 21.87% and above for the higher temperature treatment, and 9.83% and above for the ambient temperature treatment. The gain in muscle weight and protein content of animals showed exponential increase for the ambient temperature treatment. However, an S-shaped curve was observed for, both muscle weight and protein content, in individuals exposed to the higher temperature treatment, reaching a plateau at 36.97% protein. These results indicate that juvenile abalone require less protein for growth in higher temperature environments. Animals exposed to ambient temperature also had bigger gonads than those in higher temperature treatments. Crude lipid levels were 0.8~1.9%, and did not significantly differ between temperature treatments. In general, muscle weights were higher than shell weighs within the ambient temperature treatment, and reversed for the higher temperature treatment, except when protein levels higher than 36.97% were given. These results provide important information regarding the relationships between protein requirements and cultivation temperature for the New Zealand blackfoot abalone

Recreational Fishing Patterns in the Hauraki Gulf

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There is growing multi-agency interest in the spatial intensity of recreational fishing effort as the nature and extent of this activity has become increasingly apparent. Until recently, the only informational available on recreational fishing effort has been anecdotal and largely qualitative, which is of limited use to resource managers.

Trialling a novel method for estimating age of free-swimming Hector's dolphins (Cephalorhynchus hectori) at Banks Peninsula

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Quantifying age structure of a population is important for modelling its growth and understanding its biology. While estimating age is possible from dead dolphins, it is difficult from live ones without resorting to tooth extraction procedures. This research investigates the viability of a new, non-invasive method for measuring Hector's dolphins at sea. The system comprises a digital camera with two parallel laser pointers mounted 10cm apart, and secured to the tripod mount. An identification photograph of a dolphin's dorsal fin is taken with the laser dots projected onto it. Graphics software is then used to calibrate the image using the known distance between the dots. Fin dimensions can then be obtained from the digital image. Collated autopsy data (n=194) of measured and aged dolphins are used to plot growth curves and then estimate total length and age from the dorsal fin photographs. There are several photogrammetric errors; horizontal axis error (subject not perpendicular to the camera), parallax error (photographer looking down on the subject) and measurement error. The major error in this laser metric technique is horizontal axis error, which has been investigated by photographing a dolphin model. Results show that the subject needs to be at less than 20º to perpendicular for the measurements to be within 2% of the true value. A total of 32 identifiable dolphins have been photographed, including six individuals on five or more occasions. CVs of fin length for individuals photographed more than five times ranged from 1.57% to 6.27% (mean=3.90%, n=6).

The Kermadec Islands – a high latitude haven for corals adapted to extreme environmental conditions?

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As its largest marine reserve, the Kermadec Islands, located 1000 km to the northeast of New Zealand, are of ecological and political importance to the country, and are under consideration for World Heritage status. Their marginal, sub-tropical location potentially makes them susceptible to temperature shifts and to environmental impacts. Assessments of the coral and associated algal symbiont communities have been conducted. Coral diversity and abundance was assessed using photo-quadrats at 9 sites around the island chain, from latitudes of 29°1S to 30.3°S. 17 species of coral were identified, with both coral abundance and species diversity significantly greater at the northern end of the chain, where water temperature was warmer by an average of 1.5°C at the time of study. The potential effects of turbidity, chlorophyll concentration and algal cover on coral diversity and

abundance were further analysed, specifically in relation to the distinct species groupings observed. Molecular analyses examined the diversity of algal symbionts in 5 host coral species from various sites and depths. It is thought that the variability of physical and biochemical factors may offer the environmental heterogeneity necessary for niche or ecological diversification of the algal symbionts. Preliminary analysis has found only Clade C Symbiodinium sp. to be present within corals at the site, with further analysis intended to assess the sub-cladal diversity. Knowledge of coral community structure, and host-symbiont flexibility and specificity in the symbiosis between coral host and algal symbiont is important for understanding the potential for adaptive responses to climate change and coral bleaching.

The role of invasive species in the diet of coastal fish throughout Hauraki Gulf

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The role of invasive marine species in the diet of fish caught throughout Hauraki Gulf is reported. Diet, based on stomach content analyses, is determined for 4 species of fish, collected between May 2006 and July 2007. For three of these species – snapper (Chrysophrys auratus), jack mackerel (Trachurus sp.) and blue cod (Parapercis colias) – the following invasives comprise variable portions of the diets: the crab Pyromaia tuberculata (snapper); the polychaete Chaetopterus sp. (snapper and blue cod); and the bivalves Limaria orientalis and Theora lubrica (the former for snapper, jack mackerel and blue cod, the latter for snapper only).

Biosynthesis of EPA and DHA in Paphies australis and their use as Biomarkers for the Study of Marine Trophic Interactions

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The biosynthesis of two important omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), was investigated *in vivo* in the tissues of the pipi (Paphies australis) – an estuarine bivalve mollusc commonly found in New Zealand. EPA and DHA are present in high concentrations in diatoms and dinoflagellates and are frequently used as biomarker indicators in the study of marine food web dynamics and trophic interactions. If these fatty acids can be biosynthesised in significant amounts from other omega-3 fatty acid precursors by certain marine organisms, then there would be an overestimation of diatom/dinoflagellate consumption when using EPA and DHA as biomarkers. The content of EPA and DHA in the pipi tissue was determined before and after different dietary treatments which included feeding the pipis with the essential precursor molecules to the biosynthesis pathway as well as utilising a coupled Δ 5/Δ 6 desaturase enzyme inhibitor, CP-24879 p-(Isopentyloxy)-aniline hydrochloride to inhibit the biosynthesis mechanism. The study showed there was no significant conversion of the precursor molecules to EPA and DHA by P. australis. All the shellfish, including the control, produced similar levels of EPA and DHA after the selected treatments.

RESEARCH NEWS

Auckland Regional Council

http://www.arc.govt.nz

Over the past year Auckland Regional Council (ARC) has continued its state-of-the-environment (SOE) monitoring. These programmes have been running variously for 7 – 20 years and provide a valuable pool of information describing the state of the regions marine environment. **Marcus Cameron** is running the sediment and shellfish contaminant monitoring programmes, and the marine water quality monitoring programme. These programmes examine long term trends in coastal environment quality, particularly with respect to stormwater contaminants, pesticides, suspended sediments, nutrients and faecal contaminants. **Megan Stewart** is responsible for the Manukau, Waitemata, and Mahurangi ecological monitoring programmes, which track long-term trends in predominantly infaunal invertebrate communities.

On the 8th April 2008, ARC hosted a technical symposium on current state of knowledge about the environmental quality of the Maunkau Harbour. 2007 marked the 20 year anniversary for the establishment of a comprehensive water quality management framework. The region now has a large number of long term data sets on environmental aspects of the Manukau Harbour that can be used to identify natural variations and detect anthropogenic changes over and above natural variations. Speakers included ARC past and present staff, as well as representatives from Department of Conservation, University of Auckland, NIWA and Watercare Services Ltd.

A detailed survey of Kawau Bay which was initiated in 2005 has been completed and a report will be released before June 2008. This survey provides habitat maps and benthic community information to assist with the management of the harbour, and enable long term changes to be identified. A similar detailed survey has now being initiated in the Tamaki Straight.

In addition to baseline monitoring the ARC has been carrying out specific investigations related to land-sea interactions and the effects of urbanisation and rural intensification on estuarine and coastal ecology. These include:

- programmes to examine the effects of urbanisation on Long Bay subtidal reef communities, and the effects of rural intensification on intertidal soft sediment communities within Okura and Whitford Estuaries.
- jointly with the relevant territorial authorities, modelling studies to examine long-term stormwater contaminant accumulation in the Central Waitemata Harbour and Pahurehure Inlet (Manukau Harbour).
- collection of sediment chemistry information throughout the Region to characterise contaminant levels, sources and trends.
- examining the effects of urban stormwater contaminants on benthic invertebrate communities.

A project designed to evaluate the potential benefits of stormwater remedial works in terms of ecosystem health and human values, and to prioritize stormwater remedial works in the Auckland region is being undertaken over three years. In 2008 there are two subsidiary programs, one based around ecological evaluation, and the other around socio economic evaluation.

Mike McMurtry has been developing EcoBase - a data management solution for storing and querying taxonomic and ecological data. Commissioned by the Auckland Regional Council and built by iQuest (Hamilton) this SQL database is a secure repository for our marine and freshwater ecological data, designed with ISO accreditation in mind. As well as taxonomic, physical /chemical and habitat data additional site and sampling information can also be amalgamated into the EcoBase record for a programme. A web-browser interface is currently being developed that will allow visitors to the ARC website to access and download ecological data for particular sites or parameters. This data base is now available for use by other public and private research organisations.

Dominic McCarthy is the manager of ARC's Coastal Policy team that has been involved in;

- Investigations underpinning development of a new regional aquaculture policy framework using tools provided by the recent aquaculture law reform,
- Commissioning; Morrisey D et al (2007) The New Zealand Mangrove: Review of the Current State of Knowledge. Auckland Regional Council Technical Publication number 325,
- Notifying a proposed plan change to the Auckland Regional Plan: Coastal to better address mangrove related issues.
- Commissioning: Battley PF et al (2007). Population Biology and Foraging Ecology of Waders in the Firth of Thames - Update 2007. Auckland Regional Council Technical Publication number 347,
- Supporting the production by Raewyn Peart (EDS) of 'Beyond the Tide. Integrating the Management of New Zealand's Coasts' (2007),
- Investigating the requirements of the Hauraki Gulf Marine Park Act (beyond those of the Resource Management Act) with a view to developing a best practice guide for its application in RMA planning documents.
- Commissioning; Haggitt, T. et al (2006). Review of environmental information on the Kaipara Harbour marine environment. Auckland Regional Council Technical Publication Number 350.
- Commissioning work to identify regionally significant coastal environments, threats to these from land derived sediment, and calculation of the relative risk they are exposed to.
- Contribution to the 3 yearly update of the Hauraki Gulf Forum's State of the Environment report.

Auckland University of Technology

SCHOOL OF APPLIED SCIENCES

Dr Andrea C. Alfaro has research interests in Marine Ecology and Aquaculture. For the past nine years, Andrea has been investigating the ecology of New Zealand's green-lipped mussel (reproduction, dispersal/transport, settlement/recruitment, growth, and population dynamics). Another area of interest is Estuarine Ecosystems (New Zealand and Fiji), where Andrea has investigated habitat structure and diversity (i.e., mangrove, seagrass, sand flats), food web dynamics, and inputs from ocean and catchments to the system. Targeted research on rocky shore species and communities integrates aspects of population dynamics, food web structure and trophic interactions, and larval and settlement processes. Aquaculture projects include mussel, paua, and eel cultivation. Andrea currently supervises postgraduate students in aspects of freshwater and marine ecology.

Ms Emma Beatson is a marine biologist whose research currently focuses on diets of and anthropogenic threats to cetaceans in New Zealand waters, particularly toothed whales. Diet has been reconstructed from stomach-contents recovered from stranded individuals, but is shortly to include

captive cetaceans in the United States. Emma is also actively involved in all aspects of SCUBA and vessel use at AUT, and is a fully qualified Dive Instructor, Scientific Diver, and Launchmaster.

Dr Barbara Bollard-Breen joined the Division of Applied Sciences in 2007 as an expert in Geographical Information Systems (GIS), and their application in marine conservation. Barbara is also actively involved in cetacean biology and conservation, particularly that of Maui's Dolphin along West Coast of North Island, in conjunction with WWF. She also has considerable experience in the physiology of marine organisms. In conjunction with the Earth & Oceanic Sciences Research Institute (EOS) Barbara is assisting in the development of a new online marine biodiversity database that will focus on reporting the current status of benthic marine invertebrates throughout Hauraki Gulf and Manukau Harbour. Barbara currently supervises postgraduate students in aspects of GIS and inter- and subtidal ecology, and terrestrial ecology.

Dr Lindsey White is a phycologist whose research revolves around the utilisation of seaweeds by marine herbivores and humans. His current research projects include: diel variation in nutritional content of seaweeds; diet analysis of New Zealand herbivorous fishes; analysis of algal territories from tropical herbivorous pomacentrids; and the impacts of harvesting beach-cast seaweeds. Lindsey currently supervises postgraduate students in aspects of inter- and subtidal ecology.

EARTH AND OCEANIC SCIENCES RESEARCH INSTITUTE (EOSRI)

EOS is a centrally funded research institute at AUT, affiliated with the School of Applied Sciences, and is involved in all aspects of strategic development of postgraduate research in terrestrial and aquatic faunal and floral biodiversity, and in infrastructure development at AUT. Research is geared towards documenting biodiversity around New Zealand's largest city, Auckland, although it is not limited to this region. Research focuses on the conservation and sustainable management of New Zealand's biological resources.

EOS has expanded considerably its research operations and facilities, staff and postgraduate student research output and media coverage, in addition to significant increases in postgraduate researcher numbers and contracted research. Recent highlights include the purchase of two new coastal vessels, two new vehicles, an ROV (to 100 metres), considerable field sampling equipment (such as nets, core and grab samplers and assorted probes and electronic devices) and microscopes to cater to the ever-increasing demands of its rapidly expanding research base, especially that oriented towards applied marine research. Further domestic and international contacts and projects have been developed that serve to further develop international research and collaboration through 2008.

Dr Steve O'Shea, is both Director of the Earth & Oceanic Sciences Research Institute, and a Discovery Channel Quest Scholar. As a marine biologist, he is a recognised authority in the taxonomy and systematics of cephalopods (octopus and squid), and also has considerable experience in aspects of environmental impact assessment, conservation, fisheries surveys, biodiversity studies, documentaries, marine invertebrate fixation and preservation techniques, and museum curation. The majority of his published work has been the alpha taxonomy of cephalopods, including a monographic revision of the New Zealand octopus fauna. Steve continues to research New Zealand cephalopod systematics and culture techniques, be actively involved in documentaries that involve cephalopods, deep-sea invertebrates, and marine conservation, and lectures to and supervises postgraduate students in aspects of terrestrial and aquatic (primarily marine) conservation, systematics and biodiversity. Steve supervises postgraduate students in aspects of deep-sea fisheries ecology, food webs and fisheries management, toothed whale biology, cephalopod systematics and culture, subtidal ecology, and terrestrial ecology.

Dr Kay Vopel is a Senior Lecturer, holding a joint position between EOSRI and the School of Applied Sciences. Kay joined EOS and the School of Applied Sciences early in 2008 after working at universities in Germany, Austria and USA and, for the last 5 years, the National Institute of Water and Atmospheric Research in Hamilton. His research interest is in the functioning of interfaces in aquatic systems. He employs electrochemical and optical microsensors in situ and in the laboratory to investigate how interactions between aquatic organisms and mass transport and reaction processes affect ecosystem functioning. During the last 15 years Kay has applied his research in diverse marine and freshwater systems worldwide, including the Arctic deep-sea, perennially ice-covered lakes of Antarctica, the Mediterranean Sea, and tropical Barrier Reef systems.

POSTGRADUATE STUDENTS (AQUATIC)

PhD

Annapoorna Ganesan
Effect of biofilms on settlement of mussel and abalone larvae.

Hernado Acosta
Biosecurity models of introduced marine species.

Jorge Hirt-Chabbert
Aquaculture techniques for New Zealand eels.

Kat Bolstad
Systematics and biogeography of hooked and warty squid (Cephalopoda: Onychoteuthidae).

Leane Makey
The Marine Conservation Status of northeastern New Zealand.

Matthew Jones
Determination of deep-sea food webs (400◎1100m) based on dietary analysis of fisheries bycatch.

Monalisa Palacio
New Zealand coastal marine habitat classification and conservation.

Neetha Punchihewa
Population dynamics, spatial and temporal habitat requirements, and anthropogenic effects on freshwater and estuarine invertebrates in the Waitakere Ranges (West Coast, Auckland).

Victor Cauty
The Ecology and Economic value of Billfish in the New Zealand Exclusive Economic Zone (EEZ).

MAppSc

Jeremy Barker
The role of structural complexity in blue cod recruitment and growth in Hauraki Gulf.

Sheree Boyd
Infaunal diversity and bioturbation in deep-sea hydrothermal vent sediments.

Ann Bui
The environmental effects of whale burial in coastal environments.

Barrack Carle
How Didymo survives under oligotrophic conditions.

Severine Dewas
Characterisation of benthic invertebrate communities in biogenic (Tucetona laticostata) marine habitat in Hauraki Gulf.

Suzannah Dodd
Benthopelagic coupling in Hauraki Gulf: the role of invasive species in the diets of coastal fish.

Rod Lockie
Development of mysid shrimp aquaculture systems.

Rosemary Phillips
Habitat requirements and life histories of Echyridella (Bivalvia: Unionidae) species in the Auckland Region.

Clara Wong
The effects of mussel aquaculture on benthic invertebrate communities in Hauraki Gulf.

Tim Young
Chemical characterisation of mussel spat and algal associations.

MPhil
Nik Hannam
Acoustic tracking and monitoring of Bronze Whaler sharks (Carcharhinus brachyurus) in Manukau Harbour.

Jochen Zaeschmar
Cetacean abundance and distribution in Northland's East Coast offshore waters.

Cawthron Institute

http://www.cawthron.org.nz

AQUACULTURE GROUP
The focus of this group is shellfish aquaculture, and research on large-scale spat production and shellfish selective breeding is carried out at the Cawthron Aquaculture Park. The group is led by **Henry Kaspar**, with scientists **Achim Janke**, **Steve Webb**, **Kevin Heasman**, **Serean Adams**, **Samantha Gale**, **Nick King**, **Andrew Fidler**, **Norman Ragg**, **Liz Keys**, **Aditya Kesarcodi-Watson** and **Olin Pilcher**. They are supported by a team of technicians, in addition to three long-term industry secondments.

Major Aquaculture Research Programmes

Cryopreservation
Methods for live-freezing and thawing shellfish sperm, eggs, embryos and larvae will provide important tools in the shellfish selective breeding programme, and give flexibility and efficiency in the production of commercial quantities of shellfish spat for New Zealand aquaculture industries. Methods for cryopreserving oyster and mussel sperm are well developed and rearing of larvae from cryopreserved mussel and oyster eggs is thought to be a world first.

Greenshell™ Mussel
Research focuses on selective breeding and refining techniques for large-scale spat production. Early results have shown good heritabilities for growth rate (shell length and meat weight). Selections from the 2002, 2003, and 2004 cohorts have been used for production of commercial-scale quantities of spat. From 2006, engraving (rather than tagging) has been used for spat identification, yielding a major improvement in data quality. Projects on spat retention have made good progress. A series of intensive experiments aimed at optimising techniques for the hatchery rearing of Greenshell™ mussel larvae has successfully identified the working ranges for the principle husbandry variables. The resulting enhancement and stabilisation in performance is now being demonstrated in a series of proof-of-concept commercial-scale trials.

Open ocean aquaculture
Aquaculture and structural aspects of open ocean fish and shellfish farming are being investigated in conjunction with other groups in Cawthron and various industry parties. The present programme is drawing to an end with some interesting and positive results.

Aquaculture biofouling
Collaboration continues with shellfish industries locally and overseas, regarding the control and mitigation of biofouling on aquaculture structures (in conjunction with Cawthron's Biosecurity and Biotechnology Group).

Pacific oyster
The benefits of high quality commercial spat have lead to more oyster growers using hatchery spat. Cawthron's production of most of the New Zealand industry's hatchery spat needs enabled the continued evolution from stick culture to single-seed cultivation. The selective breeding programme continues to provide oyster producers with benefits in yield and product quality.

Paua
2007 has seen a major increase in involvement with the paua industry. Cawthron is conducting a major project aimed at optimising and standardising animal and meat handling practices in the paua fishery. Assistance is also being provided to the fishery to help develop fine-scale geographic monitoring of fishing areas using data collected by the industry.

Shellfish Health
Trials are continuing with a Cawthron-devised mussel spat test (Webb & Heasman 2006 Aquaculture 252, 305-316) that can predict percentage spat retention on seeded culture ropes after exposure to stresses such as emersion and high temperature. Development of the method continues with the intention of predicting spat retention in commercial conditions. Current work includes assessment of relative fitness of retained spat as compared with those lost. It may be that lost spat 'choose' to go and that they are not necessarily less healthy than those remaining. An understanding of spat retention/loss

'decision criteria' will assist in devising optimal conditions to minimise spat losses on re-immersion after translocation.

In collaboration with the Virginia Institute of Marine Science (VIMS) a molecular method (PCR) using extant primers has been used to detect Bonamia in the New Zealand oyster Ostrea aupouria – a first report. The same method has proved successful in detecting Bonamia in formalin-fixed paraffin impregnated histology specimens of New Zealand flat oysters.

A PCR primer pair used to detect Pacific oyster DNA has been found to detect DNA from a range of other molluscs including bivalves and gastropods. This wide specificity is useful as the primer pair is used to monitor successful extraction of DNA before further tests by PCR to detect pathogens such as Bonamia and the ostreid herpes virus (OsHV-1). Trials have shown that the primer pair can amplify DNA extracted even from 20 year old histology tissue preparations. Recent work has refined PCR protocols such that the effect of PCR inhibitors is greatly reduced.

Commercial hatchery rearing of juvenile bivalves usually involves the feeding of micro-algae from eutrophic ponds, with the attendant risk of dangerous fluctuations of pH, temperature and un-ionised ammonia. An extensive series of experiments characterised Greenshell™ mussel spat tolerances using behavioural and physiological indicators; these have lead to a refined understanding of permissible water quality thresholds in land-based aquaculture and provided the material for two post-graduate theses (Andi Brunner, Swiss Federal Institute of Technology; Johannes Pucher, University of Constance, Germany).

Aquaculture Genetics

A Perna canaliculus female gonad expressed sequence tag (EST) database (>4000 sequences) has been analysed in detail and annotated (Cawthron Report No. 1301). Subsequent analysis of the expression of four selected candidate 'marker' genes (glycogen phosphorylase, vitellogenin, cyclin-B, VASA-like protein) indicates that they will prove robust molecular markers for major stages in gametogenesis in the female and possibly also the male. Controlled conditioning experiments are in progress and RNA extracts from various key stages are being analysed for the levels of the marker genes in parallel with conventional histological studies.

Triploid mussels have been produced in the hatchery and will be assessed over the winter for their ability to maintain condition when normal diploid mussels have spawned and become unharvestable. In trials of the newly developed mussel microsatellites, it was shown that parentage could be assigned with a high degree of confidence.

Hatchery Biotechnology

Work continues on scaling up the continuous culture of Chaetoceros calcitrans. Large-scale, reliable production of this micro-algal strain as live feed in shellfish hatcheries will be a significant advance for mussel spat production.

Research into probiotics for larval rearing of Greenshell™ mussel is the subject of a PhD project (collaboration with the University of Technology, Sydney). 40 potentially promising strains of probiotic bacteria are currently being tested in the hatchery environment.

COASTAL AND FRESHWATER GROUP

Cawthron's Coastal & Freshwater group combines the expertise of both marine and freshwater ecologists to provide research and advisory services to a wide range of regulators and businesses

needing assistance with requirements of the Resource Management Act where aquatic ecosystems are affected.
The group has specific expertise in:

- Marine farming and fisheries: assessing the sustainability of marine farming and fishing activities, assisting stakeholders in improving the sustainability of marine farming and fishing operations, developing resource and environmental management tools.
  Discharges and contaminants: the effects on land, water and sediments.
- Coastal and estuary health: knowledge and advice on monitoring, mapping, management and restoration.
- Resource management: advice and knowledge on coastal and estuarine systems for Regional Resource Management Plans.
- Biosecurity: risk assessment, incursion response tools, marine pest and biofouling management.

There are now 27 in the group, which is made up of 12 PhD and 10 MSc qualified staff, with the following new staff qualifying and/or graduating through the year: **Claire Conwell PhD**, **Joanne Clapcott PhD**, **Robyn Dunmore PhD**, **Barrie Forrest PhD**, **Richard Piola PhD**, **Reid Forrest MSc**, **Robin Holmes MSc**

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Recent research focus has been on developing new tools for the management of aquatic ecosystems, such as Microbial Source Tracking (MST) – a developing technology that helps pinpoint animal sources likely to contribute to bacteria and viruses in faecal-contaminated samples. Our research in this area has been lead by **Marek Kirs** in collaboration with leading MST laboratories in the US, including those headed by **Valerie (Jody) Harwood** at University of South Florida and **Rachel Noble** at University of North Carolina.

Paul Barter and his impact assessment team have a number of ongoing projects looking into effects from a variety of point and non-point source discharges. Recent examples include an assessment led by **Ross Sneddon** for re-consenting dredge spoil disposal by Port Nelson. **Claire Conwell** has been working collaboratively with **Carol Stewart** (VUW) on contaminant bioavailability assessments in Picton Inner Harbour with funding from MfE's contaminated site remediation fund.

In addition, Paul has been developing a desktop ecological database for councils under FRST's Envirolink fund. This database is a scaled down version of Cawthron's in-house database called CADDIS (Cawthron Archival and Data Delivery Information System) and is designed to assist councils in their day-to-day analysis of ecological datasets as well as standardising submission formats for national datasets like FBIS.

Our integrated catchment management (ICM) research continues with the coastal component, lead by **Paul Gillespie** and assisted by **Reid Forrest**, investigating river outwelling influences that define the river plume and coastal ecosystem effects, which will lead on to providing a blueprint for establishing catchment-based management criteria for New Zealand's coastal environment.

Chris Cornelisen, assisted by **Kim Clark** and **Robyn Dunmore**, is leading ongoing monitoring of the near-surface oceanography and rock wall communities in Doubtful Sound under continued operation of the Manapouri Power Station and the discharge of freshwater into Deep Cove. Included in the programme is an array of physical moorings for measuring the low-salinity-layer and analyses of permanent photo-quadrats for monitoring the diverse communities that inhabit the steep rock walls.

Nigel Keeley and **Dan Govier** have been kept busy with marine farming assessments, in particular with salmon farm annual seabed monitoring in the Marlborough Sounds and monitoring of mussel

spat-catching activities in Golden Bay and Tasman Bay. Nigel is also part of Cawthron's Open Ocean Aquaculture research team which is continuing its pioneering FRST-funded research at New Zealand's first true offshore marine farm site in Hawke Bay.

Cawthron hit the news this year when **Grant Hopkins** and **Richard Piola** became involved in assessing the potential biosecurity risks posed by the recent defouling of the oil exploration drilling rig Ocean Patriot in Tasman Bay waters. Amongst the defouled material were several species that have not previously been recorded in New Zealand, including the non-indigenous brown mussel Perna perna. What followed was a massive clean-up operation that to date has resulted in greater than 40 tonnes of defouled material being dredged for disposal to land fill. Grant, Richard and **Rod Asher** were tasked with overseeing this operation and assessing the occurrence of defouled organisms within the dredge material.

The role of artificial structures as beach-heads for the incursion for marine pests and as reservoirs for their spread to natural habitats is the subject of OBI research led by **Barrie Forrest**. The fouling sea squirt Didemnum vexillum is used as a model organism to address these questions, with **Lauren Fletcher**, a Masters student from Victoria University, investigating the reproductive biology and dispersal of this species. Barrie has also explored whether natural barriers to the spread of Didemnum and other invasive species can serve as 'internal borders' around which vector control, surveillance and incursion response systems can be developed. This work has been underpinned by the PhD research of **Hernando Acosta** from AUT, who has developed Tasman/Golden Bay regional models for the human-mediated and natural spread of pest species.

OBI research into biosecurity risks and management options for shipping and other vectors continues at Cawthron. Ongoing work led by **Richard Piola** uses a magnetic plate method to investigate the survivorship of hull fouling organisms on vessels, while **Grant Hopkins** is investigating the efficacy of rotating brushes for hull cleaning, and the relative pros and cons of vessel management options ranging from active defouling to doing nothing.

After identifying ships' sea chests as an important vector for the spread of marine pests, the next phase of work by **Richard Piola** and **Tim Dodgshun** assesses the efficacy of steam sterilisation as a management tool. This complements earlier research by **Kath Blakemore** and **Barrie Forrest** into in situ steam sterilisation as a response method for marine pest incursions in natural habitats and on artificial structures. Other work on response tools by the marine biosecurity team has included freshwater as a treatment for aquaculture biofouling, and research into the efficacy of eco-friendly chemical spraying as a tool for treating incursions of pests in intertidal areas and on fouled structures.

A benefit-cost model for assessing marine biosecurity risks and establishing priorities for management was developed by Barrie Forrest, Mike Taylor and Jim Sinner. Continuing work by **Ibrahim Elmetri** and **Chris Batstone** builds on this platform and explores how marine biosecurity priorities can be determined alongside other environmental risks, and how economic and social valuation methods, and societal attitudes to biosecurity, can be incorporated into risk management processes.

SUSTAINABLE BUSINESS GROUP

This group, which consists of resource and system analysts and modellers, ecologists, a resource economist and a project management specialist, was formally established in January 2006 with the goal of assisting businesses to maximise value while minimising impacts on the environment. Managed by **Jim Sinner**, the group focused on four key themes: sustainable fisheries and aquaculture; environmental valuation; natural resource allocation and sustainability strategies for businesses.

Major research projects during 2007 were open ocean aquaculture, Meridian's high flow trial in Doubtful Sound, indicators for sustainable mussel farming, and valuation of coastal use values in the Auckland Region. The Open Ocean Aquaculture programme involved investigating new physical structures suitable for shellfish farming in the open ocean, modelling how structures would perform in the oceanic environment, and bioeconomic modelling to determine optimal farm management practices for open ocean aquaculture farms.

The indicators project involved development and measurement of suitable parameters for certifying the sustainability of shellfish production, a discussion that is now moving into a wider arena as governments and NGOs consider developing standards.

Meridian's high flow trial, in which Cawthron is leading a collaboration of scientists from multiple organisations, is assessing whether Meridian can increase the flow through its existing facilities to generate more renewable energy without adverse impacts on the high biodiversity values of Doubtful Sound. This project is led by **Chris Cornelisen** of the Coastal and Freshwater Group, with significant contributions from **Ben Knight**, **Eric Goodwin** and **Weimin Jiang**, and managed by **Bethany Roberts**.

Chris Batstone is leading a multi-year project for Auckland Regional Council to assess how values in the coastal environment are impacted by stormwater runoff, and how these impacts might vary depending on stormwater management options. This project also involves collaboration with universities and other science providers.

During 2007, with the arrival of **Jim Sinner**, the Sustainable Business Group also initiated work on the impacts of climate change on the seafood industries and the implications of the government's emissions trading scheme.

BIOSECURITY & BIOTECHNOLOGY GROUP

The Biosecurity & Biotechnology Group comprises research platforms in marine biosecurity, seafood safety, environmental technologies and algal technologies. The group is managed by **Mike Taylor** and utilises the skills of other researchers at Cawthron and students and scientists from other New Zealand organisations and overseas.

Seafood Safety

The Cawthron-led FRST Seafood Safety Programme includes AgResearch, Crop & Food and ESR, was set up in 2007 and is working with industry and regulators to develop a comprehensive approach to seafood safety. Cawthron is also exploring real-time remote monitoring as a prospect and is collaborating in research with AgResearch to define more closely the true potential for human harm from the toxins. The joint toxicology work is also underpinning the setting of regulations worldwide for toxic compounds. Cawthron scientists are **Lesley Rhodes** (Programme Leader) **Pat Holland** and **Lincoln MacKenzie**, with technicians **Veronica Beuzenberg** and **Janet Adamson**. **Krystyna Ponikla** is curator of the nationally significant Cawthron Institute Culture Collection of Micro-algae, which is backed up by the successful cryopreservation of more than 20 micro-algal strains including shellfish feed species, small dinoflagellates and diatoms in addition to some species of cyanobacteria (blue-green algae). Cawthron's marine biotoxin analytical laboratory and harmful phytoplankton monitoring programme are major commercial laboratory service activities that originated from this research.

Environmental technologies

Environmental technologies is currently focused on developing and applying Microbial Source Tracking (MST) techniques for identifying sources of micro-organism contamination (e.g. bacteria) in

aquatic systems such as rivers, streams (e.g. for Regional Councils) and aquaculture growing areas. Scientist **Marek Kirs** is Cawthron's MST expert.

Algal Technologies
Algal technologies scientists **Doug Mountfort**, **Mike Packer** and **Lincoln MacKenzie** are researching beneficial applications of active compounds in micro-algae and novel marine compounds and enzymes which are useful for producing new products such as nutraceuticals. We are also investigating the development of a hydrogenase electrode which involves incorporation of the algal enzyme hydrogenase to act as catalyst in an electrochemical device. This might later be used as part of a biofuel cell for the production and/or consumption of hydrogen as a fuel.

Department of Conservation

The Department's main marine science involvement is under the Marine Mammals Protection Act, the Wildlife Act, the Marine Reserves Act, the Conservation Act, and statutory processes under the Resource Management Act. More information is available on the Department's website (www.doc.govt.nz), and the standard email address for DOC staff is firstinitiallastname@doc.govt.nz.

Marine Conservation Unit, Department of Conservation, Wellington (Manager: **Felicity Wong**).
The Marine Conservation Unit is part of the Research Development and Improvement Group (RD&I) of DOC's head office. The unit has the following sections:

Marine Sites and Species Section (Manager, **Simon Banks**) with oversight of

- protection of marine priority species and priority sites, and ecosystem maintenance,
- marine mammal protection and advice,
- advice on marine biodiversity protection;
- identification of priority sites for marine protection;
- advice and support for marine reserves establishment; and
- marine conservation communications and advocacy.

National stakeholder engagement includes co-ordination with Mfish (under the Marine Reserve Protocol), and development of proposals relating to offshore marine protection.

One new marine reserve was fully approved in 2007 (Tapuae in Taranaki) and once gazetted will bring the number of marine reserves in New Zealand to a total of 32. The Department is currently managing formal applications for three marine reserves (Aotea/ Great Barrier Island, Dan Rogers (Akaroa Harbour) and Tawharanui (Hauraki Gulf)), and in 2008 will also be gazetting the fully approved reserve on Wellington's south coast.

Marine Protected Area Policy and Implementation
Policy and plan announced by Ministers of Fisheries and Conservation January 2006. Progress on Stage One (Protection Standard and Classification) of the Policy continuing.
Current MPA Planning Processes include:

- West Coast Marine Protected Area Forum – forum established/ information gathering and planning underway.
- Subantarctic Islands Marine Protected Area planning process – background document public released. Process/Forum under establishment

- Hauraki Gulf – information gathering underway/ Process/Forum under establishment.
- Otago-Southland - process/Forum under establishment.

Coastal Management Section (Manager **Guy Kerrison**) that provides advice and support on sustainable management of coastal areas under the RMA; aquaculture, and foreshore and seabed management under new legislation. Key areas of work have included:

Aquaculture projects
The Department of Conservation is part of the whole of government Aquaculture Implementation Team. The programme of work aims to assist implementation of the recently enacted aquaculture reform legislation. Key projects the coastal team are involved in include:

- leading a project to assist Northland Regional council to develop new space for aquaculture in the Northland region
- input into other regional projects to develop new and existing space for aquaculture, such as Auckland, Waikato and Canterbury
- preparing planning guidance for the establishment of aquaculture management areas and additional support material, including commissioning a stock take report of experimental aquaculture provisions in existing plans and input into a report on risk management options for aquaculture
- policy advice on technical amendments to aquaculture legislation, a new regime for experimental aquaculture, and Maori settlement issues.

Regional coastal plans
The Southland Regional Coastal Plan was approved by the Minister and became operative (in part) on 31 March 07. The part of the Plan that was excluded from the Minister's consideration was Section 15 – Marine Farming, which was being addressed by the Environment Court, and is in the process of being resolved by consent order. Submissions were made on the Proposed Horizons Oneplan (Manuwatu-Wanganui) and the Proposed Hawke's Bay Coastal Environment Plan. The Oneplan incorporates the regional policy statement and regional plan, including the regional coastal plan. The Minister's approval will be required for all the provisions (objectives, policies and rules) related to the coastal marine area, which constitute the regional coastal plan. The Proposed Hawke's Bay Coastal Environment Plan relates to both the coastal environment and the coastal marine area. However, as above, the Minister's approval is only required the provisions that relate to the coastal marine area.

Restricted coastal activities and vesting of reclamations
The Minister of Conservation is responsible for deciding on coastal permit applications for restricted coastal activities and vesting of reclamations. Numerous restricted coastal activity applications have been processed including; reclamations, sewage discharges, seawalls, marinas, disturbance of foreshore and seabed, marine farms, and the exclusive occupation of the coastal marine area. A number of applications for the vesting of reclamations have also been processed.

New Zealand Coastal Policy Statement
A review of the New Zealand Coastal Policy Statement (NZCPS) is currently underway. The NZCPS has been confirmed for public release and the Board of Inquiry will soon be appointed. The policy statement is expected to be notified by the Board of Inquiry in 2008.

Marine Science Section (Manager, **Ian West**): Research and science advice services to the department on protection and restoration of priority marine species and priority sites including captive rearing/translocation of seabirds; seabird ecology; population investigations and recovery; marine

mammal ecology; population investigation and recovery; advice to the International Whaling Commission; marine classification and identification of design, protection and monitoring for priority marine sites; impacts of marine farming and coastal development; science communication.

Members of the Science Section include:
Dr Louise Chilvers is undertaking New Zealand sea lion research including population dynamics and foraging ecology.

Hugh Best: Studying New Zealand fur seals at three west coast South Island rookeries.

Brian Lloyd is leading a three-year research project, funded by MoRST, to investigate the effects of mussel farms on marine mammals and seabirds.

Peter Moore: Seabird scientist.

Clinton Duffy: Scientific Officer (Marine Conservation), supervised contracted research on modelling inshore demersal and coastal rocky reef fish distributions, diversity and community composition; and genetic connectivity of rocky reef algal and invertebrate assemblages. He has an ongoing research project on the conservation biology of New Zealand white sharks, and co-ordinates recording of observations of whale sharks, basking sharks and mobulid rays in New Zealand waters. He is also involved in taxonomic research on deepwater squaloid dogfishes, including re-description of the northern spiny dogfish (Squalus griffini), description of S. raoulensis sp. nov. from Kermadec Islands and recognition of Harrisson's dogfish (Centrophorus harrissoni) from the Norfolk, Three Kings and Kermadec Ridges. He is based in Auckland Conservancy Office.

Dr Debbie Freeman: Scientific Officer (Marine Ecology). Completed a research project on the ecology of spiny lobsters on fished and unfished reefs. She is currently researching the use of remote operated vehicles for survey and monitoring purposes and is leading a project aimed at describing the subtidal habitats and trophic interactions around the New Zealand Subantarctic Islands.

Lou Hunt is carrying out an economic impact analysis of the Cape Rodney Okakari Point (Leigh) Marine Reserve on the Rodney District

Marine Conservation Services Section (Manager: **Johanna Pierre**) runs the Conservation Services Programme. The programme investigates adverse effects of commercial fishing on marine protected species including: understanding and monitoring protected species interactions with commercial fishing activities (e.g. through the protected species observer programme), monitoring the status of protected species populations known to be incidentally taken in fishing operations, and developing ways of mitigating the bycatch of protected species. Most population and mitigation projects are contracted out by open tender. The section is also involved in other related work areas, including collaboration with the Ministry of Fisheries in developing government policy related to fisheries interactions with protected species. For more information on CSP, see www.csp.org.nz.

Staff of the Marine Conservation Services Section include:
Stephanie Rowe: Scientific officer with a focus on interaction projects, including the protected species observer programme.

Igor Debski: Scientific Officer with a focus on population and mitigation projects.

DOC Science & Technical Publishing (key contact **Sue Wilkins**) is within the Research, Development & Improvement Division (RD&I).

The team continues to do business as usual, i.e. mostly assess, edit and publish contract research reports for its "DOC Research & Development Series, DRDS" (formerly "DOC Science Internal Series, DSIS"), "Science for Conservation, SFC" monographs, "DOC Technical Series, DOCTS" handbooks and a variety of newsletters, factsheets and occasional "real books". Many of these works are relevant to the marine science community within and outside New Zealand.

Hardcopy is distributed to key individuals and libraries on a monthly basis; and PDF files of all new publications are mounted in full on the website as they come out: see http://www.doc.govt.nz > Publications > Science and Research, where the issues are listed (by series then year of publication). A programme of retrospective pdf-ing up key publication pre-1999 is underway. A searchable database is accessible at the website also. Single copies of publications under $35.00 are free of charge while stocks last. We are happy to deal with orders (address see below).

Our listserver continues to advise subscribers of new DOC RD&I Publications as they come out; on average two per week. Such notifications include bibliographic information with a full abstract and link to the PDF on the website. An alternative, summary list sends out monthly summaries with bibliographic information and links to PDFs only. If you'd like to subscribe to either list, please email us and specify "detailed" or "monthly". A spruced-up printed monthly notice can be posted to you upon request.

Science & Technical Publishing, RD&I, DOC, PO Box 10 420, Wellington, New Zealand
(fax+64-4-496 1929), mailto:science.publications@doc.govt.nz .

Conservancies
The Department includes 12 conservancies with marine responsibilities.

Northland Conservancy (Key contacts **Paul Buisson** & **Vince Kerr**)

Auckland Conservancy (Key contacts **Kala Sivaguru** and **Dan Breen**)
A fish baseline survey was completed in the proposed Great Barrier Island Marine Reserve Area (Langlois et al, 2006) and a benthic baseline survey will be undertaken in March 2008. BUV fish surveys were carried out in Cape Rodney Okakari Point Marine Reserve and in Tawharanui Marine Park area in 2006 (Parsens, 2006).

Offshore aerial survey for Maui dolphin was completed (Raymant and DuFresne, 2008). Use of Harbours by maui dolphin has been undertaken using the Porpoise Detectors (PODs) in the Manukau, Raglan, Kawhia and Aotea harbours (Scali & Dawson, 2008).

Waikato Conservancy (Key contact **Kristina Hillock**)

Te Whanganui-a-Hei marine reserve (key contacts **Daniel Rapson**, **Kristina Hillock**, **Jason Roxburgh**)
In May-June 2007 lobster and benthic (rocky reef and soft sediment communities) monitoring programmes were carried out (Haggitt & Mead, 2007). The operational plan for the marine reserve that was started in 2006 was completed. The biannual reef fish survey will be undertaken in 2008.

An intertidal habitat and shellfish mapping survey was undertaken in Kawhia and Aotea Harbours over summer. The aim of the project is to identify key areas of shellfish habitat, as well as providing baseline data for future studies in Kawhia and Aotea Harbours.

Bay of Plenty Conservancy (Key contacts: **Kim Young**, **Brendon Christensen**, **Alan Jones**)

Wanganui Conservancy (key contacts **Bryan Williams**, **Callum Lilley**, **Helen Kettles**)
The Conservancy continued ecological monitoring programmes in the Sugar Loaf Islands Marine Protected Area (reef fish and rock-lobster surveys) and in the Parininihi Marine Reserve (rock-lobster surveys). Reports on Metocean Conditions at the Parininihi Marine Reserve and a Parininihi Marine Reserve Reef Fish Survey were prepared under contract by MetOcean Solutions Limited. A report on Sessile Invertebrate Surveys of the Parininihi Marine Reserve, Adjacent Reefs, and Sugar Loaf Islands Marine Protected Area was prepared under contract by Marine Ecological Consultant Franz Smith. In late 2007, a contract was finalised for a multi-beam survey of the proposed Tapuae Marine Reserve in order to produce a habitat map. The work will be conducted by the University of Waikato.

The proposed Tapuae Marine Reserve was approved in April 2007 and is currently waiting to be gazetted. In 2007 a draft of the Parininihi Marine Reserve Operational Plan was written and will be finalised in 2008

Responses to beachcast NZ furseals were carried out and issues with little blue penguins being attacked by dogs are being addressed. A southern right whale and two humpback whales were biopsied and 6 blue whales were observed and photographed near Cape Egmont. Predator control work was conducted on the Sugar Loaf Islands.

East Coast Hawke's Bay Conservancy (key contact **James Holborow**)
Monitoring at Te Tapuwae o Rongokako and Te Angiangi marine reserves went ahead in 2007, including UVC of crayfish and trials of fish monitoring techniques. Pot surveys of crayfish also continued at Te Tapuwae o Rongokako and information was used in assisting Ngati Konohi with their proposal for a mataitai adjacent to the reserve. Te Angiangi passed the 10 year mark with a celebration at the reserve including iwi, the Department, and politicians.

The Conservancy has been involved in the North Eastern Bioregion Collective with other northern North Island Conservancies. The Collective has been developing methods and workplans to provide technical information into the Marine Protected Area Classification. ECHB's particular focus has been on the development of a national bathymetry layer, and modelled information on wave exposure.

We have continued monitoring of New Zealand fur seals expansion in range up the east coast, also petrel and shearwater spp., New Zealand dotterels, and shore plovers.

Wellington Conservancy (key contact **Helen Kettles** (marine) and **Nadine Bott** (marine mammals))
The proposed marine reserve on the south coast was approved and is awaiting gazettal. A lot of baseline data is being, and has been, collected by Victoria University and in 2008 this will all be summarised and an ongoing monitoring program developed. The department will initiate survey work in the summer of 2008/09. An operational plan is currently being written.

Monitoring will be carried out in the summer of 2008/09 at the Kapiti Marine Reserve. A new committee is also being formed this coming year.

A Wellington region marine information project was completed in 2007 which resulted in the development of a draft interactive CD resource, GIS and a searchable bibliography with over 1200 references. These will be invaluable for future MPA planning and RMA information support.

The annual humpback whale survey in Cook Strait was undertaken for the fourth year in 2007. The survey is to assess the status of humpback whales and investigate the level of recovery from commercial whaling after 45 years of protection.

Nelson/Marlborough Conservancy (key contact **Andrew Baxter**). The existing ecological monitoring programmes at Long Island-Kokomohua Marine Reserve (Queen Charlotte Sound), Tonga Island Marine Reserve (Abel Tasman National Park) and Horoirangi Marine Reserve (north Nelson) were continued. The Conservancy also continued to work with Te Korowai o Te Tai o Marokura (Kaikoura Coastal Marine Guardians) to develop a management strategy for the Kaikoura coastal and marine environment with a report characterising values and uses along the coast finalised late in 2007 (Te Korowai o Te Tai o Marokura (Kaikoura Coastal Marine Guardians) 2007). In support of the latter process, Dr Islay Marsden, Canterbury University, completed a review of scientific literature on the bio-physical environment of the Kaikoura coast for the Department (Marsden 2007). A separate research/monitoring programme investigating the effects of tourism on dusky dolphins at Kaikoura has also been commissioned.

West Coast Conservancy (key contact **Don Neale**). The Conservancy's major programme in 2007 was supporting the continuation of the West Coast Marine Protection Forum, a community-based group set up to investigate and progress options for marine protection in territorial waters between Kahurangi Point and Awarua Point. This included a published report on the West Coast marine and coastal environment (Neale et al 2007) as well as supplementary GIS mapping, to provide a summary of information for the forum to use. The forum's website www.westmarine.org.nz gives more details about this project. The conservancy also continues to monitor and manage populations of Hector's dolphin, fur seal kekeno, Fiordland crested penguin tawaki, and Westland petrel taiko.

Canterbury Conservancy (key contact **Laura Allum**)
The Conservancy undertook a preliminary project to compare methods of assessing NZ fur seal abundance around Banks Peninsula, using varying techniques including thermal imagining, aerial counts, boat and cliff top counts and walk throughs. The project will be ongoing in 2008. The Conservancy has initiated a project examining the diet of NZ fur seals in 2 Banks Peninsula colonies to better understand their interaction with recreational and commercial fisherman. Conservancy support for research looking at Hector's dolphin tourism and understanding their interaction with boats is ongoing.

A habitat map of Pohatu Marine Reserve was produced for the first time in 2007. This ties into an ecological survey which is planned for Pohatu Marine Reserve in April 2008, using a combination of methods (UVC for reef fish and invertebrates, BUV for reef fish, and potting for blue cod and lobster). The Akaroa Harbour marine reserve application departmental report is near its final form and should be ready soon for the Minister. Canterbury Conservancy is also undertaking a project collating all physical, ecological and human-use information on the coastal/marine environment, useful for RMA and MPA planning.

Several operational responses to NZ fur seal reports and Hectors dolphin beach cast/strandings were carried out. The Conservancy continues to manage populations of white-flippered penguin, yellow-eyed penguin and sooty shearwater through predator control work and survey and monitoring programs around Banks Peninsula.

Southland Conservancy (key contacts **Greig Funnell**, **Kath Blakemore** (Te Anau AO), **Morven Carruthers** (Southern Islands AO) and **Ros Cole** (Murihiku AO)).
Fiordland Marine Area monitoring:
Baseline monitoring in the Fiordland (Te Moana o Atawhenua) Marine Area continued in 2007, revisiting previous sites and adding new monitoring sites in outer coast areas. The project included surveys to assess the abundance and size structure of key species, reef fish diversity, kelp and rock wall diversity, oceanography, and broad-scale marine mammal and seabird surveys. A report on this work is being finalised.

Doubtful Sound bottlenose dolphin population:
A threat management public consultation process was initiated in 2007 to address the issue of a decline in the Doubtful Sound bottlenose dolphin population. This process has resulted in a voluntary set of measures being introduced that all users of Doubtful Sound will be encouraged to adopt. To support this, the Department is undertaking monitoring work to continue to provide data for abundance and calf survival estimates, and has extended this to include the somewhat comparable Dusky Sound population.

Environment Canterbury

http://www.ecan.govt.nz

Environment Canterbury has ongoing state of the environment monitoring programmes.

INVESTIGATIONS AND MONITORING
Dr. Lesley Bolton-Ritchie is responsible for running the water quality and coastal ecosystems monitoring and investigations programmes. As part of the ECan coastal water quality programme there was sampling in selected Bays of Banks Peninsula from January to June (end of the financial year) and at sites in Lyttelton Harbour from July. A long term coastal water quality monitoring programme at 32 sites was instigated in July 2007. Sampling at these sites is quarterly. As part of the ECan coastal ecosystem health programme an investigation of the impact of three drains on sediments and biota in the Avon-Heathcote Estuary/Ihutai was undertaken by EOS Ecology. Lesley assisted by **Leigh Tait** (Ph.D. student, University of Canterbury) sampled the mudflats of inner Lyttelton Harbour in late 2007. The recreational water quality programme consists of weekly sampling of about 45 sites over the summer months. The weekly bacteriological results are available on the Environment Canterbury website.

January 2007 saw the instigation of the 'Healthy rivers and estuary of the city' programme. This is a joint Environment Canterbury, Christchurch City Council and Ihutai Trust programme. For the estuary this programme includes monthly routine monthly water quality monitoring, weekly recreational water quality monitoring over the summer months and annual benthic monitoring. In 2007 the benthic monitoring was undertaken by EOS Ecology.

Justin Cope the Coastal Resources Scientist is responsible for running the regional physical coastal monitoring and investigations programme with assistance from the Coastal Resources Officer Bruce Gabities. Their work continues on investigating coastal processes and long term state of the

environment monitoring and reporting in the Canterbury region. This programme involves the surveying and analysis of 250+ coastal profile and topographic survey sites, collecting data on trends shoreline movement, sediment volumes and sediment size characteristics. Environment Canterbury enjoys several project partnerships including the operation of a Directional Wave Buoy off Banks Peninsula (with NIWA and Christchurch City Council) and sea level recorders at Sumner and Timaru (with NIWA). Starting in late 2007 and continuing in 2008 is an investigation programme into the sedimentation rates of Brooklands lagoon as a result of community concern.

Council
Professor Bob Kirk is an Environment Canterbury Councillor.

Resource care
The Ashley Estuary community group with assistance from **Rob Gerard** has been working towards increasing the protection and understanding of the ecosystem of Ashley and Saltwater Creek estuaries and on issues of beach access to the open coast. The Akaroa Harbour community group with assistance from Jenny Bond has been involved in recreational water quality sampling and coastal water quality issues including the consent renewal for the discharge of treated Akaroa sewage into the harbour and sediment runoff from subdivision developments. Lyttelton Harbour community group, with assistance from Shelley Washington has been involved in recreational water quality sampling and coastal water quality issues particularly the issue of increasing sediment runoff into the inner harbour. The Avon-Heathcote community, with assistance from Shelley Washington has been involved in recreational water quality sampling and other estuary ecosystem health issues. The South Canterbury coast care group with assistance from Judith Earl-Goulet has no ongoing projects at present.

Geological and Nuclear Sciences

Web address: www.gns.cri.nz

OCEAN EXPLORATION

Marine research at GNS Science

Marine research and commercial projects at GNS Science are focused in several broad areas: 1) regional analysis of stratigraphy, structure and prospectivity of New Zealand's offshore basins, 2) studying the crustal structure and plate tectonic evolution of New Zealand to better understand the distribution of resources and the occurrence of hazards, 3) studying hydrothermal processes along volcanic arcs to better understand massive sulphide mineralisation, and 4) application of regional geological and geophysical expertise to determine the outer limits of the continental shelf, both for New Zealand and for other Coastal States. Staff from the Ocean Exploration and Hydrocarbons sections usually lead these projects, often working closely with New Zealand and international colleagues. Recent major collaborative projects include the MANGO survey of gas hydrates along the East Coast, the survey of Brothers volcano in the Kermadec Arc, the survey of Aeolian Arc volcanoes in the Mediterranean Sea, and the survey of the Raukumara Basin north of East Cape.

The Ocean Exploration Section at GNS Science has grown, and now has 20 scientists and technicians. Current staff are: **Stephen Bannister** (geophysicist), **Dan Barker** (marine geophysicist), **Rebecca Bell** (geophysicist), **Heidi Berkenbosch** (data technician), **Jenny Black** (contract geophysicist), **Bob Brathwaite** (minerals geologist), **Tony Christie** (minerals geologist), **Bryan Davy** (marine geophysicist),

Cornel de Ronde (marine geologist), **Ian Graham** (isotope geologist), **Stuart Henrys** (marine geophysicist), **Gwen Hemery** (minerals technician), **Rick Herzer** (marine geologist), **Matt Leybourne** (fluid geochemist), **Neville Orr** (technician), **Ray Soong** (clay mineralogist), **Vaughan Stagpoole** (marine geophysicist), **Rupert Sutherland** (tectonic geologist), **Jiashun Yu** (geophysicist), and **Ray Wood** (section leader).

REGIONAL EXPLORATION

Northwestern New Zealand

GNS Science is investigating the Paleogene through Miocene evolution of the South Pacific sea floor northwest of New Zealand.

In the South Fiji Basin, new magnetic anomaly picks have been made that are internally consistent and better-satisfy recently acquired data, e.g., petrological ages, basin margin structure (from seismic reflection) and seafloor/basement morphology (from swath bathymetry). Work on further integration of results is proceeding.

On the Northland Plateau, synthesis of seismic reflection data, dredge sample petrology and dating (radiometric and paleontological) from several surveys has elucidated its late Cenozoic stratigraphy and structure, and revealed a tectonic relationship between the plateau, the New Zealand margin, and the South Fiji and Norfolk basins that is consistent with widespread regional data.

Analyses of new granitic samples from Cavalli Seamount (in tandem with the Northland Plateau work above) is narrowing down the uplift history and structural context of this unique metamorphic core complex.

Integration of the above studies and the various constraints they provide continues to improve models for evolution of this part of the SW Pacific and the Pacific – Australian plate boundary in the NZ region.

Research team: Rick Herzer, Nick Mortimer, Dan Barker, Bryan Davy, Craig Jones and Chris Hollis. Collaboration: Walter Roest (IFREMER), Pat Quilty (U. Tasmania), George Chaproniere (ANU).

Southeastern New Zealand

GNS Science is investigating the Mesozoic evolution of the Gondwana margin along the Chatham Rise, from convergence and subduction of the Hikurangi Plateau to the break-up of Gondwana and rifting of New Zealand from Antarctica.

The rifting mechanisms that developed behind the convergent margin throughout the New Zealand continental area consequent to Hikurangi Plateau subduction, particularly within the Great South Basin/Canterbury Bight and Bounty Trough, are being investigated to better understand the evolution of these offshore sedimentary basins. The breaking apart of the Gondwana convergent margin and the transition to a rifted margin in the area of the Wishbone Ridge at the eastern limit of the Chatham Rise are being studied to gain understanding of how such processes have occurred throughout the Earth's history and to understand the tectonic evolution of the south-eastern New Zealand continent in the period 110-85 Ma.

Interpretation of the data from past collaborative surveys by r/v Sonne and N.B. Palmer is well advanced as are papers describing the results. A collaborative paper with principal author **Jan Grobys** (AWI) on the crustal structure of the Bounty Trough derived from Sonne refraction surveying has been published in JGR. A similar paper lead by **Jan Grobys** on the structure of the Great South Basin has also

been submitted to JGR. A paper on the structure and evolution of the Hikurangi Plateau has been submitted to G-cubed.

Research team: **Bryan Davy**, **Nick Mortimer** and **Dan Barker**. Collaboration: **Karsten Gohl**, **Gabriele Uenzelmann-Neben** and **Jan Grobys** from AWI (Bremerhaven), **Kaj Hoernle** from GEOMAR (Kiel) and **Joann Stock**, **Robert Clayton** (Caltech) and **Bruce Luyendyk** (UCLA Santa Barbara).

Inshore Surveys

Small airgun and boomer seismic reflection data collected in 2001-2002 in the Auckland-Whangaparoa-Firth of Thames are in the process of interpretation and publication. The airgun data reveal much about the basement and basin structure of the region, as well as faulting and buried volcanism. A submitted paper to NZJGG interpreting greywacke basement structure beneath Auckland and buried volcanism in the Waitemata Channel is being revised following review.
Research team – **Bryan Davy**

Frontier Basins

Non-confidential work was concentrated on promoting the Deepwater Taranaki Basin as a petroleum prospect and on preliminary interpretations of the new Crown Minerals seismic data in the Raukumara Basin. The Deepwater Taranaki Basin is currently held under Crown Minerals exploration permit PEP38451 by Global Resources Holdings (Global). During the year, GNS Science undertook an extensive geological review for Global and made a number of presentations at petroleum industry conferences on the basin prospectivity.

Interpretation of newly acquired seismic reflections data (collected by Crown Minerals) indicates that the Raukumara Basin has a substantial thickness of sediments and is potentially a new petroleum exploration province, but with a different geological history to either the adjacent East Coast Basin or the Taranaki Basin. Research has initially concentrated on correlation with nearby onshore outcrop and understanding the basin genesis and evolution. An initial prospectivity assessment was undertaken at GNS Science and results presented at the New Zealand Petroleum Conference in Auckland in March 2008. GNS Science is also investigating the history of subduction along the East Coast and is collaborating with IFM-GEOMAR and Victoria University of Wellington on data acquisition and interpretation using onshore and ocean bottom seismograph data. The results of these surveys will be integrated with the MED data to provide a better understanding of the basin history and petroleum potential.

Research team: **Chris Uruski** with **Vaughan Stagpoole**, **Stuart Henrys**, **Rupert Sutherland**, **Brad Field**, **Callum Kennedy** (MED), **Dan Basset** (VUW), **Heidrun Kopp** (IFM-GEOMAR, Germany) (Raukumara). **Greg Browne**, **Richard Sykes**, **Malcolm Arnot**, **Liz Kennedy**, **Guy Maslen**, **Tony Harrison**, **Bryan Davy**, **Ray Wood**, **Phil Scadden**, **SuzannahToulmin**, **Mike Milner**, **Mac Beggs** (Geosphere), **Phil Barron** (Arete consultants), and NPA (Deepwater Taranaki)

Gas Hydrates

New Zealand has one of the world's largest occurrences of offshore methane gas hydrates along the east coast of the North Island. Research activity in the last year has focussed on the analysis of results from 2006 and 2007 surveys undertaken by GNS Science in conjunction with NZ, USA and German Scientists. Otago University has also been investigating methane gas hydrate occurrences on the Hikurangi Margin (**Gareth Crutchley**, (partly funded by GNS Science) and Fiordland margin (**Miko Forman** partly funded by GNS Science). The goal of these marine research surveys has been to characterise the geological setting in which submarine cold methane vents occur and the dynamics of gas hydrate formation.

This year has seen a major shift in the perception of New Zealand's methane gas hydrates from a scientific novelty to a vast potential energy resource and potential wealth generator for the country. GNS Science, in collaboration with NZCAE, has been leading debate on the development of New Zealand gas hydrate resources and the refinement of government policy on exploration allocation and development rights. Several leading overseas experts gave presentations at the New Zealand Petroleum Conference on the international move to produce gas from naturally occurring hydrates and the potential global importance of New Zealand's resource.

Research team: **Stuart Henrys**, **Kevin Faure**, **Andrew Gorman** (Otago University), **Ingo Pecher** (Heriot Watt, UK), **Jens Grienert** (University of Ghent, Belgium), **Rick Coffin** (US Naval Research Laboratory), **Joerg Bialas** (IFM-GEOMAR, Germany)

Marine Minerals

Research is now extending to detailed investigations of hydrothermal vent sites on submarine volcanic centres, with continued regional exploration extending into the Havre Trough.

MANGO Cruise, April-May 2007

The German research vessel Sonne left Auckland on the 26th of April for a three-week exploration of submarine hydrothermal systems along the Kermadec and Tofua arcs. The primary exploration tool was the Canadian remotely operated vehicle (ROV) ROPOS, although cruise objectives also included EM120 mapping, water column sampling with CTD and bulk sulfide and rock sampling via TV grab.

The cruise was a mix of German (BGR and University of Kiel; **Uli Schwarz-Schampera** was Chief Scientist), Canadian (Universities of Ottawa, Laurentian and Victoria) and New Zealand (NIWA and GNS) scientists including geologists, fluid and gas geochemists and biologists (vent fauna and micro). From south to north, sites investigated included Calypso Vents, Monowai, Volcano V, Volcano 19, the Hine Hena vent field on the Valu Fa ridge, and Volcano 1.

Some of the more significant highlights included:

- The first collection of high temperature massive and chimney sulfides (with significant bornite and chalcopyrite mineralization) from the Hine Hina vent field.
- Boiling and phase separation at 565 meters water depth at Volcano 19 (fluids were venting at 270°C).
- Recovery of flat fish, a rare vent associated species previously observed on the Mariana Arc.
- A ROPOS dive during a gentle eruptive episode at Monowai (significant gas discharge was observed on the sea surface). At the Monowai cone, the sector collapse observed by bathymetric mapping in 2004 has apparently been filled and the cone is now < 100 meters deep.
- The TV grab recovered crystalline native sulfur, with crystals up to 10 cm long and 1 cm in width.
- Massive barite and pyrite chimney with up to 5% As mineralization from Volcano 19 (as revealed by a hand-held XRF analyser).
- Mapping of the caldera wall at Volcano 1 revealed sequences of submarine fall and flow pyroclastic deposits.

ROVARK Cruise, July-August 2007

In July-August, 2007, GNS Science partly funded a NZ-German-US cruise to the Kermadec Arc and Havre Trough on the R/V Sonne. The principle objectives of the cruise for the New Zealand/American team was to use the AUV (ABE = Autonomous Benthic Explorer) to map in high resolution and using a

number of sensors, the caldera of Brothers volcano, located 400 km NE of New Zealand along the Kermadec volcanic arc. A second aim was to map and sample the water column of numerous deep (>3000 m) basins in the backarc using the GNS CTDO profiling system. In total, 10 basins were surveyed for hydrothermal emissions, including the very deep (>3500 m) Ngatoro Rift basin. Finally, three volcanoes were re-sampled for their hydrothermal plumes (Brothers, Healy, Rumble III) using the GNS CTDO system as part of an ongoing time series project on venting along the Kermadec arc.

This cruise (NZASRoF'07 or ROVARK) produced the first high-resolution holistic map of an active submarine arc volcano. Multiple sensors deployed on ABE produced co-registered layers of bathymetry, total magnetic field, water temperature and conductivity, water turbidity, electrical redox potential (Eh), and (on some dives) pH. The success of this approach is underscored by the robust correlations made between the crustal magnetization, submarine geomorphology and hydrothermal indicators in Brothers caldera. The cruise also resulted in the first systematic survey for hydrothermal anomalies in the Havre Trough lying west of the Kermadec arc.

GNS Science personnel on the ROVARK cruise were **Cornel de Ronde**, **Bryan Davy**, **Kevin Faure** and **Matt Leybourne**. American participants (NOAA and WHOI ABE team) included **Ed Baker**, **Bob Embley**, **Dana Yoerger**, **Joe Resing**, **Sharon Walker**, **Ron Greene**, **Susan Merle**, **Al Duester**, and **Andrew Billings**.

PALEONTOLOGY AND ENVIRONMENTAL CHANGE

Marine Paleoclimate

GNS Science is establishing a modern analogue dataset for the oceanic area around New Zealand. This study uses surface sediment samples to investigate variation in the relative abundances of calcareous-shelled, siliceous-shelled and organic-walled plankton species. Quantitative estimates of sea surface temperature and nutrient characteristics of surface waters can be derived from these data by using various statistical techniques. This study incorporates several plankton groups (diatoms, radiolarians, dinoflagellate cysts and foraminifera), in order to cross-validate data and interpretations and to identify the best groups for oceanographic reconstructions in the specific settings. Some preliminary results are published (radiolarians: Hollis and Neil, 2005) and others have been submitted for publication (diatoms: Cochran et al., submitted; dinoflagellate cysts, pollen and spores: Crouch et al., submitted).

The ultimate aim of this project is to test the developed paleotemperature equations on sediment cores from the New Zealand area, and reconstruct paleoclimate variability in this area over several climatic cycles, with a focus on the early Holocene and marine isotope stages 5 and 11. This research is being carried out within the GNS Global Change Through Time FRST programme.

Giuseppe Cortese has recently joined the GNS Science teams and currently is refining and extending the radiolarian-based modern analogue dataset. During his previous work he focussed on high-resolution paleotemperature reconstructions over five glacial to interglacial cycles in the Cape Basin (ODP Site 1089) and in the Norwegian Sea. He is also interested in the paleoceanography of the Southern Ocean and various aspects of biogenic silica production, export and burial.

Martin Crundwell and a team from GNS Science and the Antarctic Research Centre at Victoria University of Wellington have just published a milestone paper in Palaeo3. Using planktic foraminiferal assemblages and artificial neural network estimates of sea-surface temperature at ODP Site 1123, east of New Zealand, the team has revealed a high-resolution history of glacial–interglacial variability at the Subtropical Front for the last 1.2 million years. Leads in SST minima and maxima over ice volume during this period suggest ocean climate variability at the Subtropical Front is driven by alternate polar

and tropical forcing. This contrasts with the established hypothesis that southern hemisphere ocean climate is driven by continental glaciations.

Percy Strong has been working on a Marsden Fund project "Collapse of the Ross Ice Shelf in a warmer world", led by **Gavin Dunbar** (Victoria University of Wellington). Work has focused on a c. 15 m thick interglacial diatomite interval (marine isotope stage 31) in the ANDRILL drillhole from the McMurdo Ice Shelf which includes sediments (mainly diatomites) deposited during MIS-31. Laser ablation will be used to determine the Mg/Ca ratio in the planktic foraminifer Neogloboquadrina pachyderma to derive sea surface temperatures.

Research team: **Ursula Cochran**, **Giuseppe Cortese**, **Erica Crouch**, **Martin Crundwell**, **Chris Hollis**, **Dallas Mildenhall**, **George Scott**, **Percy Strong**.
Collaboration: **Helen Neil** (NIWA), **Lionel Carter**, **Gavin Dunbar**, **Tim Naish** (VUW), **Vanessa Luer** (U. Bremen)

EMERITUS SCIENTISTS

Fred Davey has been working on two related marine projects with two US research groups:

- Morphology of the seafloor of the north-western Ross Sea continental margin (shelf and slope) and the relationship between seafloor sediment structures, icebergs furrows and tidal and bottom currents
- The interaction of icebergs and the seafloor, iceberg breakup and its morphological, acoustic and seismic effects, and seafloor sedimentary scour.

VISITORS

Julien Collot, PhD student from IFREMER (France), visited GNS for 10 weeks and has commenced a collaborative study of the New Caledonia Basin designed to integrate studies done from New Zealand and New Caledonian shores and regional geological perspectives. His work is continuing at the New Caledonia Geological Survey SGNC in Noumea.

POSTGRADUATE STUDENTS

PhD

Vanessa Lüer is completing her PhD study (co-funded by GNS Science and University of Bremen) on radiolarian assemblages in sediment cores from offshore eastern New Zealand. She has one paper in press on the late Quaternary record from ODP sites 1123 and 1124 and another in preparation on a subantarctic sediment core.

Amandine Chambord started her PhD study two months ago at GNS Science and Victoria University of Wellington. She will be working on magnetic profiles, as well as bathymetric and gravimetric data, and using magnetic anomalies to make kinematic reconstructions for the region between Australia, East Antarctica and New Zealand, and for the South-West Pacific for times older than the Hawaii-Emperor bend. She also has a paper in preparation on her Master's research project results ("Pacific-Farallon-Baja California interactions since 15My").

Geomarine Research

www.geomarine.org.nz

During 2007, **Bruce Hayward**, **Hugh Grenfell**, and **Ashwaq Sabaa** continued their foraminiferal research at their laboratory near Tamaki Campus, Auckland. Recent MSc graduate **Rhiannon Daymond-King** worked with us for most of 2007.

DEEP SEA FORAMINIFERAL ECOLOGY

The composition and distribution of over 500 benthic foraminifera in the deep-water parts (>100 m) of the New Zealand EEZ, was analysed and related to various environmental factors, as part of our forthcoming monograph and illustrated atlas.

FORAMINIFERAL RECORD OF HUMAN IMPACT

We completed our study of the impact of Spartina and Musculista on estuarine foraminiferal and ostracod ecosystems in northern New Zealand and submitted a manuscript. Shifts in FRST funding emphasis has resulted in us curtailing our research in this theme, but we are now starting research on whether ocean acidification is yet impacting on New Zealand estuarine systems.

FORAMINIFERAL RECORD OF LATE HOLOCENE SEA-LEVEL RISE

A manuscript has been submitted (with **Roland Gehrels**, Plymouth) on foraminiferal proxy evidence for accelerated rise in sea level since the late 19th century, based on studies at Pounawea, Catlins Lake. We are now working up the record from Mokomoko Inlet (Bluff) and will move on to Waikawa Harbour (S Catlins) and NW Nelson this year.

CAUSES OF SEA EXTINCTION IN THE DEEP SEA

We have begun our 2007-9 Marsden study on the causes of extinction in the deep-sea, with PhD student **Liesbeth Van Kerckhoven** documenting events through the Cenozoic in the Weddell Sea and ourselves focussing on the record elsewhere in the Indian Ocean and Mediterranean Sea.

OSTRACOD STUDIES

Margaret Morley wrote up her studies on the impact of Asian date mussels and cordgrass on ostracods and is now looking at intertidal zonation of ostracods in coralline algal pools and in different salinities around Big Lagoon, Marlborough.

Golder Associates (New Zealand) Ltd.

(formerly Kingett Mitchell Ltd.)
www.golder.com

As of 1 December 2006, Kingett Mitchell Ltd. became a part of the Golder Associates global team. The decision for Kingett Mitchell to merge with Golder Associates (New Zealand) Ltd was the result of a long standing relationship between the two companies in providing complementary services to clients. The combined New Zealand business has offices based in Takapuna, Tauranga, Nelson, Christchurch and Dunedin. Golder Associates comprises a wide variety of environmental scientists in numerous multi-disciplinary specialist groups. These comprise Air Quality & Noise, Chemistry, Contaminated Land, Ecology, Geotechnical & Geophysics, Planning & Landscape Architecture, Mining, and Water Management. The Ecology Group includes terrestrial and freshwater ecologists, and marine scientists who are capable of providing a broad range of environmental services.

The Ecology Group undertook a diverse range of marine-based projects during 2007. This work comprised primarily marine biosecurity research, environmental monitoring and assessment, and subtidal and intertidal benthic surveys. The Auckland office's Marine Group includes **Dr. Dan McClary**, **Emily Jones**, **Claire Phipps** and **Sandra Hinni**, and was joined in February by **Leigh Anderson**. Leigh has a Masters degree in Environmental Science (Distinction) from the University of Otago and is involved in the Ecology Group as an Aquatic Scientist in both, marine and freshwater projects. In Dunedin the Ecology group is comprised of **Dr. Mike Stuart** and **Coralie Dignan**. The Ecology Team has ongoing support from other coastal and aquatic scientists within Golder Associates in New Zealand; these include **Paul Kennedy**, **Scott Speed** and **Ivan Holland**, who has joined us in the Christchurch office in November. The Marine Group also works in close collaboration with Golder Associates marine scientists in Australia, in particular **Elena Lazzarotto** and **Amy Lomax**.

MARINE BIOSECURITY

In 2007 Golder Associates' Ecology Group was involved in several marine biosecurity projects ranging from biosecurity risk assessments to incursion response and tools development.

MAF Biosecurity New Zealand (MAFBNZ) commissioned Golder Associates to undertake baseline biosecurity port surveys to elucidate the species present within ports, marinas and "pristine" regions within New Zealand waters. Two such surveys were undertaken around the Chatham and Pitt Islands (with assistance from **Dr. Marnie Campbell** of the Australian Maritime College) and in Golden Bay (in collaboration with the Cawthron Institute) at the top of the South Island. These surveys were based on the design provided by MAFBNZ and followed the CRIMP (CSIRO Research - Introduced Marine Pests) protocols.

Other marine biosecurity work undertaken for MAFBNZ involved the completion of hull inspections of international cruise and fishing ships, as well as domestic vessels moving around the Subantarctic and Chatham Islands and Fiordland. The aim of these projects was to determine the relative risks posed by the biofouling on these vessels to New Zealand's marine environment. This work has involved collaboration with the Department of Conservation to complement existing hull inspections of vessels visiting the Subantarctic Islands.

Our marine team was involved in several incursion response projects commissioned by MAFBNZ. Research into the reproductive behaviour of the clubbed tunicate Styela clava in New Zealand waters,

which began in 2006, was completed in 2007. It investigated the reproductive periodicity of this species, including the timing of gonad development, larval release and subsequent settlement in Bayswater Marina in Auckland. Results indicated that populations are able to potentially reproduce from spring to autumn. An incursion response tool for marine biosecurity was also investigated, as work on controlling the non-indigenous crab Charybdis japonica continued. Six weeks of trapping of this non-indigenous paddle crab in Turanga Creek in the Whitford Embayment was conducted. This intensive trapping regime, which was not sufficient to eliminate the crab population, was followed by several one week monitoring events at 3-month intervals.

Golder Associates was contracted to independently monitor and report on the efficacy of wrapping as a tool for incursion response in the marine environment. The HMNZS Canterbury, which was scuttled in the Bay of Islands to provide an artificial reef and dive site, was the focus of a research project coordinated by MAFBNZ. Its hull was wrapped in polythene sheeting (while the vessel was berthed at the Devonport Naval Base) in order to kill the invasive sea squirt Styela clava. While the wrap did fail prematurely, Golder Associates scientists were able to extract useful information from the trial in anticipation of further developing the tool for use on very large vessels.

In March 2007, Golder Associates staff was consulted by the Northland Regional Council to help assess the biosecurity risk posed by an abandoned floating shipping container off Cape Brett in the Bay of Islands. Closer inspection revealed this potential shipping hazard to be the remains of a sunken fishing vessel, lost in the Indo-Pacific several years ago. The wreck was recovered by barge and carried into Opua Marina where it underwent further inspections, sampling and risk assessment by MAFBNZ.

Most recently, Golder Associates was commissioned by MAFBNZ to undertake the development of new tools for responding to invasions in the marine environment. A 'containment and treatment system' is being developed and tested aimed at targeting invasive epibenthic organisms in a subtidal environment. It utilises a recirculating system to treat organisms contained within a tarpaulin placed over the target area. The use of microwaves as a means of responding to invasive species is also being tested. Laboratory tests are being conducted to determine the depth of sediment penetration, temperature ranges and the efficacy of microwaves as a treatment to manage non-indigenous marine species.

ENVIRONMENTAL MONITORING AND ASSESSMENTS

Throughout 2007, the Ecology Group has continued on working on intertidal and subtidal monitoring and assessments. These projects have typically involved faunal and sediment sampling in marine environments that included, but were not limited to, sewage outfalls, marinas, ports and harbours.

Golder Associates, with assistance from Dive Co commercial divers, has continued its marine biological surveys of the Rangitoto Channel for Port of Auckland Ltd (POAL). Two pre-dredging sample collections and one post-dredging sample collections have been completed and sediment textures and the benthic communities were assessed. Golder Associates also supervised the installation of marker pins on the seafloor for the relocation of sampling station in ongoing monitoring events.

The Ecology Group also completed the five yearly Clive wastewater outfall survey for Hastings District Council. It was the third survey undertaken (previous surveys were in 1995 and 2000) and involved the collection and analysis of benthic samples and physiological examination of flounder samples collected from around the outfall and at control sites. Another monitoring programme involved sampling of marine communities in the vicinity of the Fort Nautilus Marine Park in Tauranga. The survey was

undertaken during construction of a boat drystack and followed a pre-construction survey conducted in 2002.

Investigation of oyster beds and reef management in the Manukau Harbour was undertaken for the Auckland Regional Council, including a feasibility study of removal and management methods and a cost-benefit analysis.

In 2007, Golder Associates was involved in an ongoing international project in the Philippines for the Mindoro Nickel project. Scientists visited the site for an environmental study that will lead into the preparation of the Environmental Impact Statement (EIS) and an Environmental and Social Impact Assessment (EISA) which will address the Equator Principles. This study will be conducted in close cooperation with Philippine specialists, including indigenous people representatives and a broad range of local NGOs and political leaders.

Greater Wellington Regional Council

Greater Wellington Regional Council's investigation into sediment quality in Wellington Harbour is nearing completion. Seventeen sub-tidal sites were sampled in 2006/07, with surface sediment analysed for a range of contaminants including metals, polycyclic aromatic hydrocarbons and organochlorine pesticides. Benthic fauna samples were also collected from each site. A report documenting the findings should be available at the end of June 2008.

Together with DoC, Greater Wellington Regional Council is contributing funding to NIWA's side-scan sonar survey of the entire Wellington Harbour sea floor. The project is already well underway and will provide detailed information on the bathymetry, sediments and ecology of the seafloor, including sediment deposits from the Hutt River and a very high resolution scan of the navigation channels into the harbour.

Hawke's Bay Regional Council

www.hbrc.govt.nz

COASTAL AND ESTUARINE ECOLOGY

Hawke's Bay Regional Council has continued its coastal State of the Environment monitoring. Over the last 3 years this programme has been expanded from basic microbiological water quality monitoring to include annual monitoring of estuaries, hard and soft-shore ecosystems and coastal waters.

Monitoring undertaken in Ahuriri and Porangahau estuaries has shown that the concentration of contaminants within sediments are generally well below levels of concern, although some point source discharge contamination has been identified. Animals and plants living in the estuary were typical of

east coast, North Island estuaries. Council plan to continue to monitor the health and state of our regions estuaries to ensure the retention of key ecosystem services.

Coastal sediment quality in the nearshore zone was assessed in 2007. This will allow point source discharge levels to be assessed against regional background levels as well as environmental guidelines.

Hawke's Bay Regional Council also undertakes investigations in areas where further research or the development of monitoring programmes may be required to provide for effective management. The second round of sediment sampling has been conducted for areas surrounding boat maintenance and repair facilities. This follows from earlier work in 2006, and will provide some indication as to whether work undertaken with boat maintenance companies and sports clubs is achieving environmental benefit.

Council is also in the final year of a three-year investigation into the role of sediment resuspension in elevating bacterial levels in overlying water bodies.

COASTAL WATER QUALITY

A nearshore coastal water quality monitoring project has been added to Councils state of the environment monitoring network. Seven coastal areas are monitored at 6-weekly intervals for indicators of coastal water quality, including nutrient concentrations, chlorophyll a levels, physicochemical properties and bacteria.

A review of the data to date suggests that nutrient levels in nearshore coastal waters are not as high as was indicated by the 2005 pilot study.

Council also undertakes work reporting in the levels of bacteria in waterways for contact recreation and shellfish gathering.

Industrial Research Ltd

www.irl.cri.nz

CARBOHYDRATE CHEMISTRY - GLYCOACTIVES

Dr Ruth Falshaw continues to manage Industrial Research Ltd's FRST programme on seaweed glycotherapeutics. **Dr Susie Carnachan** and **Dr Tracey Bell** are assisting Ruth to undertake research to develop new biologically active products from macroalgae and to develop seaweed aquaculture in New Zealand. Our group has extensive experience in structural analysis of polysaccharides from seaweeds and other natural products. The endemic red seaweed, Gigartina atropurpurea, was successfully aquacultured on a small-scale on a mussel farm in the Marlborough Sounds. This seaweed aquaculture work was undertaken in collaboration with NIWA.

INTEGRATED BIOACTIVE TECHNOLOGIES

For over 25 years **Dr. Vyssotski** has been involved in research and development of methods for lipid analysis, structure elucidation and chemical modification. His research interest is in the field of bioactive lipids – isolation, identification and modification, including novel lipids and unusual fatty acids of marine organisms. Dr. Vyssotski led a number of basic research and commercial projects

related to bioactive lipids of marine and terrestrial origin, including use of fatty acid analysis for rapid identification of marine microorganisms; very-long chain polyunsaturated fatty acids of marine organisms; and unusual less-polar phospholipids. **Dr. Vasily Svetashev** has scientific interests in investigation of structure, distribution and role lipids and fatty acids in marine organisms. He has more than 30 publications on marine lipids and methods for lipid analysis. **Dr. Andrew MacKenzie** has 14 years experience in the extraction, modification and analysis of lipids. Recent research has involved phospholipids from a variety of sources (including marine organisms). Analysis of phospholipids using 31P NMR has been established at IRL, and is available at a fee for service basis.

VISITORS

Prof. Yutaka Itabashi (Hokkaido University, Japan); via RSNZ-JSPS exchange programme, July-September 2007. Focus of research: Analysis, distribution and utilization of functional lipids from New Zealand marine organisms

Massey University (Auckland and Palmerston North)

http://cmrg.massey.ac.nz
http://wildlife/research/common_dolphin/common_dolphin.asp
www.massey.ac.nz/~dhbrunton

Auckland
COLLEGE OF SCIENCES
INSTITUTE OF NATURAL RESOURCES: COASTAL-MARINE RESEARCH
ECOLOGY AND CONSERVATION GROUPS

Palmerston North
NEW ZEALAND WILDLIFE CENTRE
INSTITUTE OF VETERINARY, ANIMAL AND BIOMEDICAL SCIENCES

Massey University is primarily involved in marine sciences through staff and post graduate research in interests. However, undergraduate modules in marine biology are currently planned for next year as part of the taught undergraduate degree in Biological Sciences (offered on the Auckland campus).

Brief summary of staff members/research interests and projects over the past year

Assoc. Prof. David Raubenheimer (Auckland campus)
Field-based studies of nutritional ecology of marine fauna
Principal projects:

- The relationship between nutritional ecology and life history of the marine herbivorous fish Odax pullus along a latitudinal gradient.
- Macronutrient selection in herbivorous, omnivorous and carnivorous marine fishes.
- Nutritional ecology of marine amphipods.

Assoc. Prof. Dianne Brunton (Auckland campus)

The ecology and conservation of little blue penguins (Eudyptula minor), North Island, New Zealand
Principal projects:

- The feeding and breeding ecology of little blue penguins on Tiritiri Matangi Island, New Zealand.
- The significance of parasites loads in little blue penguins on Tiritiri Matangi Island, New Zealand.

Dr. Karen Stockin (Auckland campus)
The New Zealand Common Dolphin Project (NZCDP)
Field and lab-based research focussed on New Zealand common dolphins (Delphinus sp.).
Principal projects:

- Taxonomic identity of New Zealand Delphinus.
- Biology and life history of common dolphin in New Zealand waters.
- Anthropogenic threats to New Zealand common dolphins, namely by-catch, tourism, pollution.
- Behaviour and ecology of common dolphins in the Hauraki Gulf, Auckland.

Wendi Roe (Palmerston North campus)
A senior veterinary pathologist at Massey University, Palmerston North, Wendi is primarily interested in disease and pathology of New Zealand marine mammals. Key species include Hector's dolphins, common dolphin and New Zealand sea lions (Phocarctos hookeri).

POSTGRADUATE STUDENTS
PhD

Jürgen Kolb
The role of Piscicolidae (Annelida: Hirudinea) in the marine ecosystems of Antarctica and New Zealand.

Emmanuelle Martinez
Tourism impacts on Hector's dolphin (Cephalorhynchus hectori) at Akaroa harbour, Banks Peninsula, New Zealand.

Laureline Meynier
Feeding ecology of the New Zealand sea lion (Phocarctos hookeri).

Vincenzo Petrella
Acoustic repertoire of common dolphins (Delphinus sp.) in the Hauraki Gulf, New Zealand.

Wendi Roe
Investigation of markers of traumatic brain injury and drowning in pinnipeds, with particular emphasis on the NZ sea lion (Phocarctos hookeri).

Wendy Schrader
Dusky dolphins (Lagenorhynchus obscurus) off Kaikoura, New Zealand.

MSc
Elizabeth Burgess
Foraging ecology of common dolphin (Delphinus sp.) in the Hauraki Gulf, New Zealand.

Jacqueline Guerts
The feeding and breeding ecology of little blue penguins (Eudyptula minor) on Tiritiri Matangi Island, New Zealand.

Monika Merriman
Abundance and behavioural ecology of bottlenose dolphins (Tursiops truncatus) in the Marlborough Sounds, New Zealand.

Jodi Smith
Tourism impacts of humpback whales (Megaptera novaeangliae) off Moreton Island, Queensland, Australia.

Monique van Rensburg
Parasitology of little blue penguins (Eudyptula minor) on Tiritiri Matangi Island, New Zealand.

Ministry of Fisheries (MFish)

www.fish.govt.nz

The Ministry of Fisheries has a dynamic team of 14 full time scientists and 2 part-time contractors who are responsible for:

- coordinating and convening research planning working groups to identify fisheries research needs and define research objectives;
- overseeing contracted research projects and providing quality assurance of such research;
- coordinating and convening stock assessment working groups to provide estimates of biomass and sustainable yields for fish stocks;
- coordinating and convening aquatic environment working groups to assess the effects of fishing on the aquatic environment, including biodiversity and bycatch species;
- coordinating and convening the biodiversity research advisory group to plan and to evaluate biodiversity research;
- overseeing some aspects of research on aquaculture and enhancement projects;
- providing scientific input to Fisheries Plans, fisheries standards and other Ministry initiatives;
- providing scientific advice to the Ministry;
- providing science input to international fisheries management organisations; and
- administering and providing quality assurance for an annual research budget of more than $20,000,000 to support the above activities

In addition, the Ministry has a number of research programmes in place to generate high quality information on biodiversity. These programmes are intended to improve our ability to:

- protect the richness and health of the marine biodiversity of New Zealand and the Ross Sea region;
- ascertain the role of different organisms and habitats in maintaining the health and sustainability of our aquatic environment; and
- contribute to required information to set environmental standards under the Strategy to Manage the Environmental Effects of Fishing (SMEEF)

Highlights of the 2007 year include:

- awarding the first joint MFish/NIWA scholarship in Quantitative Fisheries Science to **Oliver Hannaford** to undertake an MSc at the University of Auckland;
- implementing bird mitigation measures at the Western and Central Pacific Fisheries Commission (WCPFC);
- retrieval of the first batch of data from the satellite tagging programme for swordfish and bluefin tuna which will eventually be used in stock assessments for these species;
- initiation/ development of the process for Challenger finfish and Highly Migratory Species Fisheries Plans;
- substantial advancement in the negotiations for the formation of the South Pacific Regional Fisheries Management Organisation (SPRFMO), with scientific contributions including preparation of a benthic assessment framework incorporating definitions of vulnerable benthic marine ecosystems (VMEs), protocols for evaluating evidence of VMEs in bottom trawl by-catches, analysis of the New Zealand bottom trawl and longline effort footprint on the high seas, and development of proposals for a multi-tiered approach to protect areas on the high seas containing VMEs from the impacts of bottom trawling;
- collaborative development of a new Harvest Strategy Standard to ensure that fish stocks are harvested at sustainable levels with special measures to rebuild them at the fastest practical rate if they become depleted;
- collaborative development of a Seabird Standard to minimise the impact of fisheries on the incidental mortality of seabirds;
- ongoing Ministry of Fisheries efforts to elevate the profile of environmental considerations into management decisions;
- the Oceans Survey 20/20 programme overall, and in particular a scientifically-designed survey to compare productivity and biodiversity between the Chatham Rise and Challenger areas; and development, with the Department of Conservation, of a new initiative under MoRST's Cross-Departmental Research Pool to complete the analysis of samples and data collected during the Oceans Survey 20/20 Chatham-Challenger project. This study will generate maps of species diversity, abundance and distribution of animals living on, in, or near the sea-bed, including endemic species, and assess commonly used metrics and indicators of biodiversity. The maps and analyses will be used to assess the extent to which sea-bed photographs can be used to assess biodiversity and to examine the performance of current marine classification systems for benthic habitat; and
- active cooperation between the aquaculture industry, research providers and MFish scientists and managers resulting in effective implementation, completion and review of a large number of Fisheries Resource Impact Assessment (FRIA) research projects.

CHIEF SCIENTIST

Pamela Mace was appointed as the Chief Scientist of the Ministry in 2005. She has more than 30 years of fisheries science and management experience, including many years working in Canada and the United States, and in international forums. Pamela's main areas of expertise are fish stock assessments, the development and implementation of fisheries harvest strategies, ecosystem approaches to fisheries, and the development of criteria for defining species at risk.

STOCK ASSESSMENT

Kevin Sullivan is the Science Manager for Stock Assessment within the MFish Science Team. Kevin's responsibilities include the following research areas: deepwater species, hoki, middle depth species,

rock lobster and stock assessment methods, including stock assessment, research planning and research management processes. Kevin is the New Zealand representative on the Scientific Committee of CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources).

Stephen Brouwer joined the Science Team in 2006. He is a Principal Scientist in the Stock Assessment Team and has both domestic and international responsibilities. Domestically he is involved in Fisheries Plans, stock assessments and research planning for highly migratory species and southern inshore fisheries. Internationally he is one of the MFish representatives at the Western and Central Pacific Fishing Commission (WCPFC).

Shelton Harley joined the Science Team in 2004 from the Inter-American Tropical Tuna Commission in La Jolla, California. Shelton is a Principal Scientist, and is the primary MFish science representative for the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). Domestically, he is involved in research planning, project management and stock assessments for highly migratory species and northern inshore species.

Sophie Mormede is a Senior Scientist who was with the Science Team until November 2007. She assisted in the stock assessment of deepwater fisheries, hoki, shellfish and eel fisheries. She was involved in the Antarctic fishery and customary fishery scientific processes.

Neville Smith joined the Science Team in 1998. Currently a Principal Scientist, he convenes the Antarctic Fishery Working Group/Research Planning Group, coordinates Science Team input to a wide variety of international fisheries forums, convenes the CCAMLR Working Group on Incidental Mortality Associated with Fisheries, manages the three Science Officers and is studying part-time for an MBA.

Peter Todd is a Principal Scientist in the Stock Assessment Team with responsibilities for research planning for marine recreational fisheries, and stock assessment and research planning for shellfish (excluding rock lobster) and freshwater eels. In addition, Peter is involved in research on customary fisheries management practices and other research needed by local customary fisheries managers.

AQUATIC ENVIRONMENT AND BIODIVERSITY

Martin Cryer joined the MFish Science Team as the Science Manager for Aquatic Environment and Biodiversity in 2005. After 15 years at MAF Fisheries and NIWA working on shellfisheries, recreational fisheries, and the effects of fishing, he is now responsible for managing research and science advice on biodiversity and the effects of fishing on the aquatic environment. He currently convenes the Aquatic Environment Working Group and specialises in benthic effects of fishing, but also has support roles in shellfish stock assessments and recreational fisheries research.

Julie Hills is a molecular ecologist and Senior Scientist in the Aquatic Environment and Biodiversity Team. She is responsible for managing research and science advice on the positive and negative effects of fisheries enhancement, on the impacts of aquaculture on fisheries and on the impacts of fishing on genetic population structure within various fish populations. Julie is also providing scientific input into paua fisheries plans and provides science advice on risks associated with transferring marine organisms around New Zealand.

Sebastian Holmes was with the Aquatic Environment and Biodiversity Team as a Principal Scientist until October 2007. His role in the team focussed on coastal biodiversity and the wider ecosystem

effects of fishing. Sebastian was involved in the Oceans Survey 20/20 programme survey design and represented the Ministry at sea for both the Challenger and Chatham voyages.

Mary Livingston joined the Aquatic Environment and Biodiversity Team in 2004 after 20 or so years working on hoki and middle-depth species at NIWA. Mary manages the Ministry's projects and research planning for biodiversity and is involved with projects on the effects of fishing on the environment, particularly on bycatch, deepwater habitats, and ecosystem issues. She continues her involvement with the Oceans Survey 20/20 programme, which now includes New Zealand's International Polar Year-Census of Antarctic marine Life project (IPY-CAML) as well as the ongoing Chatham - Challenger project to map seabed habitats and biodiversity in those two areas. Mary also represents the Science Group on the Interdepartmental Climate Change Adaptation Group (ICCA) and the NZ Royal Society Biodiversity Committee, and has ongoing involvement with stock assessment working groups for hoki and middle depth species.

Rob Mattlin is a part-time contractor with the Aquatic Environment and Biodiversity Team. He deals with the effects of fishing on marine mammals and all related marine mammal issues.

Ben Sharp was a Senior Scientist in the Aquatic Environment and Biodiversity Team until March 2006. He is currently living in Vanuatu and is a contracted to the Ministry Science Team to provide advice on Antarctic and biodiversity topics.

Susan Waugh is a Principal Scientist who was with the Science Team until June 2007. Susan managed the Ministry's endeavours to understand the interactions between fisheries and protected species (e.g. sea lions, seabirds and dolphins). Susan worked closely with other government and non-government agencies to develop effective management for protected species. Susan was also involved in the Customary Fisheries area, with whakapapa to Te Atiawa and Ngati Raukawa iwi.

Nathan Walker is a Senior Scientist who joined the Aquatic Environment and Biodiversity Team in February 2007. He has previously worked for Trophia Ltd as a fisheries scientist and for WWF-New Zealand as a Sustainable Fisheries Programme Leader and as a Marine Team Leader. Nathan is currently working on fisheries interactions with protected species, which includes overseeing MFish research into estimating bycatch levels and rates, the development of environmental standards, and involvement in the testing of bycatch mitigation techniques. Nathan is part of the Seabird Mitigation Technical Advisory Group and is also coordinating the Aquatic Environment and Biodiversity Team input into Fisheries Plans.

SPECIAL PROJECTS SCIENTIST

Andrew Penney joined the Science Team as Special Projects Scientist in December 2006. He spent 19 years as a fisheries scientist in South Africa, and 8 years providing marine and coastal research and management consultancy services to fishing and marine mining industries, during which time he was also Chair of the Scientific Committee of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). He is now involved in scientific observer planning, science-management integration relating to implementation of fisheries plans, represents New Zealand's scientific interests at the proposed SPRFMO and convenes the SPRFMO science working group.

SCIENCE OFFICERS

Michelle Brock joined the Science Team in 2006 following completion of her MSc at the University of Auckland. Michelle is involved in providing technical support for several aspects of the Science Team's

work, including contributing to the Aquatic and Environment research planning and plenary, providing support for Stock Assessment and Research Planning Working Groups, particularly for shellfish and recreational fisheries, and liaising with the Observer services which included time at sea completing the duties of an Observer. Another key task has included participation in the Oceans Survey 20/20 research voyage to the Chatham Rise.

Rebecca Lawton was with the Science Team until April 2007 as a Science Officer. Rebecca was involved in providing technical support for many aspects of the Science Team's work. Key tasks included providing support for Stock Assessment and Research Planning Working Groups, particularly for Deepwater Fisheries, updating various Medium Term Research Plans, co-authoring a paper on governance of deep sea fisheries, and involvement in a number of Ministry-wide projects to make information more readily available via the internet.

Rebecca Edmonds joined the Ministry of Fisheries mid 2007 after completing a BSc in Biology at Victoria University. Rebecca is involved in providing technical support for several aspects of the Science Team's work, including Stock Assessment and Research Planning Working Groups, particularly for Deepwater and Middle depths Fisheries. Rebecca provides support to the Chief Scientist in the development of the Harvest Standard Strategy. In particular, this includes the development of an annotated bibliography on the use of biological reference points internationally. Rebecca is also involved with the tracking science publications and processing Ministry scholarship applications.

Te Puoho Katene joined the Ministry of Fisheries in July 2007 after completing a joint BSc, majoring in Marine Biology, and BA in Maori Studies at Victoria University. TP is working with IT to construct a searchable Research Report database to make information more readily available via the internet. TP is also involved in customary research planning, and providing support to the customary research tender rounds and subsequent projects. Other key tasks include contributing to the Aquatic and Environment plenary on customary issues and administering the Ministry of Fisheries science working group website.

Museum of New Zealand – Te Papa Tongarewa

www.tepapa.govt.nz/

Te Papa holds major, nationally important collections in marine fishes, invertebrates, marine mammals, seabirds, macroalgae and marine reptiles. At present these areas are covered by collection managers and/or curators. A major strategic issue for Te Papa is the very minimal staff to cover the large number and wide range of collections. There are key gaps, especially in echinoderms, cnidarians, copepods and polychaetes. The collections are arranged systematically, allowing any researcher to find and do research on specimens. Our goal is to have every specimen catalogued, imaged and recorded in a database system that assigns each a unique number and is accessible via the internet. The collections, together with their associated data, provide an ever-expanding knowledge base that underpins Te Papa's research, exhibition, publication and information programmes. In addition, the marine group actively participates with other organisations, individuals and universities in research projects as diverse as taxonomy, evolution and molecular ecology.

COLLECTION MANAGEMENT

Simon Whittaker (Head of Collections Management) is the key liaison between the Natural Environment Team and Mainzeal, who have been contracted to undertake the construction work on the new Spirit Collection Facility. Technical staff, **Trevor Tutt**, **Mark Fenwick**, **Nicholas Hay**, **Nathan Whittaker** and **Brad Welch** have been working to package up the entire jar collection, approx. 54,000 jars and to ensure the specimens and alcohol volumes/concentrations etc. can be easily managed in the new facility. All tanks have been replaced with new HSNO complainant stainless steel tanks, and all 20L polypails are being replaced with HSNO compliant polypails.

INVERTEBRATE GROUP

Rick Webber has spent some time rehousing and databasing wet collections of Crustacea and marine invertebrates in tandem with work on the new Spirit Collection Facility. He has contributed to a paper submitted for publication by Canadian and US colleagues, on the phylogeny and ecology of hydrothermal vent shrimps from the Mariana Trench with a further paper describing a new shrimp taxon in progress. He has also published a third paper with **Dr Masatsune Takeda** of Japan, on crabs of the Kermadec Islands, this one describing parthenopid crabs.

Dr Wilma Blom of Auckland Museum is into her third contract to identify invertebrates from deep sea hard substrates, collected by Observers. Museum Associate **Elliot Dawson**, and colleagues, published a paper on a new species of ('snow crab') from Western Australia.

Bruce Marshall continued research on systematics and biogeography of Mollusca of the New Zealand EEZ. Revisions of Pectinoidea and Nuculoidea (Bivalvia), and Coralliophilinae (Gastropoda: Muricidae) are nearly ready for submission. Revisions of Lottiidae, Scissurellidae (Gastropoda) and Nuculoidea (Bivalvia), and a paper describing a new giant mussel from shallow submarine volcanoes on the Kermadec Ridge are proceeding. Papers were published during the year on molluscan biodiversity in the New Zealand region during the Cenozoic, genetic analysis of a new freshwater mussel species from the north-western South Island (with **Mark Fenwick**), and techniques for collecting, storing, and examining small molluscan specimens.

VERTEBRATE GROUP

Anton van Helden (collection Manager - Marine Mammals), has continued investigating new records of cetaceans from the New Zealand region. The exhibition Whales/Tohora opened on Dec 1 2007 with 56,000 visitors in its first 1.5months. New discoveries continue to be made with fresh stranding of beaked whales, a rare spectacled porpoise and pygmy right whales. Studies of the anatomy of the head of Gray's beaked whale and other less commonly stranding beaked whales is ongoing. Recent access to MRI and CT facilities will aid future understanding of these poorly known species. Records of all cetacean strandings in New Zealand have been recorded and updated on to the New Zealand Whale Stranding Database (owned by the Department of Conservation), which is reported on to the International Whaling Commission. Specimens of rare and unusual specimens have continued to be collected by Te Papa.

The fish team, **Clive Roberts**, **Andrew Stewart** and **Carl Struthers**, continued FRST-funded systematic investigations on EEZ fishes. New coastal and deep-water fish species have been discovered within the NZ EEZ, through fieldwork and donation from networks and the subsequent research by taxonomic specialists. **Clinton Duffy** (DOC Auckland) visited the collection to work on spiny dogfishes and published with **Peter Last** (CSIRO Hobart) descriptions of several new and rare species (CSIRO Marine

and Atmospheric Research Paper 014, 130 pp) and recorded the occurrence of the Eastern dogfish in NZ waters for the first time (NZ Journal of Marine & Freshwater Research 41: 163-173). **Eric Anderson** (SAIAB, Grahamstown, South Africa) described a new species of brotula from the Kermadec Islands (Species Diversity 12: 1-8) collected by Andrew on scuba in 2004. In February, Clive presented an illustrated talk on NZ deep-sea fishes as guest speaker at an international symposium in Okinawa, Japan. Afterwards, Clive visited the National Science Museum, Tokyo, to examine and identify NZ fish specimens in the NSMT collection. Redevelopment and rehousing of the wet collections continued all year, including inventory, packing and moving fishes in jars, drums and tanks. As a consequence, direct access and new loans have been limited. Nevertheless, a basic level of operation has been maintained.

PROJECTS & COMPLIANCE (NE MANAGEMENT)

CHRIS PAULIN continued his research project to investigate the form and function of traditional Mäori fishing hooks made of wood, stone, bone and shell.

BOTANY

Jenn Dalen (Collection Manager - marine algae) continues incorporating collections generated from various marine algae biodiversity projects carried out by NIWA (Wellington) researchers - **Wendy Nelson**, **Tracy Farr**, **Kate Neill** and collaborators. Studies on the Rhodymeniales also continue, with a focus on documenting new records for the New Zealand region.

New Zealand Rock Lobster Fisheries

The NZ Rock Lobster Industry Council Ltd is the principal contractor to the Ministry of Fisheries (MFish) for the provision of rock lobster fisheries stock monitoring and stock assessment research services. The company shareholders comprise the regional commercial stakeholder organisations (CSOs) for each of the nine rock lobster fishery management areas operating within the New Zealand Quota Management System (QMS). In addition to the principal contract, the NZ RLIC Ltd coordinates and facilitates the delivery of a range of industry-generated and industry-funded research services in support of CSO initiatives.

The NZ RLIC Ltd has an extensive array of contractual relationships with skilled service providers in New Zealand and overseas which enable delivery of the research services provided under contract to MFish. These include NIWA, Trophia Resources, StarrFish, Haist Consultancy, Lat37 Ltd, and seven other sub-contractors doing field work.

The main objectives of the principal contract are determined annually by a research planning process overseen by MFish. The core objectives are consistent with a medium term research plan for lobster fisheries developed by the National Rock Lobster Management Group (NRLMG), a multi-sector cooperative user group providing rock lobster fisheries advice to the Minister of Fisheries.

In addition to the services contracted from the NZ RLIC Ltd, MFish also contracts a separate lobster settlement monitoring project from NIWA which represents the longest time series of biological data for any New Zealand fisheries.

The current stock monitoring work programme for the NZ RLIC Ltd and contracted providers comprises

- observer catch sampling in four management areas and vessel Logbook programmes in three management areas to collect length frequency and other biological data; and
- a tag release and recapture programme to measure the growth of lobsters for use in a length-based population model.

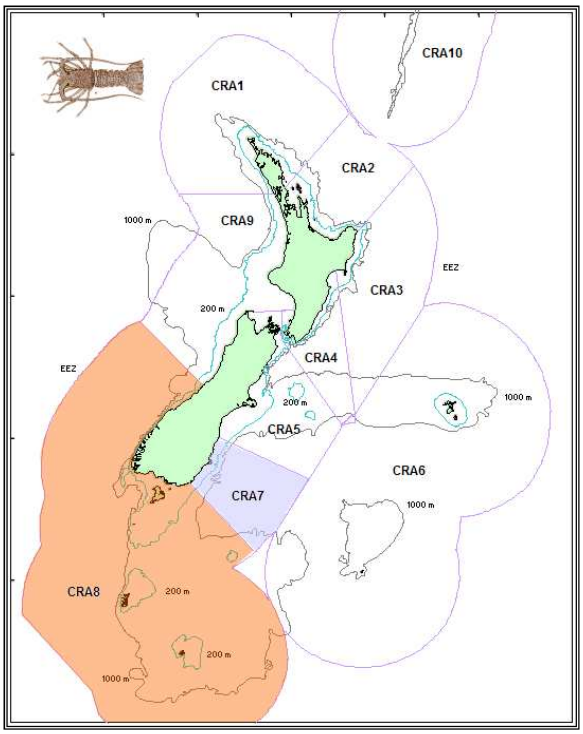
Observers completed 116 samples days in 2007/08 and measured 55, 700 lobsters, recording details of size, sex, maturity, location, depth and condition. The vessel Logbook programme has over 70 participant commercial fishermen delivering similar information from 3,900 fishing events, 14,000 potlifts, and 67,000 lobsters. 3000 lobsters were tagged and released in 2007 and recaptures reported from all management areas covered by the tagging programme.

The NZ RLIC and Trophia Research have implemented a web-based tag and release "track and trace" system that enables more timely reporting of tag recapture data by commercial and non-commercial extractive users. The system can be accessed at www.tagtracker.trophia.co.nz
The stock assessment science team is principally engaged in

- updating the standardised CPUE analysis from all management areas and report on the operation of current decision rules;
- estimating biomass and sustainable yields for nominated rock lobster stocks; and
- evaluating new management procedures for rock lobster fisheries.

The assessment team members are also science advisors to the NRLMG.

Two new management procedures developed in 2007/08 informed the TAC/TACC decisions for the Otago and Southland rock lobster fisheries implemented in April 2008. Two other management procedures incorporating harvest control rules to adjust commercial catch limits were reviewed and updated. One of those informed a CSO decision to voluntarily reduce catches for the 2008/09 season.



In addition to the research services delivered to MFish under contract, the NZ RLIC Ltd has oversight of a number of elective research programmes initiated by CSOs. In 2007/08 these included supplementary puerulus collection and fine scale spatial mapping of fishing grounds in two management areas. The NZ RLIC Ltd has a business relationship with the NZ Seafood Industry Council (SeaFIC) in support of GIS programmes for the lobster industry.

The NZ RLIC Ltd has invested in updating and improving the TagTracker web site and has commissioned a preliminary analysis of vessel Logbook data collected but not used in assessments. Pot type and discard data could inform future

industry harvest initiatives.

The NZ RLIC Ltd continues to invest in the development of electronic data collection technology. The ERNIE electronic data system developed by the NZ RLIC Ltd in partnership with Lat 37 Ltd and R White Woods is now routinely used for most observer catch sampling and all tag and release work. On behalf of a number of constituent CSOs the NZ RLIC is exploring options for the deployment of electronic logbooks that will enable the recording of fine scale catch and effort data in real time.

National Institute of Water & Atmospheric Research Ltd

Christchurch

MARINE HYDRODYNAMICS GROUP

Roy Walters continued to develop his numerical model for the study of tsunami inundation, storm surge and general coastal circulation. Roy retired this year, but model development will continue under his guidance in collaboration with **Emily Lane** and (recently arrived) **Phil Gillibrand**. Emily led two major modelling studies of tsunami inundation potential on the Otago and Auckland coasts, with assistance from **Jade Arnold**, **Matt Enright**, **Michelle Wild** and **James Goff**. James has continued his work in tsunami research and education. **Dave Plew**, with assistance from **Matt Enright** and **Jen Dumas**, has modelled tidal currents at selected locations around New Zealand to assess potential for tidal power generation. Dave, Matt and Jen have also conducted laboratory studies of flow through suspended canopies to help quantify effects of aquaculture development (e.g., long-line mussel farming) on flow and circulation.

MARINE SYSTEMS AND AQUACULTURE GROUP

Christchurch staff involved in the 12-year Coasts and Oceans Objective Based Investment (OBI) programme and the four-year Sustainable Aquaculture Project have made significant progress on outcome delivery.

In the OBI, progress continues in a time series of sampling in Hauraki Gulf with a focus on the Firth of Thames biophysical mooring and associated hydrographic sampling by **John Zeldis**. A highlight has been the acquisition of continuous water column fluorometric (chlorophyll-a) and associated biophysical data over minute-to-annual time-scales for a number of years, which will be analysed in conjunction with Sustainable Aquaculture and client-based time series from the adjacent Wilson Bay marine farm. An allied project, led by **Mark Gall**, aims to provide a bio-optical classification system for remotely-sensed data nationwide, using river and marine sampling of optical parameters from the National River Water Quality Network (NRWQN) survey and industry-funded marine farm monitoring in Firth of Thames and Pelorus Sound. In association with staff at Greta Point (**Matt Pinkerton**, **Sean Kennan**), John Zeldis has been developing climatology's of remotely sensed ocean colour data dating to the start of the SeaWiFs mission analysed for the NZ EEZ, with a subset focused on the Hauraki region.

A focus on land-ocean interactions in coastal zones by **John Zeldis** has led to important findings on the relative contributions of catchment and oceanic nutrient fluxes to Firth of Thames and the Nelson bays.

These have informed stakeholders with perspectives on the significance of these drivers of coastal productivity, and allows them to estimate sustainability of shellfish and finfish aquaculture, and catchment nutrient loading to these key NZ embayments.

Progress has been made in modelling currents and waves in the Cook Strait region by the Marine Hydrodynamics Group, to provide a test-bed for incorporation of coastal ocean modelling into the NIWA EcoConnect facility. This is now augmented with data from the Golden Bay Met Buoy, which is delivering ocean state data for the mouth of the bay by telemetry to the Tasman District Council website.

The Sustainable Aquaculture Project (**Barb Hayden**) has made significant progress. Mussel feeding experiments continued to further understanding of phytoplankton selection. A detailed spatial analysis of Pelorus Sound data was used to formulate an in situ mussel growth and condition experiment for the coming year. A re-vamp of the online (free), Marlborough Sounds environmental monitoring service has been completed, significantly improving temporal and spatial visualisation of CTD casts and water data collected by the Marlborough Sounds Quality Programme (see www.niwa.cri.nz/services/free/sounds for more information). Barb Hayden and **Chris Woods** are studying the successional development of fouling communities during normal mussel cropping cycles on two commercial farms in Pelorus Sound. The resulting data will be used in ecosystem pathway modelling to determine the ecosystem impacts of fouling organisms associated with mussel farming to possibly improve crop yields and farming sustainability.

Within Sustainable Aquaculture Project, **John Zeldis**, **Dave Schiel** and **Clive Howard-Williams** showed that climate has a pivotal role in condition of mussels farmed in Pelorus Sound, because it affects nutrient supply to this estuary, affecting primary producer biomass underlying mussel growth. Hypotheses generated by the work led to a recently completed, year-long project (led by **Mark Gall**, **Barbara Hayden** and **John Zeldis**) examining the environmental correlates of mussel growth and condition along the river-ocean axis of Pelorus Sound.

A project studying the restoration of the Avon-Heathcote Estuary / Ihutai after diversion of the Christchurch City wastewater stream to the ocean outfall in Pegasus Bay in late 2008 continued with intensive pre-diversion sampling of the estuary and its rivers. The work is bolstered by numerous student projects across four universities, ranging from undergraduate to PhD level, and the involvement of a number of NIWA staff all working closely with the Ihutai Trust, Christchurch City Council and Environment Canterbury. The NIWA team is led by **John Zeldis**, **Graham Fenwick** and **Chrissie Williams** and **Alex Drysdale** of Ihutai Trust.

The Marine Ecosystems Group (**Jeanie Stenton-Dozey**, **John Zeldis**, **Mark Gall** and **Graham Fenwick**) continued to do a wide range of commercial projects in the coastal zone, including research to support resource consent applications for marine farms, and surveys of the marine environment for port companies and regional councils.

The development of complementary aquaculture in New Zealand (**Jeanie Stenton-Dozey**, **Jeffrey Ren**) has made significant progress. This international, FRST-funded project aims to develop co-culture on New Zealand mussel farms to advance economic diversity and growth in the aquaculture industry based on balanced trophic interconnections between the farmed species. This collaboration with researchers in Yellow Sea Fisheries Research Institute and Shandong Mariculture Institute of China has developed and implemented methods for the cost-effective, sea-based culturing of multiple species that are ecologically complementary.

One important milestone for this project is the development of a numerical co-culture model to help plan and manage multi-trophic co-cultures. **Jeffrey Ren** has continued improving this co-culture model for application to aquaculture embayments under a wide range of environmental conditions. For calibration and validation of the co-culture model, field studies measured seasonal variability of biophysical parameters, together with mussel and seaweed growth around a mussel and salmon farm. This included mapping nutrient and biodeposition footprints, and phytoplankton dynamics. The feasibility of sea cucumber ranching was assessed, including novel tagging programmes for assessing the associations of transplanted cucumbers with the benthos beneath mussel farms in Pelorus Sound. Because the sea cucumber serves as a bio-mediator, its supply from hatcheries is essential for the development of multi-trophic co-culture farming. Knowledge transferred through Professor Zhaoxing Qiu's (Shandong Mariculture Institute of China) visit to NIWA has made sea cucumber aquaculture a practical reality by producing sea cucumber juveniles. In a New Zealand first, NIWA successfully cutlured sea cucumber larvae through to settlement. This break-through knowledge has enable NIWA to produce and supply sea cucumber juveniles for aquaculture in New Zealand.

The Sustainable Aquaculture Project (**Barb Hayden**) has made significant progress. Because predicting shellfish growth is one of the milestones, **Jeffrey Ren** has developed an ecosystem model for estimating the effects of shellfish cultivation on food web dynamics and nutrient cycling, as well as potential culture production in sheltered coastal waters. The model now provides a predictive tool for managing shellfish aquaculture within a coastal embayment that estimates relationships between the stock level and the growth rate of shellfish, and the potentially achievable harvest and stocking density in relation to environmental variability.

Seabird research at NIWA has centred around an examination of the possible effects of fishing activities on population trends in several key species. **Paul Sagar** and **David Thompson** continued their examination of the demography and foraging of white-capped albatrosses from the Auckland Islands. This 4-year study, funded through the Conservation Services Levy by DoC, aims to determine survival rates and breeding performances, as well as the spatio-temporal overlap between foraging birds and fisheries activities. The latter uses geo-locator loggers, satellite telemetry and GPS loggers to examine the movements of birds over various scales and time. In addition, a separate 5-year project to determine the population size and trend and foraging areas of white-chinned petrels and grey petrels breeding at the Antipodes Islands is now in its second year.

Paul and David are also continuing the long-term study of Buller's albatrosses at The Snares islands. This project began in 1992 and annual visits to study colonies since then have provided detailed information about survival and recruitment rates, breeding success and frequency, and foraging areas. Population data from this study are being used by **Chris Francis** to develop a population model that can incorporate the direct effects of fishing mortality on population viability of seabirds compared to other sources of mortality or trophic effects of fishing.

Martin Unwin (in association with **Nick Davies**) has analysed recent data for swordfish caught in the New Zealand longline fishery as part of a Ministry of Fisheries contract. This work builds on two previous MFish studies in 2005 and 2006, updating these earlier analyses with complete data for the 2005-2007 fishing seasons. The final phase of this project (to be completed in March) will use the new data to derive standardised catch-per-unit-effort (CPUE) indices for swordfish, which New Zealand is obliged to provide to international agencies, such as the Western and Central Pacific Fisheries Commission.

Martin Unwin, **Chris Woods**, **Sheryl Miller** and **Helen Hurren**, in collaboration with the Marine Ecology Research Group at the University of Canterbury, completed a study of recreational shellfish

harvesting around Banks Peninsula for the Ministry of Fisheries, in response to concerns that stocks are becoming depleted as harvesting pressure increases. The study involved workshops with Banks Peninsula iwi to identify areas traditionally used for gathering kai moana, document the main species involved, and highlight stocks considered most at risk. The University contributed to the study by compiling an exhaustive dossier of shellfish research around the peninsula based on archival data from as early as 1929. For species such as cockles in Christchurch's Avon-Heathcote Estuary, this information was sufficient to identify temporal trends in size and abundance, but such data are limited or non-existent for most species. The study concluded by recommending methods for a recreational survey to quantify shellfish harvest at sites of concern, ideally with input from pertinent stakeholders and tangata whenua.

Chris Woods completed his PhD on aquaculture of the big-bellied seahorse Hippocampus abdominalis, centred on the collation of his research examining alternatives to the exploitation of wild seahorses. This research was carried out as a part of the National Institute of Water & Atmospheric Research's (NIWA) development of new species aquaculture programme, and largely funded by the Foundation for Research, Science and Technology.

MARINE BIOSECURITY AND BIODIVERSITY GROUP

The new, FRST-funded Marine Biodiversity and Biosecurity OBI is a joint programme involving NIWA, Te Papa and Cawthron Institute, and is lead by **Wendy Nelson** (Wellington) and **Graeme Inglis** (Christchurch). It is continuing to address biodiversity and biosecurity issues for a wide range of ecosystems covering five general themes:

- measuring and maintaining biodiversity,
- marine taxonomy and care of the NIWA invertebrate collection,
- tools for marine pest risk assessments,
- surveillance and monitoring for marine pests, and
- management and mitigation of marine pests.

NIWA's Marine Biosecurity Group (**Graeme Inglis**, **Barb Hayden**, **Nick Gust** (recently departed), **Oli Floerl**, **Chris Woods**, **Olivia Johnston**, **Lisa Peacock**, **Marie Kospartov**, **Kimberley Seaward** and **Don Morrisey**) continued work on a wide range of projects. Port baseline surveys of native and non-native marine organisms were completed for Biosecurity NZ at Port Underwood and Kaikoura in 2007. To date, 172 non-indigenous and cryptogenic species have been recorded from the port surveys, including 22 species that are new records for New Zealand's coastal waters. Many new, undescribed species have also been documented.

Draft Rapid Response Manuals have been developed for the Australian Department of Agriculture, Forestry and Fisheries (DAFF) on five marine pests that are currently listed on the emergency response trigger list of the Australian Intergovernmental Consultative Committee on Introduced Marine Pest Emergencies. The manuals provide detailed information and guidance for emergency responses to incursions of these pests: the Northern Pacific seastar (Asterias amurensis), Wakame or Asian seaweed (Undaria pinnatifida), European shore crab (Carcinus maenas), the Asian green mussel (Perna viridis) and the black striped mussel (Mytilopsis sallei). A generic response procedures manual is also in development [**Graeme Inglis**, **Kimberley Seaward**].

A review of arrangements for managing biosecurity risks associated with the Australian trade in marine aquarium species was also completed for DAFF. The project used a combination of data and literature reviews, interviews with commonwealth, state and territory government agencies and surveys of industry representatives to characterise the marine aquarium trade in Australia, and identify

the governance arrangements used by these agencies to regulate the movement of marine species and assess their pest potential [**Donald Morrisey**, **Anna Bradley**, **Isla Fitridge** (departed beginning 2007), **Graeme Inglis**]

Two further research projects commissioned by Biosecurity NZ aimed to assess the relative risk of hull fouling on all major vessel types to NZ's marine biosecurity. Between 2004 and 2007, NIWA sampled fouling assemblages on 168 international yachts in a range of NZ ports and marinas. Assemblages on merchant, fishing and cruise vessels were sampled by other providers. The draft final project report for international yacht fouling assemblages has been finalised and submitted to MAF-BNZ for review. The report examines the risk of hull fouling on international yachts as an introduction vector of non-indigenous marine species to New Zealand [**Oli Floerl**, **Matt Smith**, **Graeme Inglis**, **Nikki Davey**. **Kimberley Seaward**, **Olivia Johnston**, **Isla Fitridge**, **Nicola Rush** and **Crispin Middleton**]

The second MAF Biosecurity New Zealand (MAF BNZ) project aimed to assess the relative risks of biofouling on different classes of international vessel. Standardized data on the distribution, identity and abundance of fouling organisms (native and non-native) were assembled from separate MAF BNZ projects that sampled merchant vessels, private yachts, and cruise liners that entered New Zealand between 2005 and 2007. Companion data collected on the maintenance and travel history of each of the more than 400 vessels are being modelled to identify useful predictors of the presence and abundance of non-native species on the vessels. [**Graeme Inglis**, **Martin Unwin**, **Oli Floerl**].

Aroha Miller completed her PhD on parasites of the introduced portunid crab, Charybdis japonica, and the nesting mussel, Musculista senhousia.

Chris Woods, **Oliver Floerl**, **Isla Fitridge**, **Olivia Johnston** and **Karen Robinson** concluded reporting on a project examining the seasonal efficacy of various vessel hull-cleaning methods and facilities on the viability of fouling organisms and their associated potential biosecurity risks for Biosecurity New Zealand.

National Institute of Water & Atmospheric Research Ltd

Greta Point

www.niwa.co.nz

BENTHIC FISHERIES AND ECOLOGY

This Wellington based group focuses on the stock assessment and ecology of commercial benthic species such as paua, kina, dredge oysters and surfclams as well as undertaking ecological research on a wide variety of benthic and pelagic habitats and species including reef fishes, shallow, deepwater and Antarctic benthic species, seamount and vent fauna, mesozooplankton and sea birds. This research is supported through a combination of funding from the Ministry of Fisheries, FRST, Department of Conservation, the fishing industry and international funding sources.

Jenny Beaumont is a benthic ecologist and at present principally works on projects mapping habitat and species distributions around New Zealand with Megan Oliver and Alison MacDiarmid. She has worked extensively on benthic species around the Antarctic peninsular.

David Bowden is a benthic ecologist working on species distributions in a range of habitats including methane seeps, the Chatham Rise and Challenger Plateau, and the Ross Sea. He has played an important role over the last year in developing NIWA's capacity to acquire, manage and analyse seabed images of continental shelf and deep sea habitats.

Vonda Cummings works on benthic community ecology and shellfish population ecology especially with her colleagues from NIWA's Hamilton campus. Work in the past year has included investigating settlement cues and dispersal of post-settlement macrofauna in response to disturbance, determining suitable methodology for community-based shellfish reseeding projects, and developing NIWA's Ross Sea (Antarctica) shallow water coastal research.

Jeff Forman continues to follow rates of puerulus settlement along the major rock lobster fishing coasts of New Zealand. He also plays an important role in assessing the rates of Bonamia infection in the Foveaux Strait oyster stocks.

Jane Halliday recently transferred to Greta Point from NIWA Hamilton where she worked for the Benthic Marine Ecology Group for the past four years. Jane will be continuing her work on Hamilton based projects. Predominately this work is to quantify human induced changes on estuarine systems, using benthic soft-sediment macrofauna as indicators of ecosystem health.

Kerstin Kröger works on the impact of disturbances on the benthic fauna. Kerstin is specifically interested in the effects of iceberg scouring on benthic assemblages, and in particular on polychaete assemblages from the Ross Sea. The effects of environmental factors on the distribution of Antarctic polychaetes is also one of her fields of interest. She is involved in the field collection and analysis of fauna from seamounts, seeps and vents along with Ashley Rowden, and Rob Stewart.

Alison MacDiarmid has been working on a new research initiatives examining historical changes in NZ's marine ecosystem over the last 1000 years as well as projects on mapping New Zealand's marine environmental values and another developing a risk assessment model examining anthropogenic impacts on New Zealand's coastal ecosystem. Her rock lobster research now takes place within the context of a broader project examining the functional ecology of north-east New Zealand rocky reefs.

Keith Michael continues his research on the biogenic reefs in Foveaux Strait and interactions with the dredge-oyster fishery. Keith is also heavily involved with stock assessment surveys of the dredge oyster fishery.

Reyn Naylor with support from Pete Notman and Steve Mercer has responsibility for stock assessment surveys of paua and kina populations around New Zealand. Reyn has also been involved in planning surveys and analysis of deepsea crab populations. Steve Mercer continues his role as NIWA's chief diving officer and plays a critical role in training NIWA and other NZ scientists for ice diving and overseeing Antarctic diving operations.

Megan Oliver has recently completed her PhD on the feasibility of rock lobster population enhancement. More recently her research focus has moved to seamounts, in particular assessing the risk of damage to seamounts from bottom trawling and familiarising herself with the Stylasteridae family of hydrocorals commonly found on seamounts.

Catherine Stevens recently started a two year post-doctoral fellowship working on mesozooplankton from New Zealand and Antarctic waters. Her appointment represents a first step toward re-establishing active mesozooplankton ecological research and expertise at NIWA after the retirement of Janet Grieve. Mesozooplankton parataxonomy forms a large part of her work. Identification of mesozooplankton species and determination of abundance and biomass in the Ross Sea and on the Chatham Rise will provide valuable biodiversity data and feed into predictive, trophic models.

Rob Stewart works on a wide variety of projects including organising and taking part in biological sampling aspects of ocean voyages and the analysis of benthic images from deepwater cameras primarily used on seamounts. Other tasks include phytoplankton enumeration and management of the Greta Point aquarium facility.

David Thompson is primarily involved in research on the foraging and population biology of seabirds, and the use of stable isotope techniques in ecology. He has recently been joined by Leigh Torres, a post doctoral fellow who is working on integrating the foraging patterns of tagged seabirds with oceanographic and fisheries data.

Lianos Triantafillos leads NIWA's research on surfclam fisheries assessment, biology and ecology. This is being undertaken with the close collaboration of the fledgling surfclam fishery. Lianos has a background in squid fisheries biology and assessment in Australia and the Falkland Islands and it is hoped his expertise can be applied to the NZ squid fishery.

Ashely Rowden undertakes research on benthic assemblages on seamounts, vents and seeps and other habitats. He is a co-lead PI on the CenSeam project which is part of the international Census of Marine Life programme.

DEEPWATER FISHERIES GROUP

Staff in the deepwater group are involved in a wide variety of research across NIWA, but their focus is primarily research on deepwater commercial fishes and fisheries, specifically for orange roughy, oreos and black cardinalfish. Work on these species involves assessing stock size using acoustic and trawl techniques, analysing commercial catch and effort data and researching their biology. There is an increasing emphasis on examining broader ecological and environmental aspects of the fish, their fisheries, and the by-catch species, and also including the general ecology of seamounts.

Matthew Dunn is the Group Manager. The focus of his work continues to be orange roughy stock assessments for MFish with Owen Anderson, Andy McKenzie, and Sophie Mormede, including analyses of commercial fisheries catch per unit effort data, descriptive analyses of the fisheries, and stock assessment modelling. This stock assessment modelling was focused on the orange roughy stock on the east coast of the North Island. In July, Matt completed a deepwater trawl survey for orange roughy on the east Chatham Rise. Matt is also leading research into the feeding interrelationships of middle depth fish species on the Chatham Rise (with M.Sc. student Amelia Connell, and NIWA staff Brent Wood, Rob Stewart and Darren Stevens), and the effects of climate on marine fish stocks (with Rosie Hurst, Jim Renwick, Chris Francis and Jennifer Devine).

Malcolm Clark has continued work on aspects of stock assessment of orange roughy around New Zealand, with a particular focus on fisheries outside the EEZ. Malcolm also heads a FRST-funded programme on the ecology and effects of fishing on seamounts in the New Zealand region. NIWA staff involved in this include Ashley Rowden, Ian Wright, Michelle Kelly, Dennis Gordon, Rob Stewart, Neil

Bagley, Brent Wood, Kevin MacKay, Richard O'Driscoll, Anne-Nina Loerz, Peter Smith, Kerstin Kroeger, Mireille Consalvey, and Di Tracey. This programme is compiling information on the physical and biological characteristics of seamounts, and the effects of fishing on seamount habitat and fauna. In 2007 this included related work on assessing the potential environmental impact of deep-sea mining in the New Zealand region (with Mireille Consalvey, Rob Stewart and Ashley Rowden). Malcolm is also a principle investigator of CenSeam (a global census of marine life on seamounts), along with Ashley Rowden and Karen Stocks (San Diego SuperComputer Center), with Mireille Consalvey as project coordinator. CenSeam has been actively supporting the preparation of a book on seamount ecology, fisheries, and conservation which was published in 2007. Malcolm is one of the editors of this. Malcolm has maintained an active presence at international meetings related to seamounts, deepwater fisheries research and management, and over the last year has presented papers at several overseas conferences and workshops.

Di Tracey has continued to work on biological aspects of ageing and age validation of orange roughy, black cardinalfish, black oreo, smooth oreo, and lookdown dory for stock assessment. This includes the use of radiocarbon and radioisotope methods for age validation. Coral research has intensified for Di, and along with Helen Neil she is on the local and international organising committee for the 4th International Symposium on Deep-Sea Corals which will be hosted by NIWA, and held in Wellington in December 2008. Other local committee members for this symposium include Malcolm Clark, Ashley Rowden, Mireille Consalvey, and Dennis Gordon. Research continues on bamboo corals, on the distribution of habitat-forming scleractinian or stony corals in the New Zealand region with Ashley and Kevin Mackay, and on protected and proposed to be protected corals with Kevin, Mireille and Dennis. Seamount ecology work for Di also includes work with Malcolm and Ashley on fish compositions. Di represented NIWA during a voyage on the German research vessel Sonne, and completed a hoki survey on Tangaroa. Di continues to have some involvement with mercury in fish, recently working on a report on mercury levels in Antarctic species. Di continues to lead research on the by-catch of invertebrate species in trawl fisheries, including updating the guide to common deepsea invertebrates in New Zealand, projects to identify and catalogue archive benthic invertebrate samples, and a literature review of protected deep-sea coral species.

Owen Anderson has focused on deep water fisheries projects, largely with Matt Dunn and Andy McKenzie. His work included projects to estimate non-target catches in commercial fisheries, and to describe the fisheries, biology, and standardised CPUE analyses for orange roughy. Owen also analysed fisheries conversion factor data, reviewing and updating the official factors used to convert landed weights of processed fish to greenweights, including a new analysis for paua in 2007. He leads NIWA work to produce marine species distribution maps for the Ministry of Fisheries NABIS website. Owen has been involved as a diver in various shellfish projects, especially surveys of paua and kina stocks, and for invasive species. Owen has continued to develop an expertise in echinoderm taxonomy, and worked in the invertebrate collection identifying echinoid specimens collected on MFish funded voyages. He has produced identification sheets for echinoderms for the Benthic Invertebrate Guide (with Di Tracey), and he now effectively manages the NIWA echinoderm collection. In 2007 he also completed his first primary paper describing a new echinoderm species. Owen also completed a voyage on Tangaroa, with a role as a specimen photographer.

Peter McMillan, along with Alan Hart, Ian Doonan and Ralph Coburn continued with stock assessments of smooth oreo and black oreo. Work has focused on the large fisheries for smooth oreo on the Chatham Rise, and included a two-vessel (RV Tangaroa and FV San Waitaki) trawl and acoustic survey of the south Chatham Rise, which Peter lead from the San Waitaki. Peter also completed a research trawl survey for orange roughy on the east Chatham Rise in July, onboard Tangaroa. Alan and Peter worked on an ageing project for smooth oreos from the south Chatham Rise, and Peter also

completed ageing of black cardinalfish otoliths. Peter worked on variety of other Ministry of Fisheries projects, including running the acoustic survey of Cook Strait and Pegasus Canyon hoki using Kaharoa, and he is leading a project to produce an identification guide for fishes caught in the Ross Sea long-line fishery, and a second guide for New Zealand waters, for which he has been busy collating and collecting the necessary photographic material.

Paul Grimes is carrying out histological gonad studies on hoki and Antarctic toothfish. Samples from the December subantarctic surveys are being used to estimate the spawning percentage of hoki using a range of indicators of previous spawning. For Antarctic Toothfish similar techniques are being used in an attempt to estimate age at first maturity. Paul is also looking at using a combination of macroscopic and microscopic techniques to estimate size at maturity of four rattail species.

Alan Hart has continued to focus on deepwater acoustics. Alan analysed the acoustic data collected during the oreo and orange roughy surveys on the Chatham Rise, and which is used to estimate biomass. Alan was also the principle otolith reader in a project to age smooth oreo, and completed an analysis of oreo biological data. Alan spent over 2 months at sea, completing an oreo trawl and acoustic survey, a hoki trawl survey, and a 4-week duration Oceans 20/20 survey to study biodiversity on the Chatham Rise.

Brent Wood continues to provide database and Geographic Information System (GIS) expertise to support deepwater fisheries, biodiversity, and other NIWA projects. He has a primary interest is the use of Open Source (free) software GIS and database tools, and within NIWA takes a lead role in specifying and building computer systems and analysis methods. Recent projects include an designing and implementing the new NIWA fisheries modelling computing cluster (with Alistair Dunn), devising and implementing a new approach to analysing and plotting commercial benthic fisheries data (with Suze Baird), and developing new tools for data driven mapping of data (allowing, in one example, what would have taken 2 weeks of staff time to be done in less than one hour). Brent also spent a lot of time at sea, on surveys of the SubAntarctic, Chatham Rise, Challenger Plateau, and in Oman.

Peter "Chazz" Marriot came from the Stock Monitoring Group to join the Deepwater Group in 2007. Peter does a wide variety of work, and in 2007 designed and constructed a photographic system for specimen photography, and he has continued to lead the fish imagery component of the new finfish identification guide (with Peter McMillan). Chazz also maintained and trained staff in the use of the micromill, which is used to obtain tiny and accurate samples from within corals or otoliths. He completed a survey in Antarctica, including photographic and video dive surveys under the ice, and analysed video samples after the trip. He also worked on the taxonomy of icefish, and completed two research voyages on Tangaroa, and a fisheries survey in Oman.

Mireille Consalvey is the co-ordinator of the international Census of Marine Life project CenSeam (a global census of marine life on seamounts) to which NIWA plays host to the secretariat (also comprising Malcolm Clark and Ashley Rowden (NIWA) and Karen Stocks from the San Diego Supercomputer Center, USA). CenSeam Phase II started in June 2007. Mireille is also involved in the MFISH/FRST Seamounts Programme (participating in several voyages), an MFISH project examining by-catch from previous NIWA fishing voyages (with Di Tracey, Neil Bagley and NIWA taxonomists from Wellington and Nelson) and has also been involved in assessing the potential environmental impact of deep-sea mining in the New Zealand region (with Malcolm Clark, Rob Stewart and Ashley Rowden). Mireille is also involved in the "Research plan for diagnosing Avon-Heathcote Estuary Remediation" with John Zeldis, Graham Fenwick, Kay Vopel, Hilke Giles, Islay Marsden (University of Canterbury), Graham Inglis and Dannielle Walrond (University of Birmingham, UK).

INSHORE AND PELAGIC GROUP

Suze Baird continued work with Brent Wood on the characterisation of the temporal and spatial extent of commercial mobile bottom fishing methods— within the EEZ. With Murray Smith, Suze also completed several projects on the estimation and prediction of total numbers of marine mammals and seabirds caught in New Zealand waters during commercial fishing activities. Suze and David Gilbert prepared material for a workshop involving government, non-government, NIWA, and industry participants, including the development of a mortality index, as part of an assessment of risk to selected seabirds from fishing operations.

Lynda Griggs continued the port sampling of albacore tuna caught in the troll fishery, aided by NIWA sampling teams in Greymouth and Auckland. She also continued her involvement with a catch sampling programme of swordfish and other highly migratory species and summarised recent swordfish biological data (with Nick Davies). Lynda continues to work with longline fishery observers and observer data, and to provide sea surface temperature tuna forecasts to fishers. A new thing for Lynda this year was getting involved in the large project on trophic relationships on the Chatham Rise (with Matt Dunn).

In 2007, a NIWA team carried out a beach seine survey of small fishes in southern North Island estuaries, thus completing our nationwide survey programme. **Malcolm Francis** is now beginning an analysis of the geographic patterns of species distribution, richness and other diversity indices. This will involve fitting GAM models incorporating a suite of environmental predictors. It is hoped that this will allow us to make predictions for unsurveyed estuaries throughout the country. Malcolm and **Michael Manning** continued their collaboration with **Clinton Duffy** (Department of Conservation) and several USA researchers investigating the migrations and diving behaviour of great white sharks. They carried out a tagging expedition to Stewart Island and successfully deployed popup satellite tags on two sharks. One of the sharks was also fitted with dorsal fin tag that provides real-time GPS fixes every time the shark surfaces. Unfortunately the dorsal fin tag failed after three weeks, during which time the shark swam backwards and forwards through Foveaux Strait. The popup tag from the same animal surfaced off Mana Island and the limited data retrieved suggested it had been to the tropics and back. The popup tag on the second shark surfaced off the Great Barrier Reef in Australia and transmitted lots of useful data. A short expedition to Fiordland attempted to deploy popup tags on porbeagle sharks for the first time, but bad weather restricted fishing to within the fiords and no porbeagles were caught. Malcolm and **Larry Paul** generated catch histories for the top 25 fish species caught in the Hauraki Gulf and Otago between 1931 and 2006 for a large programme led by **Alison MacDiarmid** that investigates the effect of humans on the marine ecosystems of these two regions. Malcolm also assisted with the development of a fish identification guide, producing identification sheets for a number of elasmobranch species.

Michael Manning continued with his work on commercially important coastal elasmobranchs and teleosts. He began updated quantitative stock assessments of giant stargazer and tarakihi and led work with Ron Blackwell, Peter Horn, Lawrence Kees, Paul Lambert, Caoimhghin Ó Maolagáin, Mike O'Driscoll, Michael Stevenson, Colin Sutton and others to support these assessments. He also carried out standardised catch-rate analyses of rig, school shark, and spiny dogfish, contributed to the analysis lead by Colin Sutton on the age and growth of mackerel icefish in the Ross Sea, and wrapped up his work on stock monitoring of blue mackerel and blue moki. Michael's work with Peter ("Chazz") Marriott and Allen Andrews (Moss Landing Marine Laboratories) on validating blue mackerel age estimates using radiometric methods was also completed. And his work on validating growth zones in giant stargazer otoliths is ongoing. Michael also found time this year to carry out some honest biology. With Malcolm Francis, Clinton Duffy (Department of Conservation), Ramon Bonfil (MarViva), and

Shannon O'Brien (University of Washington), Michael continued his work on the large-scale movement, behaviour, and ecology of white sharks (Carcharodon carcharias) in New Zealand waters using satellite tags. This year, with Barb Block (Stanford University) and her team from TOPP (Tagging of Pacific Predators, a Census of Marine Life programme), John Holdsworth (Bluewater Marine Research), and Tim Sippel (University of Auckland), this work was expanded to include porbeagle (Lamna nasus) shark. Michael also began work with Steve Campana (Bedford Institute of Oceanography) on the post-discard mortality of blue shark in the North West Atlantic using satellite tags. Michael also found a few minutes to provide scientific advice for a National Geographic documentary on the transoceanic journey of Nicole, a 3.8 m white shark, from South Africa to Australia and back.

Caoimhghin Ó Maolagáin continued his fish ageing work and contributed to age and growth studies of Antarctic skates (with Stu Hanchet), hoki (with Richard O'Driscoll) jack mackerels (with Paul Taylor), tarakihi (with Michael Manning), smooth oreo dory (with Peter McMillan) and trevally (with Jeremy McKenzie). He also got involved with snapper otoliths from middens for a project on long-term ecosystem dynamics (with Alison MacDiarmid) and the preparation of a range of non-commercial deep sea species otoliths (with Ian Doonan).

Warrick Lyon joined the inshore and pelagic group in January 2007 and has been mainly involved in supporting a multitude of fisheries survey work, including inshore trawl surveys on the east and west coast of the South Island, a hoki survey in the SubAntarctic and a fisheries resource survey in Oman. He has also taken over responsibility for managing the inshore survey gear and is involved in the project on underwater observations of survey gear performance (see below). Warrick has also been involved in upgrading the trawl survey database by loading some old trawl survey data and updating the fish communities database.

Steve Parker joined the inshore and pelagic group in June 2007 and has been studying the phenomenon of skipped spawning in hoki and potentially in Antarctic toothfish (with Paul Grimes). Identifying the proportion of mature individuals that spawn each year has technical challenges but may also influence stock assessment and estimates of stock productivity. He is also working with the Ministry of Fisheries to develop benthic assessment guidelines to enable managers to identify and protect vulnerable marine ecosystems (such as coral gardens or sponge fields occurring on seamounts in international waters). Managers are working to comply with UN resolutions to protect these fragile systems from significant fishery impacts by December 2008. Steve will also work with Rosie Hurst and Emma Jones on survey gear performance and bycatch reduction with bottom trawls using underwater video to understand fish behaviour during the capture process. Steve's recent work on other subjects includes the physiology of barotrauma and acoustic telemetry with Pacific rockfishes (Genus Sebastes).

MARINE & FRESHWATER BIOTECHNOLOGY

Peter Smith and **Margaret McVeagh** are working on the population genetics of fishes and invertebrates. The NIWA genetics group are collaborating with the Dirk Steinke from the University of Guelph in the Barcode of Life programme. More than 400 species of NZ and Antarctic fishes have been sequenced for the COI DNA barcode marker. Fish specimens used for DNA sequencing have been registered into the National Fish Collection at Te Papa. A new species of Antarctic skate has been identified based on DNA sequences. The COI markers are being used to identify fillets and suspect specimens in marine fisheries.

Vicky Webb, **Anna Kilimnik**, **Sally Anderson**, **Debbie Hulston**, and **Dianna Caird** are focused on developing tailored diets for New Zealand aquacultured species and implementing innovative fish disease management tools. **Els Maas** is focused on the role microbes play in ocean ecosystems. The group's capabilities include, bioassay running and development both cell based and enzyme based; the isolation, characterisation and fermentation of microbes including extremophiles and thaustachytrids; and profiling microbial populations. **Serena Cox** has used DNA sequencing for identification of thraustochytrid species, and used fatty acid, pigment, and enzyme analysis, and cryogenic techniques for chemotaxanomic profiling of these marine microbes.

Hoe Chang pursues studies on the taxonomy, pigment composition, toxicological properties, and cultures of a group of toxic microalgae. He has also been working on a set of data which characterise the 2002 toxic Karenia concordia outbreaks using satellite imagery on the north-eastern coast of New Zealand. Work continues on the identification of cysts and live phytoplankton for BNZ.

MARINE PHYSICS

Steve Chiswell studies ocean circulation around New Zealand using satellite data in combination with moored observations and ship-board hydrography. He is interested in characterising variability in the currents surrounding New Zealand, especially in comparing model and real worlds. He is also examining the generation and propagation of internal tides. He is also interested in larval dispersal at a variety of timescales from days to months.

Brett Grant is responsible for acquiring and analysing ocean surface current data using the Acoustic Current Doppler Profiler mounted on the hull of the RV Tangaroa. In addition to this he also maintains the Marine Physics intranet site as well as manipulating other products for the group such as satellite ocean data.

Mark Hadfield spends much of his time setting up and running marine hydrodynamic models. He has been working with Graham Rickard on a NZ-region model and has made some progress in understanding how and why different model formulations give different answers for the same situation. The regional model can now provide useful boundary data for smaller-scale models. Mark is working on smaller-scale models (for Chatham Rise, d Pelorus Sound, Golden Bay) where the main aim is to couple with biological models. Mark has also been involved in several projects where the aim was to synthesise existing data for the New Zealand marine environment. He has provided data sets for NIWA's marine classification project and has advised biological oceanographers on site conditions for several experiments.

Sean Kennan brings his tropical physical oceanographic research experience to mid-latitudes. He is presently analysing satellite data (in particular ocean colour) to help underpin our understanding of processes in NZ waters in an attempt to link the physical oceanographic conditions to the observed biological response. His research involves the collection and analysis of ship-based observations, and

then combining them with the satellite output to investigate ecosystem behaviour in oceanic eddies and fronts.

Joanne O'Callaghan has joined the group as a post-doctoral fellow, extending her estuarine skills to look at cross-shelf processes. Recent observational work has looked at the potential impacts of freshwater input to the physical conditions in Doubtful Sound, with an eye on future extensions to development of a source to sink model for the Sound in an attempt to integrate together the significant forcing mechanisms on this particular environment.

Stephane Popinet develops numerical (computer approaches) to solving flow fields. He has developed a package Gerris (gfs.sourceforge.net), an Open-Source fluid flow solver that can adapt in space and time to the evolving flow. This is being used for a variety of applications including: ship mechanics, ocean dynamics (both large and small scale), airflow around buildings, wind turbines, and so forth. Recent work includes investigation of wind flow over the Wellington region, and the addition of ocean biological tracers. He maintains strong links with French researchers.

Graham Rickard continues to be involved in the development of ocean models for climate, process studies, and ocean-biology interactions, and development of an operational baroclinic ocean model for NZ. The present models resolve some of the mesoscale features of the flow (around 10 km or so) that are not contained within climatologies, and provide fully three dimensional distributions of currents and tracers; the information produced can be used to try to understand how the mean fields interact with the bathymetry, and the influences of external changes in the forcing (variability) on those mean fields. On-going interaction with Australia's BLUElink programme will hopefully bring operational ocean modelling to the NZ domain in the near future. (www.bom.gov.au/bluelink)

Craig Stevens studies small scale processes with emphasis on "entity-scale" mechanics in boundary-layers. This includes such diverse topics as bio-physical coupling in ocean surface layer mixing, under-ice boundary-layers, intertidal biomechanics, marine energy and aquaculture. The work has a strong observational focus but links to modelling and laboratory work feature also. (www.biol.canterbury.ac.nz/merg/people/stevens.shtml). He has been PI or AI on four Marsden fund projects. He also seeks to promote the underpinning role of marine physics for understanding ocean, climate and other related processes both within and external to NIWA.

Craig Stewart has recently taken over role of coordinator of the oceanographic mooring programme, involving mooring design for a wide range of field operations. He is also responsible for the Baring Head Waverider operations. When not in the field, he is involved with collation and analysis of data from the observational programs.

Philip Sutton is researching the role of the ocean in the climate around New Zealand, in particular variability in the temperature and inflow of warm, subtropical water. He has studied the East Auckland Current region for a number of years, but is presently focussed west to address the Tasman Front, West Auckland Current and Tasman Sea interior. This work is being addressed through research voyages and the USA (Scripps Institution of Oceanography), Australia (CSIRO), New Zealand (NIWA) Tasman Box repeat XBT surveys. Philip also provides physical oceanographic expertise to the interdisciplinary ocean ecosystems programme with a past focus on the Subtropical Front over Chatham Rise but which is now looking "upstream" to the west coast dynamics. Philip is New Zealand's representative for Argo, the global profiling float initiative (http://www.argo.ucsd.edu), and is a member of the Argo Science team.

Matt Walkington is NIWA's Oceanic CTD Coordinator. He coordinates and takes the lead role in aspects of NIWA's research operations that focus directly on high-accuracy conductivity, temperature, depth (CTD) and allied oceanographic observations, as obtained with NIWA's Seabird 911plus CTDs (www.seabird.com) and associated instrumentation. He has strong links with the SeaBird organisation (the prime CTD instrument developer and de facto setter of oceanographic standards) and visited them most recently in May 2006. A continuing research interest is the development of a regional oceanic climatology (OCAANZ).

Mike Williams' research is split between the McMurdo Sound region of Antarctica and the New Zealand subantarctic. In McMurdo Sound he workswith colleagues from IRL, the University of Otago, and Victoria University of Wellington on the circulation and ice-water interaction in the sound and under the adjacent McMurdo Ice Shelf. In the subantarctic he is analyzing data from a comprehensive subantarctic field programme that involved seasonal hydrographic surveys in the subantarctic and long-term measurements of temperature and velocity using moored instrumentation. Recently he has developed a project involving connections between southern ocean "climate" and Titi (mutton bird) variability which has a strong Maori focus.

Sebastien Delaux is doing a PhD on the stickiness of seaweed eggs, and their ability (or otherwise) to find safe haven in the coastal turbulent waters. The work uses laboratory experiments to mimic the in-situ stirring, as well as novel extensions to a fluid dynamic code (Gerris) in order to follow individual eggs as they migrate through the water.

Natalie Robinson is doing a PhD on the seasonal variation in ocean density stratification during growth and decay of Antarctic sea ice. Modelling of the turbulent boundary layer underneath the sea ice is being undertaken, and will be validated against measurements made on field campaigns to the Antarctic.

MIDDLE DEPTH FISHERIES AND ACOUSTICS GROUP

Staff in this combined group are involved in a wide range of research projects across NIWA, with the focus primarily on research relevant to the stock assessment of middle depth species (hoki, hake, ling, southern blue whiting, toothfish, gemfish, and warehou), and the development and implementation of acoustic and camera technology to estimate abundance of orange roughy, hoki, southern blue whiting, oreos, scampi, and other species. Projects involve assessing stock abundance using acoustic, trawl survey, and camera techniques, analysing commercial catch and effort data, and researching fish biology. There is an increasing emphasis on broader ecological and environmental aspects of the fish and their fisheries.

A major initiative for this group in 2007 was its involvement in the planning and implementation of a major fisheries project for the Oman government. This work involves a series of five 6-week fisheries resource surveys in Oman waters from August 2007 to September 2008. The first two surveys were successfully completed in 2007.

Rosie Hurst is the Science Leader for Middle Depth Fisheries and Acoustics, in addition to her role as Regional Manager for the Wellington campus. Rosie has a breadth of experience in a range of middle depth fisheries and leads the strategic development and research planning for the group. She has a particular interest in the impact of climate on fisheries and trawl survey methodology. In 2007, Rosie led an industry-funded project investigating the size selectivity of hoki by commercial trawlers.

Richard O'Driscoll is the group manager. He was again involved in a wide range of programmes using acoustics and trawling to estimate fish abundance in 2007. These include acoustic surveys of hoki in Cook Strait, orange roughy on the Chatham Rise, and southern blue whiting on the Bounty Island Platform, and trawl surveys of hoki and other middle depth species in the Sub-Antarctic and on the Chatham Rise. He has developed a number of collaborative projects with the fishing industry to collect acoustic data from commercial vessels, and was co-author of a report on this subject prepared by the International Council for the Exploration of the Sea (ICES). Richard also has an interest in Antarctic fisheries. He is the convenor of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) subgroup on acoustic survey and analysis methods and was an objective leader for the recent CAML-IPY voyage to the Ross Sea in early 2008.

Aden Abdi has become a valuable member of our electronics technical group, taking part in surveys of scampi and hoki. Aden's major role is in the maintenance of NIWA's acoustics, camera, and wetlab data capture systems. He has made design modifications that improved the reliability and operation of some major equipment.

Neil Bagley is the project leader for the Oman project and led the first survey in Oman. He also has continued to lead the annual hoki and middle depth trawl survey in the Sub-Antarctic and participated in an acoustic survey of hoki in Cook Strait in 2007. Neil was responsible for preparing tagging kits for vessels fishing in the Ross Sea toothfish fishery and liaison with vessel crew and observers. Other work has included analysis of trawl surveys, description of fish spatial distribution, coordination of NIWA's trawl gear requirements, and database management.

Sira Ballara has carried out a range of analyses associated with stock assessment. This work includes description and analysis of catch effort and biological data for the hoki fishery, and grooming and analysing tagging data from the toothfish longline fishery in the Ross Sea.

Jennifer Devine started at NIWA in June 2006. She brings with her a wide range of experience on deep sea fishes, ecology, mesopelagic fish, and time-series analyses. Jennifer carried out descriptive and standardised catch-per-unit-effort analyses for hake, kahawai, and english mackerel, acoustic analysis of data from the Rumbles seamounts, and extracted and compiled trawl survey data for projects on ecosystem indicators, mesopelagic fish, and climate change. She participated in the first survey in Oman and in a trawl survey for hoki on the Chatham Rise.

Adam Dunford provides support for users of NIWA's acoustic systems and was involved in the mobilisation/demobilisation and data management for at least 7 fisheries surveys in 2007. He is responsible for the calibration of fisheries acoustic systems, and made significant improvements to data collection and analysis software. Adam is also leading NIWA's developing acoustic research programme for freshwater fish in lakes, including smelt in Lake Rotoiti (North Island), and trout and salmon in the Southern Lakes.

Stéphane Gauthier was another new addition to the group in 2006. Stéphane's interests include fisheries acoustics and fish behaviour, particularly habitat modelling and species interactions. He participated in two surveys in Oman in 2007, as well as in an acoustic survey of hoki in Cook Strait, and a trawl survey on the Chatham Rise. Stéphane contributed to the analyses of acoustic data on trout, orange roughy, hoki, mesopelagic fish, and southern blue whiting.

Peter Horn transferred to the Middle Depth and Acoustic Group from NIWA Nelson in January 2006. Peter carries out the stock assessments for ling and hake, and leads the projects involved with commercial catch sampling and age estimation from hoki, hake, and ling fisheries. He continues to be

heavily involved in fish ageing, reviewing NIWA's ageing work in 2007, as well as reading gemfish, toothfish, hoki, ling, lookdown dory and sea perch otoliths.

Wilbert Knol left NIWA in December 2007, following 19 years of service, and is a big loss to the Middle Depth Fisheries and Acoustics Group. Wilbert was primarily responsible for the development and maintenance of NIWA's custom CREST echosounder system. Wilbert has returned to his native Netherlands where he has a sea-going position as electronics technician with a marine dredging company.

Gavin Macaulay works on a range of projects associated with fisheries acoustics. In 2007, he supervised the planning, installation, and implementation of acoustic equipment for major surveys in Oman and the Ross Sea, and participated in both voyages. He was also involved in an acoustic survey for orange roughy. Gavin's expertise in target strength research is recognized internationally. He was an invited expert to meetings in Chile, UK, and the US, and continues collaborative work with international colleagues. Gavin also contributed to the ICES report on collection of acoustics data from industry vessels.

Ben Lennard joined the Middle Depths and Acoustics Group as an Electronics Technician in April 2007, having previously worked at Victoria University. Ben is already establishing himself as a competent member of the acoustics technical team, working on a number of projects associated with wetlab, camera, and acoustic systems, and completing his first sea trips.

Dan MacGibbon is also new to the Group. Dan started as a Fisheries Technician in December 2007 following completion of his MSc at Victoria University. Dan has a wide background in biology and statistics, including previous experience as a commercial fisherman. These skills have already been put to good use with participation in a trawl survey on the Chatham Rise.

Richard Nelson has a leadership role in the acoustic workshop, and is responsible for the development of acoustic, camera, and wet-lab equipment. In 2007, he designed the hardware for a new towbody attitude reference system, suggested a new wetlab stylus which has significantly improved reliability, and built and tested a new oyster/inshore camera system. Richard also provided mobile wetlab systems for use on the chartered vessel in Oman. He participated in acoustic surveys for hoki in Cook Strait and orange roughy on the Chatham Rise, and camera surveys looking at benthic habitat in Spirits Bay and Foveaux Strait.

Darren Stevens has a lead role in a multi-year feeding study to examine trophic interactions on the Chatham Rise, and has completed comprehensive dietary studies of Antarctic toothfish and icefish. He continues to lead the important Chatham Rise middle depth trawl survey, and also participated in two fisheries surveys in Oman. Darren is developing a research interest in cephalopods, and was responsible for cephalopod collection and identification during the recent CAML-IPY voyage to the Ross Sea.

OCEAN-ATMOSPHERE

Evelyn Armstrong studies phytoplankton from waters east of New Zealand. Some species have been isolated and cultured in the laboratory so that nutrient and photophysiological experiments can be performed.

Sarah Bury's main interests are phytoplankton ecology, primary production, carbon and nitrogen fluxes in the ocean, and the application of stable isotope techniques to environmental studies. Sarah is

currently involved in several coastal ecosystem food web studies using C and N stable isotopes to trace nutrient flow through the systems. Sarah runs and manages the Deltaplus continuous flow stable isotope mass spectrometer facility at Greta Point. The Deltaplus analyses carbon and nitrogen content and stable isotope ratios in solid and liquid samples and is central to environmental process work within NIWA.

Julie Brown is the mass spectrometer technician whose work mainly involves instrument maintenance, sample processing and data management.

Kim Currie is interested in the air-sea exchange of carbon dioxide, and marine carbonate chemistry. She is particularly interested in the spatial and temporal variation of oceanic CO2 uptake in the SW Pacific. A time series transect has been established into subantarctic waters east of New Zealand to study temporal changes of CO2 uptake, spatial variation is also investigated. Kim collaborates with biologists, physicists and modellers in determining the factors affecting the marine carbon cycle.

Mike Harvey co-ordinates the FRST funded programme of research "Drivers and Mitigation of Global Change" at NIWA, which investigates anthropogenic and natural processes governing the CO2 and trace gas composition of atmosphere. In addition, Mike currently serves on the Royal Society of New Zealand International Geosphere-Biosphere Programme (Global Change) committee www.rsnz.org/advisory/igbp and is a member of the New Zealand National SOLAS (Surface Ocean Lower Atmosphere Study) committee. He has interests in factors regulating the emission of climate relevant biogenic gases including dimethylsulfide in the south-west Pacific and Southern Ocean. Two major lines of investigation are

- quantifying the source of sulphur to the atmosphere through the gas exchange across the sea-air interface and
- investigating the atmospheric fate of DMS to determine potential climatic impact. This work is a part of the regional "Surface Ocean Lower Atmosphere Studies" (SOLAS) plan.

As part of an international collaborative effort, Mike led the "SOLAS Air-Sea Gas Experiment" (SAGE) from RV Tangaroa in Mar/Apr 2004. In this experiment, the physical processes governing gas exchange and the effects of iron fertilisation were studied in a windy Southern Ocean environment with a focus on the exchange of CO2, DMS and other gases at a number of measurement scales. On the atmospheric side, the fate of DMS in the atmosphere has being investigated through a number of field studies, most recently the Precursors to Particles (P2P) 2006 campaign www.publish.csiro.au/paper/EN07041.htm seeking to understand biogenic sources of aerosol in the coastal marine environment (led by Jill Cainey, Bureau of Meteorology, Australia). This year, Mike contributed to a "research front" reviewing current understanding of sulphur cycle feedbacks on climate www.publish.csiro.au/nid/190/issue/3787.htm.

Peter Hill is an electronics and software engineer working on oceanographic and atmospheric instrumentation. His projects have included instruments and systems for gas analysis, ocean microstructure probes and vehicles, underwater optical measurements and deep sea imaging. Last year he developed DTIS, the Deep Towed Imaging System, a towed vehicle with video and still cameras for use down to 6000 meters depth.

Cliff Law is leader of the NIWA Ocean-Atmosphere group, with research interests in the cycling and fluxes of nutrients and trace gases (nitrous oxide, methane and carbon monoxide) in the surface ocean. He has been looking at nitrogen supply and productivity in the oligotrophic Tasman Sea, and marine methane sources focussing on methane seeps on the New Zealand shelf and the surface ocean "methane paradox". Recent fieldwork studies in Pelorus Sound have examined trace gas emissions in the coastal ocean, and he will be using a new instrument, a Membrane Inlet Mass Spectrometer (MIMS), to measure denitrification rates and gas exchange in both coastal regions and the open ocean. He

oversees an oceanic tracer facility that uses sulphur hexafluoride to label and track water bodies in the surface ocean for the study of atmosphere-ocean exchange, vertical mixing, and dispersal, and enables open-ocean manipulation experiments to determine the nutrients that limit phytoplankton growth. Cliff is a member of the NZ National SOLAS (Surface Ocean Lower Atmosphere Study) Committee, and International SOLAS Steering Committee, and has ongoing research with SOLAS scientists in the US, Australia, Canada and UK. One of these collaborations includes participation in a UK SOLAS research voyage studying trace gas emissions in an upwelling system off Mauretania in mid-2008.

Andrew Marriner is a research technician in the Ocean Atmosphere group. He works on measuring trace gases by gas chromatography and sulphur aerosols by ion chromatography, and oversees the new Membrane Inlet Mass Spectrometer (MIMS) facility for denitrification rates and dissolved gas measurement.

Murray J Smith studies the physical processes that govern the exchange of momentum, heat and gases between the ocean and atmosphere. A particular emphasis is on the turbulence generated by waves and wave breaking. The modulation of fluxes of climatically important gases over the ocean is being measured as part of the SOLAS program. His recent work has included leading a pilot study of trace gas exchange in coastal waters in Pelorus Sound, in which he charaterised the physical driving processes and made direct measurements of air-water exchange of CO2. A major focus of this work was the month-long SAGE voyage in the Southern Ocean where air-sea exchange mechanisms were studied in extreme conditions using radar, tracers, profilers and micrometeorological techniques (http://www.niwa.co.nz/rc/atmos/sage). This has led to a revised estimate of the ocean uptake of CO2. He has also been working on a wave energy development project in collaboration with IRL and Power Projects Limited.

David Weller has acquired a range of skills and knowledge in the last 10 years across a wide spectrum of disciplines (marine biology, fisheries, ecology, physiology, biomedical science, microbiology and molecular biology). He is researching the ecological interactions between marine phytoplankton and microbes, and whether this interaction produces the excess methane found in the surface ocean. It is envisaged that his work will include isolation and culture of a range of phytoplankton species, GC measurements of CH4, bacterial cultures and detection of methanogens by PCR and chemical isotopic work. He is working with Cliff Law and Els Maas at NIWA and Russell Frew at the Department of Chemistry, University of Otago where he's registered for a Ph.D.

OCEAN GEOLOGY

In 2007, the Ocean Geology comprised 17 permanent technicians and scientists who undertake both science research for the "Public Good" of New Zealand, and commercial consultancy. A 2 year NIWA post-doctorate fellow in seismic hazards, a PhD student from University of Canterbury and a multi-beam back-scatter technician, funded via Capability Funds, were also members of the team in 2007. **Andrew Goh** and **Miles Dunkin** from the GIS group left NIWA in 2007, replaced by **Micah Kemp** and **Simon Bardsley**, respectively. A new marine electronics position was filled by **Dylan Amyes** in October 2007.

Current research science projects continue to focus on the style and spatial distribution of active submarine faults, and fault development within the wider Pacific-Australia Plate boundary deformation zone; late Pleistocene sea-level fluctuations; back-arc rifting and rift magmatism; high resolution stratigraphic analysis of sediment dispersal along the continental shelf and margin and down deep-sea channel systems; catastrophic failure and collapse of the continental margin; characterising near-field tsunami sources; and submarine volcanism. The group also works on modern

and recently past oceanographic systems, with the aim of quantifying the rates and processes of carbon productivity and sequestration in the Southern Ocean, over seasonal to millennial timescales.

The group remains at the forefront of acquiring modern digital and geological data to characterise seafloor morphology, composition and history, and hence endeavour to better understand the interactive geological, biological, climatic and oceanographic processes that affect the New Zealand surrounding seafloor. More recently, we have integrated mapping studies with benthic biological research to undertake habitat mapping projects at a variety of scales and resolutions, and have played active roles in recent Ocean Survey 20/20 projects, funded by LINZ, MFish, DoC and NIWA. Marine geologists at NIWA run collaborative projects with other CRI's, most New Zealand Universities, and earth science research groups from the USA, UK and several European countries.

We also undertake a significant range of commercial consultancy projects including New Zealand continental shelf delimitation (UNCLOS), hydrographic surveys within New Zealand and Ross Sea (Antarctica) waters, submarine cable route investigations, offshore resource evaluations, offshore pipeline investigations, and habitat mapping for environmental management and impact assessments as well as site surveys for petroleum and offshore minerals exploration industries.

Dylan Amyes joined the Ocean Geology group as an Electronics technician in October 2007 after an 11 year stint in the NZ Army where he was a Sergeant, working as an electronics instructor and workshop supervisor. His main roles in NIWA are to facilitate and maintain electronics support for NIWA's research vessels (RV Tangaroa and Kaharoa), including scientific navigation, geophysical systems and multi-beam echosounders.

Simon Bardsley joined the Ocean Geology group as an Ocean GIS technicianin December 2007. He has completed degrees in Geography and Geology (BSc in 2001 and MSc in 2004) at the University of Canterbury, specialising in geo-spatial analysis and remote sensing, followed by 3 years working for Environment Canterbury as a GIS Analyst. He is undertaking GIS work for a range of commercial and research applications, including mapping benthic invertebrate distributions for Biosecurity NZ. Simon replaced Miles Dunkin, who left NIWA in July 2007.

Philip Barnes undertakes research on stratigraphy, fault structure, rates of active tectonics, and earthquake potential in many areas of coastal New Zealand, including the Bay of Plenty, eastern North Island, Eastern Marlborough, Cook Strait, north Canterbury, and Fiordland regions. The research involves the acquisition and interpretation of seismic reflection profiles, multibeam bathymetric data, and seafloor samples, in order to understand the sedimentary responses to major changes in sea level and climate, as well as earth deformation processes in the Pacific-Australia plate boundary forearc, backarc, and strike-slip tectonic zones. Sedimentary sequences are studied in detail to provide the temporal framework for determination of tectonic deformation rates and processes. This research involves national and international collaboration, has linkages with other NIWA, GNS, and New Zealand university programmes, and contributes to better understanding of global processes and regional coastal hazards. Phil is a Principal Scientist and recently stepped down as the FRST research programme leader for the Consequences of Earth-Ocean Change programme.

Helen Bostock is a paleoceanographer and sedimentologist who arrived from Canberra where she was working on coastal sedimentary systems at Geoscience Australia. Her main research interests are in ocean circulation changes and the sedimentary response to sea level fluctuations and climate change. Helen's research involves stable isotope analyses on foraminifera from marine cores, grain-size and mineralogy of sediments in cores and surface samples, combined with multibeam bathymetric data and

seismic profiles, focusing on west coast South Island, and in particular the acquisition of new cores from Macquarie Ridge in April 2008.

Claire Castellazzi is in charge of NIWA's marine geophysical data, processing and archiving facility. She has skills in seismic reflection data acquisition and processing, and has implemented SeisVision software for presenting geophysical data.

Peter Gerring specialises in habitat mapping utilising sidescan sonar acquisition and processing, video and still camera, and sampling. He participates in numerous surveys both in coastal waters and offshore on R/V Tangaroa. In 2006, Pete upgraded his skills in seismic reflection acquisition and specialises in the maintenance of the seismic air guns.

Micah Kemp provided support to marine geology, hydrographic and benthic habitat research and consultancy projects by undertaking GIS analyses, with emphasis on seafloor mapping, terrain modelling and imagery sensing. He joined NIWA in June 2007, replacing Andrew Goh, who left NIWA in early 2007. Micah has participated in swath multibeam and geological data acquisition surveys for publicly funded research and commercial projects, including west coast South Island canyons and the Wellington Harbour mapping project. He left NIWA in February 2008.

Geoffroy Lamarche is focussing his research work on the active geological deformation that affects the continental shelf and margin around New Zealand, and in particular in the Bay of Plenty, the East Cape Region, the Wanganui Basin and Cook Strait. The research endeavours to better understand the mechanisms of faulting, including fault interactions and fault growth and to identify earthquake sources and hazard in a variety of tectonic environments, whether extensional, transtensional or contractional. Another aspect of his research is the study of submarine slope instabilities on a large variety of scales, including that of gigantic submarine avalanches that affect the East Cape region. The aims are to constrain the timing of the slope failures, quantify the geometrical (volumes, areas) and rheological properties of the remobilised masses, and evaluate the many factors (rheology, geometry, sea-level fluctuation, presence of gas, etc…) that facilitate mass movements in the submarine environment. The research involves the acquisition and interpretation of seismic reflection profiles, multibeam bathymetric images, and seafloor samples. Geoffroy leads the marine seismic processing facilities, which has developed methods for processing sequences that optimise resolution reflectors within the first 2 km beneath the seafloor. Geoffroy Lamarche leads international collaborative research projects with the research groups of Géosciences Azur (Nice), Géosciences Rennes (Rennes), and IFREMER (Brest), all in France, and with the UK National Oceanic Centre, Southampton. He has recently taken on the role of Science Leader, leading the FRST-funded Consequences of Earth-Ocean Change programme.

Kevin Mackay is the Marine Data Manager, responsible for managing digital bathymetric and station data using Geographic Information System (GIS) and RDBMS. Current projects include: the development of systems and processes for the processing, analysis and storing of all data collected during Ocean Survey 20/20; and the integration of geological, biological and physical marine data into a single frame-work named MINZ (Marine Information New Zealand). He continues to provide support to marine geology and geophysics research, and commercial projects by undertaking GIS analysis and computer processing of swath multi-beam bathymetry and backscatter strength data, with emphasis on seafloor mapping, terrain modelling and imagery sensing. He also leads and/or participates in swath multi-beam and geological data acquisition for research (FRST) and commercial projects.

John Mitchell is project leader for the seabed resources and charting objective. He leads and participates in research and commercial voyages, concentrating on multibeam data collection and processing,

hydrographic surveys and United Nations Convention on Law of the Sea (UNCLOS) surveys. He was Voyage and Project Leader for the Western Ross Sea hydrographic voyages during 2001 and 2004, and continues to lead large, multi-disciplinary consultancy projects for government agencies and external commercial clients.

Joshu Mountjoy is a PhD candidate from the University of Canterbury, based at NIWA. He is working on understanding the dynamics of submarine landsliding in the Cook Strait region using a variety of geophysical and geological data-sets. Supervision for Joshu's PhD is provided by Phil Barnes (NIWA) and Jarg Pettinga (Canterbury).

Helen Neil is currently investigating seasonal to millennial changes in oceanographic conditions and production. The nature and timing of abrupt climate change at mid-high southern latitudes is poorly understood. A regional focus on the southern and western water masses of New Zealand aims to elucidate the transmission of climate signals at high latitudes. Modern oceanographic records are compared to analogues of environmental change derived from long-lived macro-fauna, bottom sediment characteristics, and assemblages in surface net tows, sediment traps and sediment cores records. Other research interests are derivation of climate millennial records from speleothems (with Paul Williams, University of Auckland and Jonathon Nott, James Cook University) and deep-dwelling bamboo corals, including coral ageing for use assessments of seamount ecology (with Di Tracey, NIWA, Juan Sanchez, Universidad de los Andes, Ron Thresher CSIRO and Allen Andrews, MSML). Work on the use of bomb radiocarbon to validate otolith ages and stable isotopes to investigate life histories of New Zealand's deep-dwelling fisheries is continuing in conjunction with Di Tracey, Peter Marriott, Peter Horn, Peter McMillan, Alan Hart (NIWA) and Rodger Sparks (GNS Science). This combination of modern and past records will facilitate future prediction of global processes and change in the New Zealand region. Recent research focus has been on the sedimentary, oceanographic and climatic systems of the west coast South Island, and in 2005, she co-led with Dr Geoffroy Lamarche the consortium of New Zealand scientists that funded a French-New Zealand research program on tectonic and climatic controls on sediment budgets, which culminated with the visit of R/V Marion Dufresne to NZ waters. Helen runs and manages the Micromill (for small volume sample collection) and the Kiel (small-volume) carbonate system for derivation of stable (O and C) isotopes central to paleoceanographic and fisheries-related research work within NIWA.

Scott Nodder is involved in research investigating oceanic sediment and elemental (C, N, P, Si) fluxes using floating and moored sediment traps. This work is in conjunction with benthic biological and sedimentological studies that are designed to understand the relationships between benthic and pelagic processes and the impact of such processes on the cycling of carbon in the oceans around New Zealand. Study areas include the Southern Ocean, west coast South Island, Subtropical Front (Chatham Rise), Hauraki Gulf, Firth of Thames and northeast coast of New Zealand. Strong and ongoing research links have been established with other NIWA oceanographic scientists, GNS Science (Chris Hollis, Mark Stirling), NZ universities (in particular with Conrad Pilditch, Waikato, and Keith Probert, Otago), and with overseas researchers (e.g., Gerard Duineveld, Netherlands Institute for Sea Research, Jean-Noel Proust, CNRS-Géoscience-Rennes, and Liz Sikes, Rutgers University, USA). Other research interests are Ocean Survey 20/20 benthic biodiversity and habitat mapping, Cook Strait cold seeps and methane (with Cliff Law and Els Maas, NIWA), Taranaki-Wanganui shelf sedimentology, fault structure and neotectonics, marine particulate matter and remineralisation processes, nutrient fluxes, continental shelf sediment transport, and the oceanic carbon cycle.

Lisa Northcote provides technical support for scientists such as Helen Neil, Scott Nodder and Alan Orpin as well as field support for scientists in other groups. She has adopted a leading role within the NIWA marine geology laboratory undertaking standard grain-size and chemical analyses as well as

stable isotope sample preparation, and sediment trap and macrofaunal analysis. Lisa has built up a significant knowledge of modern foraminiferal taxonomy and assemblage characterisation and is currently analysing fauna from Hawke Bay, Chatham Rise, and Campbell Plateau. The establishment of seasonal to interannual variability in ocean temperatures and productivity from living foraminiferal assemblages will allow the derivation of modern analogues for past environmental changes in subtropical and subantarctic waters.

Alan Orpin is a marine geologist working on the marine component of the transfer of sediment from mountains to the deep sea as a part of the international MARGINS programme [margin sedimentary processes]. Primarily he is investigating the accumulation of post-glacial terrigenous sediment on the East Coast margin (in collaboration with other NZ researchers, Skidaway Institute of Marine Science, East Carolina University and the Virginia Institute of Marine Science, USA). The group is also trying to establish links between the late Holocene terrestrial record of climate and landscape change with offshore sediment dispersal using sediment core proxies from the marine and lacustrine environments. Other high-sediment yield regions of the NZ margin of interest include the Westland margin, where initial fieldwork has been undertaken with Helen Neil and Scott Nodder (NIWA). He is also involved in the development of mapping tools for benthic habitats with workers from the Geological Survey of Canada (Atlantic) and sedimentation patterns in the Great Barrier Reef of Australia with collaborators from James Cook University, Australia. In late 2006, Alan has concentrated on identifying cold seeps sites from marine geophysics and geological information collected from marine geophysical and geological surveys.

Arne Pallentin is the main GIS technician for the New Zealand United Nations Convention on Law of the Sea (UNCLOS) project, working in cooperation with MFAT, LINZ and GNS Science. He is responsible for the analysis of bathymetric data, geodetic calculations and charting. He also provides support for research in the Ocean Geology and other groups, as well as commercial consultancy projects, facilitating GIS analysis for a wide range of applications ranging from biodiversity to tsunami research.

Nicolas Pondard has been working at NIWA on a 2-year post-doc project, investigating and quantifying the potential seismic hazard presented by newly identified active faults in Cook Strait. This work feeds in directly to the "Its Our Fault" project, funded by EQC, with scientists from NIWA and GNS Science.

Steve Wilcox is an electronics engineer responsible for the commissioning, installation and maintenance of NIWA's marine geotechnical systems, in particular the Simrad EM300 and EM3000 swath mapping systems; CMAX and Coda sidescan systems; and NIWA's high-resolution seismic reflection systems (boomer and multi-channel airgun sources). Steve is in charge of commissioning and maintaining our new seismic reflection digital streamer and data acquisition systems.

Anne-Laure Verdier has been working at NIWA over the last 2 years, developing our capabilities in multi-beam back-scatter data processing, via NIWA's Capability Fund. She has a hydrographic surveying background and also has developed skills in GIS during her time at NIWA.

Ian Wright continues his research work on submarine volcanism to the north of New Zealand. This research has extended from discovering many previously unmapped submarine volcanoes using modern multi-beam mapping, through to attempting to unravel eruption processes of large caldera-forming eruptions within < 900 m water-depth, and relating such processes to regional variations in seafloor morphology and geochemistry. More recent work has focused on understanding the size and frequency of submarine landsliding on these steep volcanic edifices. Collaboration continues to be an

important component of the research including work with GNS Science and University of Auckland, and scientists from Germany, Japan, US, and Ireland. A further important aspect of the work has been integrated studies with NIWA biologists on seamount ecology of these active volcanoes. This latter work has extended into research of seafloor mapping, and ultimately resolution of geological substrates and biological habitats to underpin management strategies for sustainable exploitation of the marine environment. Much of this research is technology driven in applying different techniques for differing spatial scales of seafloor mapping. Quantitative modelling of acoustic back-scattering from the seafloor to map geological substrates and biological habitats is an important focus of the current work. This work has recently included joint work on applying such techniques to the South Wellington coast. Ian continues his work on the New Zealand Continental Shelf Project, with the recent submission of New Zealand's outer extended continental shelf limits to the United Nations. Ian is a Principal Scientist at NIWA and is the current leader of NIWA's National Centre of Coasts and Oceans.

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Hamilton

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COASTAL MODELLING AND COASTAL PROCESSES

Giovanni Coco

VISITORS

Prof. David Huntley: Large-scale bedforms and their effect on sediment budget
Prof. Andy Short: a) Beach cusps b) Coastal classification

POSTGRADUATE STUDENTS

PhD

Joseph van Gaalen
LIDAR observations of nearshore morphology (student at University of South Florida, USA)

Rafale Almar
Video observations of nearshore morphology (student at University of Bordeaux, France)

Luciano
Video observations of nearshore morphology (student at University of San Paulo, Brazil)

MSc

Barend van Maanen
Sandbar migration (student at Utrecht University, The Netherlands)

Peter de Ruiter
Sandbar migration (student at Utrecht University, The Netherlands)

Summer Salmon
Extracting wave run-up from video images (student at Waikato University)

Scott Stephens
Scott has been focusing on the prediction of extreme sea levels and the joint-probability of sea levels and waves. Recent collaboration with Derek Goring of Mulgor consulting Ltd has seen the development of a Monte Carlo technique for prediction of extreme sea levels from short records. We are developing a numerical model that is capable of predicting coastal morphological change in response to long-term variations in environmental forcing parameters such as sea level, wave climate and sediment supply to the coast.

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Mahanga Bay

AQUACULTURE RESEARCH FACILITY, MAHANGA BAY
The NIWA facility at Mahanga Bay focuses on cooler water aquaculture (complementing NIWA's warm water facility at Bream Bay) across the whole spectrum of potential cultured species from micro- and macro-algae, through bivalve and crustacean shellfish and echinoderms to finfish. Research encompasses basic studies of new species, development of farming techniques, and investigation of ways to improve the efficiency of established commercial aquaculture systems.

Philip Heath, as the Group Manager at Mahanga Bay, maintains an advisory role in most of the projects at the aquaculture facility. His personal research focus remained on the development of recirculation technology, particularly for paua aquaculture. Phil's expertise in this technology has involved him in work with two NZ paua farms using recirculation, and with similar developments overseas. Phil's research has focussed on developing the technology for polyculture systems to optimise the use of water for both onshore and offshore marine farms, with particular emphasis on integrating co-culture of seaweed culture into mainstream on-shore and marine aquaculture. Phil has also been involved in projects producing aquaculture development strategies in New Zealand and overseas.

Bob Hickman's work with paua has shifted from commercial seed production to developing family lines of seed as part of Graeme Moss's selective breeding programme. Bob compiled a major information document for Te Puni Kokiri to encourage more Maori involvement in aquaculture development, and also managed a Seafood Innovations Ltd project investigating the potential for production of pearls in horse mussels. Bob is involved in several other research projects at Mahanga Bay including testing antifouling compounds, developing "accessible aquaculture" for Maori, investigating kina enhancement, studying paua behaviour in culture systems, and most recently the new projects on finfish aquaculture of kingfish, groper and butterfish. Bob was invited to give the New Zealand perspective on "developing mussel and abalone farming industries" at the international Aqua Sur conference in Chile and had talks with Chilean agencies on how to increase research collaboration.

Graeme Moss has been involved in the production of paua family lines aimed at improving paua broodstock for the aquaculture industry. He has completed work on paua husbandry, investigating the effects of photoperiod, flow rates and feeding frequency on behaviour, growth and survival of juveniles, with some help from German student Carolin Frank. He is currently running paua broodstock diet trials and some alternate paua diet trials looking at the impacts of novel ingredients. He has been involved in sea cucumber breeding work with Professor Qiu, who was visiting Mahanga Bay from China as part of the co-culture programme. Graeme's boatmaster skills have been utilized in the novel antifouling compounds programme, the kingfish programme, and during the collection of butterfish. Graeme has also been involved with the work on horse mussel pearl implantation.

Phil James continued to lead a FRST project on land-based and sea-based husbandry in relation to roe enhancement of wild caught kina, and an industry-funded project attempting to commercialise kina roe enhancement. In addition Phil took 6 months leave to complete his PhD at Victoria University on kina roe enhancement. Phil has also become involved in NIWA's kingfish project, which is rearing juveniles in sea-cages and on-shore tanks at Mahanga Bay to compare with those being reared at the Bream Bay facility.

Sarah Allen continues to maintain NIWA's micro-algal culture collection, which has seen an increase of over 20 locally isolated cultures, some with biotechnology application potential. Sarah was involved in a variety of macro-algae research projects, particularly development of spore settlement and of rope culture on-growing techniques for a range of red and brown macro-algae with aquaculture potential.

Neill Barr, who replaced **John Illingworth** when he retired in June, has brought a new range of skills to the job of senior hatchery technician responsible for the management and day to day running of the Mahanga Bay facility. This has been most evident in extensive renovation of the electrical infrastructure to meet upgraded requirements for both electrical and health and safety standards. Neill also has a background in ecophysiology in seaweeds and has recently completed a PhD in Marine and Environmental Science at the University of Auckland.

Jonathan Wright has continued to provide technical support for general hatchery maintenance and for the renovation and upgrading of facilities. Johnny is involved in Mahanga Bay's kingfish rearing trials, comparing the growth curves of juveniles from the cooler waters of Wellington Harbour to the warmer Bream Bay conditions. Johnny was involved in NIWA's assessment of commercial fisheries in Oman and spent 8 weeks in the Middle-East in late 2007. He is also undertaking an MSc in marine biology at Victoria University, with its focus on CO2 degassing processes in seawater systems.

Kevin Green, who replaced **Mike Tait** when he left to take up commercial paua farming, has been assisting researchers with technical support and husbandry for many of the various projects based at Mahanga Bay, including spore settlement and rope culture techniques for a range of red and brown macro-algal seaweeds, kina roe enhancement, lobster feeding trials, paua shell colour banding and broodstock development, toxicity tests on flounder, kingfish growth in cool water culture, and developing husbandry techniques for butterfish in culture systems.

Sheryl Miller, who is a member of the Aquaculture and Fisheries Enhancement team and of Te Kuwaha, continues to focus on seaweed aquaculture as part of the FRST-funded Complementary Aquaculture project, which is a collaboration with researchers at the Yellow Sea Fisheries Research Institute in China. Sheryl will be presenting results of seaweed aquaculture trails in the Marlborough Sounds at the 3rd Congress of the International Society for Applied Phycology in Galway, Ireland in June 2008. Sheryl is also heavily involved in the NIWA marine biosecurity programme which includes

consultating with stakeholders, reporting to Biosecurity New Zealand and organizing and undertaking field work throughout New Zealand. In addition Sheryl is leading a research project in partnership with Moeraki Runanga (Otago) that is investigating the contribution of Maori knowledge to mitigation of two invasive aquatic species; the brown seaweed Undaria pinnatifida and the monkey flower Mimulus guttatus .

Cedric Simon has continued his studies on aquaculture of juvenile spiny lobsters, Jasus edwardsii. Following on from his work with Phil James on developing a cost-effective sea-cage rearing system for culturing juvenile lobsters, Cedric has been developing new artificial diets for spiny lobsters. He presented results from some of this work at the 8th International Conference and Workshop on Lobster Biology and Management in Charlottetown, Canada, and in two published journal papers. Cedric is investigating aspects of the digestive physiology of juvenile spiny lobster when fed artificial versus natural diets, to complete his PhD at the University of Auckland.

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Nelson

Ron Blackwell has continued to be involved in a variety of inshore projects. These have included running a potting survey for blue cod in the Marlborough Sounds, running the catch sampling programme for snapper and other inshore species, and carrying out associated ageing work.

Anna Bradley runs the laboratory for the Nelson office (including dealing with safety issues), has identified many ascidians from port surveys, been involved with consent renewals and FRIAs for various mussel farms, undertaken baseline monitoring jobs at various sites and been involved with port surveillance work.

Stephen Brown has primarily been involved in continuing experimental work and monitoring as part of a research project investigating ecology and enhancement of the flat oyster in Tasman and Golden Bays. Apart from this he has carried out various small commercial benthic survey jobs.

Dan Cairney has participated in fieldwork for macroalgae – reef fish interactions, participated in the co-culture project examining aquaculture of sea cucumbers and seaweeds, participated in marine farming fieldwork, has prepared otoliths, examined sewage diffusers, mapped marine reserve habitats at Flea Bay, has side-scanned for habitat of invasive ascidians, and been involved with the acoustic monitoring for Hectors dolphins at Jacksons Bay.

Russell Cole works with macroalgae – reef fish interactions, has been applying and extending statistical methods of testing interval hypotheses with colleagues from Hamilton, and continues to be involved with marine farming investigations.

Niki Davey has been involved in the sea cucumber side of the co-culture programme in the Marlborough Sounds. She has been running the Fiordland, Marlborough Sounds and West Coast Recreational Fishing surveys, and has also been involved with sea cucumber taxonomy from various

projects, hoki ageing, reef ecology programme in Tasman Bay, and CTD/benthic work on various sea trips.

Ralph Dickson is primarily involved with hydrology work, but also oversees the operation of the faxback system for marine shellfish harvesting in the Marlborough Sounds, Golden Bay and Whangaroa Harbour. He also has been involved in trawl surveys, port surveys and telemetered data retrieval from a variety of marine based platforms.

Ken Grange continues to be involved with preparing fisheries impact assessments and monitoring of marine farm developments, as well as providing advice on the development of Aquaculture Management Areas. Over the past year he led a project that used passive acoustic monitoring of Hectors dolphins prior to a mussel farm development in Jacksons Bay, which provided new information on diurnal movements and feeding patterns. He has also had opportunities to return to Fiordland, both as an advisor to Meridian Energy Ltd associated with potential changes to the Manapouri tailrace discharge, and in his capacity as one of the Fiordland Marine Guardians. After 12 years, he has stepped down as Chair of the Kapiti Marine Reserve Committee. Ken reports that the Nelson office is continuing to grow both in staff numbers, and the breadth of research and consultancy services being undertaken.

Stu Hanchet has continued to be very heavily involved with Antarctic fisheries work. He completed his fourth and final year as convenor of the Working Group on Fish Stock assessment for CCAMLR. He managed a variety of Antarctic fisheries, inshore, and middle depths projects and developed the project proposal for the 2008 NZ IPY-CAML voyage to the Ross Sea, Antarctica. He also continues to manage the fisheries and hydrology group within the Nelson office.

Sean Handley has been involved with oysters (Pacific oysters & Tasman Bay dredge oysters), sponge aquaculture, co-culture, reef ecology, climate change, marine farm FRIA's, Biosecurity (seasquirts & port surveillance), GIS analysis, and in his spare time is Group Manager of the ecology and aquaculture group.

Jenny McLean is still Nelson's receptionist and office manager. She is also the Health and Safety coordinator for the site.

Rob Merrilees has been involved with PSA Partnership forum work this year. He also carried out hoki and ling shed sampling, but his main workload lies in freshwater hydrology.

Don Morrisey's major activities for the last year were reviews of information on the ecology and management of mangroves in New Zealand (for the ARC), and an assessment of arrangements for managing marine pest risks in the aquarium trade (for the Australian Department of Agriculture, Fisheries and Forestry).

Mike Page has identified many ascidians from port surveys, and is continuing his PhD on the chemical ecology of the sponge Mycale hentscheli. He has also been involved in an assessment of deepwater fisheries resources in Tonga.

Jenny Pollock has been visiting NIWA's Nelson office as a teacher fellow for 2008, with NIWA as her host. She is studying ocean circulation, especially around New Zealand and Antarctica, with Mike Williams as her supervisor. One of her activities is to act as the shore contact for the Tangaroa voyage to Macquarie Ridge and to carry out daily updates of the CenSeam website. A class at Nelson College for

Girls will also be following the voyage and will be posting questions that can be answered by the scientists.

Kirsten Rodgers has been involved with FRIAs, Tauranga port surveillance, fieldwork in Fiordland, and sidescanning Pohatu Marine Reserve.

Kieran Scott works primarily in freshwater, doing hydrology fieldwork. However, he gets press-ganged for marine fieldwork on occasion.

Michael Stevenson has aged tarakihi and southern blue whiting otoliths, participated in the Marlborough Sounds blue cod potting survey and the Chatham Rise hoki trawl survey, written a characterisation of the 2008 Antarctic toothfish fishery in the Ross Sea. He was also Voyage Leader for the east coast South Island trawl survey and did the data analysis for that survey and the trawl survey of the west coast South Island. Finally he wrote the Fisheries Assessment Report for the west coast survey.

Colin Sutton has processed otoliths for numerous fish ageing studies, participated in a blue cod potting survey, went on the West Coast South Island trawl survey, and spent 2.5 months in Oman on a fisheries survey.

Trevor Willis arrived in Nelson following a four-year stint in Italy at the University of Bologna. In between writing research proposals, he continues collaborations with Carlotta Mazzoldi from the University of Padova, Fabio Badalamenti from CNR (Sicily), and Karl Ugland at the University of Oslo. He was lead author of a report on the effects of climate change on the New Zealand marine environment, contributed to the Fiordland marine research strategy, led a study of the diet of fur seals in the Abel Tasman National Park, and worked on environment-recruitment relationships in southern blue whiting. He currently serves as associate editor of the journal Environmental Conservation. He is still pining for good espresso.

University of Auckland

Biological Sciences: www.sbs.auckland.ac.nz
Chemistry: www.che.auckland.ac.nz
Geography, Geology and Environmental Science: www.sgges.auckland.ac.nz
Leigh Marine Laboratory: www.marine.auckland.ac.nz
Physics: www.phy.auckland.ac.nz
Statistics: www.stat.auckland.ac.nz

BIOLOGICAL SCIENCES

Associate-Professor Kendall Clements continued his research on triplefins and herbivorous fishes.

Dr Shane Lavery (joint appointment with Leigh Marine Laboratory) focusses on the application of molecular techniques to the understanding of theoretical and applied issues in ecology, evolution and biodiversity of marine fauna.

Associate-Professor David Raubenheimer investigates the nutritional ecology of New Zealand marine fishes.

Dr Mary Sewell continues her research in three main areas:

- maternal investment in echinoderms and nutritional aspects of larval biology;
- Antarctic larval biology; and
- the development of feeds for enhancing kina roe development (with the University of Otago).

Dr Mike Taylor joined the University of Auckland from the University of Vienna. He works on microbe-sponge interactions.

Professor Rufus Wells continues his research on basic and applied aspects of the ecophysiology of marine fishes and invertebrates.

CHEMISTRY

DR BRENT COPP continues to work on the identification of novel biologically active metabolites produced by NZ marine organisms with particular emphasis on the isolation of potential antitumour and antitubercular agents.

LEIGH MARINE LABORATORY

Dr Guy Carton resigned in 2007 to take up a position at James Cook University in Townsville.

Dr Mark Costello hosted the biennial Census of Marine Life All-Programs meeting in Auckland, including a Public Symposium attended by over 200. The events got good press coverage for marine biodiversity research. Launched the World Register of Marine Species at www.marinespecies.org. This builds on ERMS (European...) and will provide an authoritative register of all valid marine species names by 2009 that are edited by taxonomic experts. Other responsibilities include Member NZMSS Council; Chair Ocean Biogeographic Information System (OBIS); Diversitas bioDiscovery Core Project; Secretary General of International Association of Biological Oceanography (IABO); Group of Earth Observations (GEO) Biodiversity Observation Network Task Force; Co-editor special issue of Remote Sensing and the Environment on marine biodiversity; organising committee of 4th international conference on Ocean Biodiversity Informatics (Halifax, Canada, Oct. 2007).

Dr Richard Ford continued his research into the effects of urbanisation on the coastline. His focus upon heavy metal pollution in sediments was increased through a post-doc and student in this area. The beach ecology area was also boosted through the work of one of his grad students on Mair Bank and the provision of a grant which enables him to build a wave flume at Leigh to test behaviour of beach organisms and how this influences distribution.

Professor John Montgomery (joint appointment with Biological Sciences) continued his investigations of fish sensory systems largely through the efforts of a great group of graduate students. A particular highlight was re-engagement with the Antarctic Program and attendance at the International Polar Year Conference "Antarctica: 50 years on the ice – just the tip of the iceberg" in Wellington. "Sound as a settlement cue": has continued to attract attention and he attended the International meeting of the Crustacean Society in Coquimba Chile as an invited Symposium Speaker. Finally, some of his fish sensory interests were presented at the International Symposium of New Perspectives on Fish Neurobiology, Evolution, Development, and Function in Shanghai, China.

Dr Alwyn Rees has been working on nitrogen metabolism in marine algae.

Dr Richard Taylor is currently working on seaweed-grazer interactions on subtidal rocky reefs, with a particular interest in the role of small crustaceans. He is collaborating with Mark Morrison of NIWA Auckland on the impacts of tourism at the Poor Knights Islands and factors structuring reef assemblages at broad scales, and with Judi Hewitt of NIWA Hamilton on the productivity of benthic invertebrates.

PHYSICS

Associate-Professor Chris Tindle was on leave during the first semester of 2007 at Scripps Institution of Oceanography, San Diego. He collaborated in a tank experiment to measure acoustic pulses reflected from the underneath of surface waves. He did the theoretical analysis of the results using the wavefront modelling approach he has developed in recent years. The agreement between theory and experiment is very good. A movie of the results can be seen at www.phy.auckland.ac.nz/html/c_tindle.html. A manuscript has been submitted to the Journal of the Acoustical Society of America.

STATISTICS

Associate-Professor Marti Anderson received a Marsden grant (co-PI with Clive Roberts and AI Carol Diebel from Te Papa) entitled: "Biodiversity highways and biogeographic origins: a voyage of discovery in the deep sea". In this work, she will be joining Australian colleagues and characterising the distributions of fish fauna along gradients of depth and latitude, including their potential interaction along the Lord Howe Rise. They will be using (among other tools) manned submersibles which can dive to a depth of 1 km.

POSTGRADUATE STUDENTS

PhD

Grant Ballard
Adelie penguins: parental investment and relationship to sea ice variability and colony size

Neill Barr
Seaweeds as biological indicators of nutrient enrichment (completed)

Daniel Bassett
Nocturnal predatory fish (completed)

Adam Cowles
Productivity of invertebrates in coastal habitats

Gabriela de Tezanos
Pinto Genetics of bottlenose dolphins

Brendon Dunphy
Aquaculture of the Bluff oyster (completed)

Daniel Egli
Movement patterns of snapper in the Cape Rodney to Okakari Point Marine Reserve (completed)

Berit Finkennest
Allometry of development

Amy Fowler
Ecology of the invasive swimming crab Charybdis japonica

Debbie Freeman
The effects of rock lobsters (Jasus edwardsii) on east coast marine communities

Atsuko Fukunaga
Effects of multiple stressors on estuarine faunal communities and their functions

Tanja Grkovic
Marine natural products

Dorothea Heimeier
Comparative genomic diversity in dolphin societies

Zoë Hilton
Physiological adaptation in New Zealand triplefin fishes

Martin Hingston
Connectivity of marine benthic populations

Stephanie Ismar
Influence of food-quality on breeding success in the gannet

Yilin Jia
Predictive models for multivariate ecological data

Jethro Johnson
Nutritional ecology of the marine herbivorous fish Odax pullus along a latitudinal gradient

Mick Kearney
Aquaculture potential of New Zealand eels

Liz Laman-Tripp
Life history variance of the marine herbivorous fish Odax pullus along a latitudinal gradient

Agnes Le Port
Do mating migrations predict population structure in short-tailed stingrays?

Meredith Lowe
Juvenile fish usage of estuarine and coastal habitats

Megan Marcotte
Eagle ray navigation

Damian Moran
Handling, transport and metabolism of juvenile kingfish (completed)

Emma Newcombe
Connectivity in a marine food web

Carlos Olavarria Barrera
Molecular ecology of South Pacific humpback whales

Mark Oremus
Genetic investigation of dolphin social organisation

Craig Radford
Are marine ecosystems structured by sounds? (completed)

Kirsty Russell
Behaviour and ecology of Hector's dolphins

Aletha Samuela
Biochemical indicators of nutrient enrichment in temperate and tropical seaweeds

Justine Saunders
Ecology of kelp holdfast fauna

Tim Sippel
Movement of striped marlin

Matt Slater
Polyculture of sea cucumbers with bivalves

Lincoln Tubbs
Kingfish aquaculture (completed)

Natalie Usmar
Ontogenetic habitat shifts in snapper

Kim Walshe
A critique of NZ Fisheries ITQ Management System

Maren Wellenreuther
Ecological speciation in New Zealand triplefin fishes (completed)

Nicola Wiseman
Population ecology of Bryde's whales

Shane Windsor
Hydrodynamic trail following

MSc

Rebecca Cowie
Nutrient-specific foraging: a mobile vs a sedentary forager (completed)

James Dare
Remaining unseen in the pelagic world

Jane Fowler
Transportation of live flounder (completed)

Suzanne Garrett
Nutritional regulation in parore (Girella tricuspidata) (completed)

Karl Geiringer
Budgetary analysis of long-chain polyunsaturated fatty acids in the mammalian diet (completed)

Naree Goodby
Lateral line in yellow-eyed mullet

Dianne Hicks
Oxygen transport in temperate teleost fishes

Kristina Hillock
Vulnerability of communities to invasive species (completed)

Yair Kohn
Pelagic duration and maximum age in New Zealand triplefin fishes (completed)

Alicia Marchant
Assessment of egg quality in kingfish, Seriola lalandi (completed)

Amanda Meier
Nutrient Balancing in the gammarid amphipod Aora typical

Kyle Morgan
Biogenic sediment controls on ebb-tidal delta stability

Kaushik Ram
Cerebellum and retinal slip in teleost fishes

Tim Riding
The role of hydrodynamic receptors in intertidal orientation of estuarine rays

Claire Ryken
Molecular methods for diet determination in a marine amphipod

Andrea Seymour
Induction of seaweed chemical defenses

Adam Smith
Statistical validation of near-shore New Zealand Marine Environment Classification (MEC)

Andrew Veale
Invertebrate population genetics (completed)

Mark Wheldon
Identifying significant temporal treatment effects in event related potential matrices: controlling familywise error across multivariate comparisons

RESEARCH FELLOWS
Dr Matthew Pawley is studying impacts of urbanisation on marine coastal communities.

Dr Karen Tricklebank continues to further her work in the identification of subtle indicators of environmental change.

Xueiqang Lu Spiking sediments with heavy metals for use in ecological field experiments

University of Canterbury

Department of Geography Coastal Studies Group

www.geog.canterbury.ac.nz

The Coastal Studies Group comprises a team of academic staff and postgraduate students researching multidisciplinary understandings of coastal environments, including studies focussed on interactions between geomorphology, ecology, climate, and hydrodynamics; and resource and hazard management challenges. This team delivers a coastal curriculum consisting of core undergraduate and postgraduate coastal studies courses as well as related components in other courses.

2007 saw the formation of the Coastal Graduate Group, a forum for postgraduate students to reflect on coastal research experiences and ideas, and from which to gain mentoring input from colleagues and supervisors. Peter Cooper has joined the group for 2008 as a Royal Society Teaching Fellow investigating shoreline change and sedimentation in Christchurch's Brooklands Lagoon. Kimberly Jupp won the 2007 New Zealand Coastal Society conference Best Student Presentation Prize from a strong field of PhD to Honours students while Andrew Wiebe and Lou Stella were jointly awarded the University's RW Morris Prize for outstanding honours research on a coastal topic. In conjunction with Associate Professor Islay Marsden from the School of Biological Sciences and Environment Canterbury, the Coastal Studies Group is currently mapping the soft sediments and shellfish beds of Lyttelton Harbour.

STAFF

Dr Deirdre Hart (PhD UNSW) lectures in coastal studies and researches high-energy temperate and tropical coastal environments. Current research projects in New Zealand include investigations into lagoon and gravel beach dynamics on the West Coast while international projects include Pacific reef island beach systems, algal blooms in the South Sea of Korea, and reef management in the Republic of Maldives and Indonesia.

Derek Todd (MSc UC, Adjunct Fellow) contributes to teaching in the areas of coastal hazards and resource management, and supervises graduate research projects in these areas. He also consults on coastal resource management and consent projects.

Justin Harrison (MSc UC), Field and Equipment Technician, actively provides technical and field support to coastal research and consultancy projects and contributes to undergraduate and graduate coastal teaching in the areas of sediment and water quality analysis, survey techniques and other field/laboratory methods.

Emeritus **Professor Bob Kirk** (PhD UC) is Councillor to Environment Canterbury and continues to contribute to coastal teaching in the Department and to research and consult on coastal management with Dr Martin Single.

Dr Martin Single (PhD UC, Senior Adjunct Fellow) continues to make teaching contributions in the areas of coastal processes and management while working on lake shore management and consulting on coastal processes and management with Bob Kirk.

Justin Cope (MSc UC, PGDip NatRes Lincoln) is Senior Coastal and Fluvial Scientist at Environment Canterbury and Adjunct Fellow of the Department of Geography.

PHD STUDENTS

Zahid began PhD research on the effects of the Indian Monsoon system on the climate and coastal and water resources of the Republic of the Maldives.

Rijal Idrus is in the final year of his research on integrated coastal zone management in Indonesia, focussing on the use and management of mangroves and coral reefs in Sulawesi.

Tim Nolan is researching the controls and significance of beach cusps on New Zealand foreshores.

MASTERS STUDENTS

Mizna Mohamed completed MSc research into the non-market values of marine park resources in the Republic of Maldives (in conjunction with UC School of Economics).

Rei Ishikawa completed MSc research into shoreline change and beach morphodynamics of Rapahoe Bay, West Coast.

HONOURS AND SUMMER SCHOLARSHIP WORK INCLUDED REPORTS BY

David Alexander on developing a protocol for quantifying the cover and biomass of sea lettuce in estuaries (in conjunction with the UC Geospatial Research Centre, UC Biological Sciences, ECAN and the Avon-Heathcote Estuary Trust).

John Carter on past and likely future shorelines of Sumner Beach, Christchurch.

Kimberly Jupp on the salt marsh communities of the Avon-Heathcote Estuary Ihutai (in conjunction with UC Biological Sciences, ECAN and the Avon-Heathcote Estuary Trust).

Lou Stella on whether an area of wetland on the margin of Te Waihora/Lake Ellesmere was suitable for restoration of kahikatea forest.

Wybren de Vries on the growth and dynamics of mudflats in Lyttelton Harbour.

Andrew Wiebe on atmospheric turbulance over the Heron Island reef flat and cay.

University of Canterbury

Biological Sciences

TEACHING PROGRAMMES

The School offers marine courses at undergraduate level.

Marine Biology (Biol 212) includes the biology of marine organisms with an emphasis on marine invertebrates, biodiversity and marine habitats. This course includes a 5 day field course at the Edward Percival Field Station in Kaikoura.

Marine Ecosystems (Biol 374) is our third year marine ecology course, which also has a field trip to Kaikoura.

We offer Certificates of proficiency, post-graduate diplomas, MSc and PhD degrees. Graduate-level courses are offered in Aquaculture and Fisheries, Marine Biology, Ecophysiology, Zoophysiology, Experimental Marine Ecology, Applied Ecology and Environmental Science.

RESEARCH GROUPS

The Marine Ecology Research Group continues with their work on coastal processes. The four main lines of research are

- a FRST-funded programmes on Ecosystem-based management of New Zealand's coastal and oceanic waters and the Coasts and Oceans OBI (in conjunction with NIWA);
- a FRST-funded project on critical coastal habitats of native fish and integration of early life stages, natal history and riparian-pelagic coupling;
- a Marsden-funded project on scale-dependent bio-physical interactions in the dispersive phase of benthic marine propagules in turbulent coastal waters, and
- the Andrew Mellon Foundation-funded project on dynamics of nearshore marine ecosystems.

Paul South continues his work in running the field programmes in nearshore processes. He is responsible for the regular diversity surveys and implementing and monitoring field experiments at many coastal sites of the South Island.

Kerry O'Connell continues her work in organising the field and lab projects across the entire programme. She works closely in all aspects of field-based projects and has taken a particular interest in relationships between science and management of coastal ecosystems.

The Aquatic Physiology and Biochemistry Research Group are developing programmes in association with the seafood industry, genetics of aquaculture species and the effects of stress, including marine toxins, on marine organisms. This group also includes research programmes in the Antarctic.

STAFF AND POSTDOCTORAL RESEARCH

Dr Paul Broady is working on algae, surveying marine cyanobacteria in local habitats including intertidal rocks, sediments and seaweeds.

Dr Annette Brockerhoff (Post-Doctoral Fellow) is undertaking research on marine bioinvasions and marine biosecurity including the impacts of exotic species; decapod crustacean biology, marine crustacean parasites and mating systems.

Prof. Bill Davison is continuing with research on cardiovascular physiology of Antarctic fish, including animals infected with X-cell gill disease, and effects of temperature on Antarctic invertebrates.

Ass. Prof. Malcolm Forster and his students are continuing with research on the cardiovascular system of hagfish and marine teleosts and the effects of stress on marine organisms.

Ass. Prof. Neil Gemmell has research interests on the population biology and social structure of marine mammals, particularly the pinnepeds. One of his main objectives is to provide fine scale analyses of population structure and social organisation necessary to develop effective management programs for the long-term conservation of these animals. Current projects include behavioural and genetic investigations of fur seal populations and breeding systems.

Dr Steven Gieseg has research interests in fish macrophage biochemistry and is assessing the effects of excessive exercise and environmental effects such as temperature on fish antioxidant systems. He is also attempting to biochemically characterise X-cell disease in the gills of Antarctic fish.

Dr Sharon Goldstein is a post-doctoral fellow and continues her work on the population genetics of invasive species. Of particular interest has been Styela clava, a tunicate that has had great impacts on aquaculture overseas. She works closely with the population genetics lab of Prof Neil Gemmell and the invasive species group at NIWA.

Dr Mike Hickford is a post-doctoral fellow and co-PI on the riparian-pelagic coupling project. His work has identified source and sink populations for whitebait. He has installed both small- and large-scale experiments at many sites around the South Island to test the effectiveness of habitat restoration and changes in management practices of riparian vegetation in enhancing egg production in streams. He works closely with end-users, particularly the Department of Conservation, Environment Canterbury and the Christchurch City Council in ensuring that this work gets translated into management practices.

Ass. Prof. Islay Marsden is continuing research on estuarine ecology, the physiological ecology of crustacea and bivalve aquaculture. This research includes a comparison of the effects of temperature, salinity and aerial exposure on the growth and energetics of cockles and tuatuas. She is also working on the ecotoxicology of marine organisms from soft sediments and the effects of toxic algal blooms on bivalve populations. She is also collaborating on projects involving restoration of salt marshes, sea grass beds and shellfish beds (cockles).

Dr Vic Metcalf (Post-Doctoral Fellow) has a FRST-funded project investigating lipid transport in Antarctic fish. The dominant fauna of the Southern Ocean are the notothenioid fish, which show adaptation to the frigid waters they inhabit. They also possess a number of unique physiological and biochemical characteristics including production of antifreeze, reduced blood viscosity and high levels of tissue lipids.

Ass. Prof. Colin McLay retired at the end of the year but is continuing work on the biodiversity of NZ marine Crustacea. Other interests include - introduced crab species from the NZ EEZ, including the Kermadec Islands; introduced crabs; behavioural and evolutionary ecology of crabs.

Dr John Pirker is employed in the School as a Senior Tutor. He has research interests in marine ecology, restoration and protection of shellfish beds and marine reserves.

Dr Bruce C. Robertson (Post-Doctoral Fellow) is examining behaviour and paternity of breeding New Zealand sea lions Phocarctos hookeri on Enderby Island in the sub Antarctic Auckland Island. His other project is involves developing a molecular genetic methodology to identify the provenance of the large number of New Zealand fur seals Arctocephalus forsteri killed annually as by-catch in New Zealand trawl fisheries.

Dr David Taylor is a post-doctoral fellow and co-PI on the nearshore bio-physical processes project. He works closely with Dr Craig Stevens of NIWA and Dr Roger Nokes of the Fluid Dynamics lab at the UC School of Engineering. His work has identified great differences in the physical behaviours of algal propagules in their abilities to be transported and settle in turbulent waters. This work will continue for another 3 years.

Ass. Prof. Harry Taylor has a continuing interest in the comparative physiology of molluscs and crustaceans. This year he has been collaborating with a visitor, Dr. Deborah Donovan, Western Washington University investigating adhesion mechanisms in Haliotis iris and the energetics of resistance to wave forces.

Prof David Schiel continues to oversee all research projects and contracts, and is the co-PI in all grants, while maintaining a full teaching load in marine ecosystems, coastal processes, and aquaculture. His own primary research involves effective and sustainable use of coastal and estuarine resources based on improved definition of their ecological services, ecological forecasting to define limits of resilience, species deletions and disturbances, and their effects on diversity and function. He plays an active role in all of the research programmes.

Ass. Prof. Frank Sin is now continuing his research part time and has interests on the molecular biology, growth and development in abalone and lobsters and genetic improvement of growth in salmon. This research received funding from FoRST. Research involves isolation and characterisation of paua growth hormone and insulin-like growth factors and functional analysis of a novel neuropeptide

in the rock lobster. He is investigating actin gene expression in embryonic and adult paua, and phylogenetic relationship of actin genes to other organisms.

STUDENT RESEARCH

PhD

Sue Adkins
Sustainability and restoration of shellfish beds

Stephen Brown is a PhD student testing the effects of shell debris, population density, and dispersal modes for the enhancement of oyster (Tiostrea chilensis) populations. He works closely with industry in the Nelson area, and is working full-time at NIWA.

Davon Callander is a PhD student working in the Mellon-funded project. She has installed major coastal experiments to test the effects of zonational patterns, density, and mixed assemblages on the physiological responses of invertebrates to heat stress. She will be working closely with the ecology group of Profs Bruce Menge and Jane Lubchenco at Oregon State University.

Andrea Contreras
Physiological effects and biotransformation of paralytic shellfish toxins in New Zealand marine bivalves

Esme Robinson
Effects of temperature acclimation on the physiology of Antarctic fish

Frantz Smith
Effects of toxic algal blooms on the physiology of Perna canaliculus

Leigh Tait
Intertidal seaweed ecology and production, testing how disturbance, diversity and recovery affect primary productivity of nearshore benthic communities. His initial work has shown that the layering of key perennial species greatly affects production and that peaks of production often occur at intermediate levels of diversity.

Sebastien Delaux is a finishing PhD student on the Marsden project. He has developed and used innovative numerical modelling using GERRIS to characterise flow and propagule movement around benthic boundary layers. He is centred at the Greta Point lab of NIWA and works closely with Drs Craig Stevens and Stéphane Popinet.

MSc/BSc(Hons)

Matilde Cagnon is an exchange student from France working on the whitebait project. She is testing the intensity and extent of predation (by slugs and mice) on whitebait eggs. This experimental study ties in with other studies being done on early life stages and their interactions with habitat.

Catherine Ertel
Masking preferences of Notomithrax ursus

Nikki Hawes is an MSc student testing dispersal models in large brown algae. Her work has shown considerable differences among species in their abilities to remain reproductively active after becoming detached. Her work with nearshore drifters has also shown great differences among species in their abilities to disperse as drifting plants.

Julia Hooper
The effects of temperature change on cardiovascular physiology of spotties

Tania Hurley is an MSc student testing the effects of coastal sediments on successional processes after disturbance and the interactions of benthic species with sediments. Her initial work has shown great effects of sediments both on diversity and recovery after disturbance through inhibition of settlement.

Iremonger Gareth
Smoltification in Chinook salmon

Alex McConway
Effects of trace metal contaminants on juvenile cockles (Austrovenus stutchburyi)

SUCCESSFUL COMPLETION OF PHD DEGREES

Kelly Merrin
Taxonomy of the isopods Ilyarachninae and world-wide relationships

Robin Dunmore
The influence of variable settlement on the recruitment of habitat-forming seaweeds in the intertidal zone

SUCCESSFUL COMPLETION OF B.SC./M.SC. DEGREES

Kim Seaward
Rocky shore community ecology

EDWARD PERCIVAL FIELD STATION

In 2007 the Edward Percival Field Station hosted numerous University of Canterbury graduate and undergraduate field courses ranging form Intertidal Ecology to Coastal Geography. A significant number of Universities, schools and colleges use the field station as a base for coastal geography, biology and tourism studies as is reflected on the bookings list at www.ffc.canterbury.ac.nz/kaikoura/bookings.shtml.

The Edward Percival Field Station is one of four field stations at the University of Canterbury providing accommodation and research facilities for UC staff and students. The field stations, located at Westport, Harihari, Cass and Kaikoura, accommodate at least 30 people and are available (at cost) to visiting groups and/or individuals when they are not used by UC staff and students. Information about availability, costs and condition of use is available at www.ffc.canterbury.ac.nz. Research and teaching activities at each of the field stations are documented annually and can be viewed at www.ffc.canterbury.ac.nz/research.shtml

The ability to work in a range of diverse habitats; of which the marine environment is one of the most significant with access to the South Island East Coast (Kaikoura) and West Coast (at Westport and

Harihari), is reflected in the people overnights recorded at UC field stations. In 2007 a total in access of thirteen thousand seven hundred overnights were recorded at UC field stations.

University of Otago

Chemistry

During 2007, the highlights of Professor Keith A. Hunter's group activities were:
Keith Hunter continues as HOD of the Chemistry Department. He has recently been appointed as co-editor of "Marine & Freshwater Research" (CSIRO Publishing) to grow the physical/chemical side of the journal. His research interests include the determination of pH in sea water by spectrophotometric methods and the development of an analytical system to measure alkalinity in a 'real time' mode. He has also received an Otago University grant to investigating the effect of seawater pH on phytoplankton and also a Marsden grant to investigate cadmium isotope ratios in seawater.

Sylvia Sander helps to manage the research group and continues her work on trace metal speciation using electrochemical methods.

Malcolm Reid continues to work on interpreting a large series of surface water spectrophotometric pH measurements made in our regular time series transect across the Otago Shelf.

Enitan Ibisanmi is continuing in his PhD research on the mechanisms of iron acquisition by phytoplankton and has completed one research cruise in the Southern Ocean.

Melanie Gault Ringold has started her PhD research on cadmium isotopes in sea water.

Dr Urszula Nowastawska has continued working on the adsorption of viruses by colloids in groundwater as part of our ongoing joint Marsden project with ESR.

Dr. Jonathan Kim, whose research interests include trace metal interactions with aquatic biota, is analyzing research results on the effects of diet, trophic level (δC13 & δN15) and life history (Sr isotope ratios in otoliths) on the bioaccumulation of methyl Hg in fishes in West Coast rivers. A most exciting finding is that from the Sr isotope ratios preserved in fish otoliths, the life history from individual trout can be reconstructed.

Dr. Barrie Peake's research interests include the photochemistry of natural waters and trace metal signatures of New Zealand Seafood species. His research group is involved in a range of marine-related chemical research projects:

PhD
Shailini Ashoka
Trace metal signatures for NZ seafood

Amir Hamidian
Trace metal biomagnification in marine food chain

University of Otago

Marine Science

www.otago.ac.nz
www.otago.ac.nz/marinescience

Associate Professor Mike Barker has broad research interests in the reproduction and larval development of marine invertebrates and a particular interest in the culture of species used in aquaculture. His recent research has focused on the ecology and behaviour of the starfish Patiriella regularis and P. mortenseni living within or just below the low salinity layer in southern New Zealand fiords. In a collaborative research project with staff at the Food Science Department (Otago University) and Dr Mary Sewell (Auckland University) he has been developing artificial diets to enhance the value of the gonads (roe) of the sea urchin Evechinus chloroticus. This research is ongoing and is being funded by a research grant from the Foundation for Research, Science and Technology in the 2003/2004 Investment Round for Innovative Foods. He is also currently involved in two other collaborative research programmes: with Dr Miles Lamare (Marine Science, Otago) investigating the effect of UV light on larval development of benthic marine invertebrates from polar, temperate and tropical regions; and a FORST-funded large scale multi-organisation, multi-national project headed by Dr Nick Laycock of Industrial Research Limited. Other Otago staff involved in this programme are Associate Professor Jim McQuillan (Chemistry Dept.) and Associate Professor Phil Bremer (Food Science Dept.). The overall aim of the research is to produce surfaces, or polymer coatings for surfaces, with a range of functional properties and study at the molecular level the interactions of a range of micro- and macro-fouling organisms with these surfaces. The group's initial goal is to develop coatings for ship hulls that resist fouling by organisms such as bacteria, algae, barnacles and mussels.

Associate Professor Steve Dawson's research focuses on the conservation biology, ecology and bioacoustics of marine mammals. With **Associate Professor Liz Slooten** (Zoology Dept), he co-ordinates long-term research programmes on Hector's dolphins, sperm whales and bottlenose dolphins. The work on Hector's dolphins (and the North Island subspecies, Maui's dolphin) focuses on their conservation biology, particularly assessing the effectiveness of protected areas. The work on sperm whales is based around the use of hydrophone arrays to study underwater behaviour. The bottlenose dolphin work is focused on long-term trends in abundance and habitat utilisation in Doubtful sound. He collaborates internationally on issues in survey design, bycatch reduction, and acoustics.

Dr Miles Lamare's research interests are in marine ecology, population biology, marine invertebrate biology, photobiology of marine species, and the ecology and physiology of marine invertebrate larval stages. This research includes an interest in Antarctic marine invertebrates and how their physiology differs from temperate and tropical species, and understanding how climate change (ocean acidification, changes in sea temperature and increases in UV-B over the Antarctic) will affect marine invertebrate larval stages from polar regions. Research in these areas in 2007 has been conducted in McMurdo Sound, Antarctica, New Zealand, Samoa and the Cook Islands.

Dr Keith Probert is Head of Department of Marine Science. His research mainly concerns the ecology of marine sediments, including the structure and function of benthic assemblages, in which he has continued collaborative work with colleagues at NIWA, including participation in the Ocean Survey 20/20 voyage to the Challenger Plateau in May-June. Studies in conjunction with research students have mainly focused on biology and ecology of coastal species and habitats, environmental effects of human disturbances on coastal systems, and biodiversity of shelf and deep-sea benthos.

Dr Candida Savage has research interests in coastal ecology, with a particular focus on the effects of anthropogenic changes on coastal ecosystems. Her recent research involves using chemical markers in biota to assess the degree of terrestrial matter incorporation in coastal food webs influenced by different catchment land-use practices (MFish). Candida is also developing a research programme in biogeochemistry and hosted Professor Thomas Bianchi (Texas A&M University) in June-July 2007. They have initiated joint projects on the use of biomarkers to assess organic matter cycling in coastal environments over different spatio-temporal scales. This research includes palaeoecological applications to assess drivers of historical changes in primary productivity in Fiordland (ORG) and the flux and selective preservation of various organic carbon sources in sedimentary environments. Candida teaches and supervises students working on topics in coastal ecology and biogeochemistry, palaeoecology, marine pollution and aquaculture.

Dr Abigail Smith continues her research into shelf carbonate geochemistry with particular reference to carbonate production by bryozoans and on temperate reefs. A major project focuses on bryozoan geochemistry and its relevance to changes in sea-water chemistry. Her other major research area is in carbonate production and growth by cool-water bryozoans. Abby teaches and supervises students working on topics in marine sedimentology and coastal management. She is beginning to delve into bryozoan taxonomy, working in particular on the cyclostome family Horneridae.

Dr Ross Vennell continues his research in physical oceanography. Two of his papers in 2007 gave the first robust measurements of secondary flows in a curved flow, and a mechanism for hour-long period waves generated by storms. Five PhD students are working with Ross on projects ranging from secondary flow at headlands, through ebb tidal jet stability, tidal straining in estuaries, long period waves and ice shelves.

Dr Stephen Wing's research focuses on population biology of marine invertebrates and fishes, food web structure and biodiversity conservation. His current research in the Fiordland marine system focuses on the incorporation of terrestrial organic matter into the marine food web, spatial structure of populations of fishes and rock lobster, and assessing the biological consequences of marine reserves in the system. Current work on food web structure of the deep basin communities relies on use of stable isotope and fatty acid biomarkers to identify carbon sources to the community. Work on spatial structure of blue cod, sea perch and rock lobster populations in Fiordland continues with both analysis of food web position using stable isotope analysis and use of trace elemental signatures to assess relative site fidelity of the different species. Long-term monitoring studies of the marine reserves of Fiordland focus on identifying trends in populations and communities associated with individual habitats and management zones in the system.

Jean McKinnon and **Andrew Gormley** were Teaching Fellows in the Department for 2007 assisting in particular with the growing undergraduate programme. **Daryl Coup** continues in his role as Computer Support, **Mrs Chris Fitzpatrick** as Departmental Administrator, and **Lynn Paterson** provides secretarial support for the campus office. **Paul Meredith** coordinates field activities in remote locations

including Fiordland and Marlborough Sounds. **Bill Dickson**, the Vessel Master, operates the RV Polaris II, with **Phil Heseltine** as crewperson.

PORTOBELLO MARINE LABORATORY

Bev Dickson, Laboratory Manager, co-ordinates the day-to-day activities of the Laboratory, including allocation of space and resources and is the Departmental diving officer.

Caroline Wills, Secretary, provides full-time secretarial and administrative and computer support.

Karen Bonney, Laboratory Technician, attends to operations in the communal laboratories including chemical ordering, chemical inventory, HSNO regulations.

René van Baalen, Field Technician, oversees local field activities including small boat operations.

Dave Wilson, Workshop Technician, undertakes construction and repairs of equipment and maintains the seawater system.

Daniel Leduc, Resident Night Supervisor, ensures continuous operation of the seawater system and maintains security of the site after hours.

VISITORS TO THE PORTOBELLO MARINE LABORATORY

Professor Tom Bianchi
Texas A&M University (Williams Evans Visiting Fellow) (biomarkers of organic matter cycling)

Professor Marcus Key
Dickinson College, (J.A. Valentine Visiting Fellow) (bryozoan geochemistry)

Dr Jo Porter
University of Wales, (genetics of bryozoans)

Professors Chris Cheng-DeVries and **Art DeVries**
University of Illinois, Urbana-Champaign, (evolution of notothenoid fishes)

Dr Simon Morley and **Professor Lloyd Peck**
British Antarctic Survey, Cambridge, UK, (latitudinal comparison within brachiopods)

NEW ZEALAND MARINE STUDIES CENTRE

Sally Carson and her team run the New Zealand Marine Studies Centre and Aquarium. As the public face of the Department of Marine Science, the Centre aims to foster understanding, appreciation and responsible management of New Zealand's unique marine environment through its education programmes and displays. In 2007 more than 25,500 people visited the NZMSC and Aquarium, and more than 3,300 people took part in off-site education programmes including our school programme at the Touch the Sea Aquarium in Mapua for the Nelson/Marlborough/Tasman region. Highlights for 2007 included over 70 media articles, a variety of holiday events and a growing education programme. It was the second year of the secondary Year 10 Gifted and Talented Programme in marine science. A new programme for year 12 gifted and talent students aboard the RV Polaris II was launched.

POSTGRADUATE STUDENTS
PhD

Ruth Arkless
Undaria pinnatifida invasion of rock pools on the Otago coastline

Cerys Bailey
Estuarine circulation physics

Claire Biggs
Dynamics of the Otago Harbour ebb-tidal jet and its associated dipole

Simon Childerhouse
Conservation biology of New Zealand sea lions (Phocarctos hookeri)

Rohan Currey
Conservation biology and behaviour of resident bottlenose dolphins in Doubtful Sound, Fiordland

Stefan Görlitz
Ecosystem functioning of Abarenicola affinis

Catherine Gongol
Assessing the effects of different land use practices on the rates of denitrification in New Zealand estuaries

Gary Griffith
The photoprotective xanthophyll cycle in phytoplankton of the Southern Ocean and Antarctic sea-ice algae

Fiona Higgins Crane
A detailed study of the midget octopus Octopus huttoni

Lucy Jack
The ecological role of rock lobsters (Jasus edwardsii) in Fiordland

Daniel Leduc Trophic dynamics and taxonomy of meiofauna in intertidal habitats

Matt McArthur
Benthic community biomonitoring in estuaries and inlets

Rebecca McLeod
The roles of key species and functional guilds in facilitating fluxes of organic matter across habitat boundaries in Fiordland

Brian Miller
Passive acoustics and 3D diving behaviour of sperm whales in Kaikoura, New Zealand

Gearoid O'Sullivan
Ecology of Galeolaria hystrix, a temperate reef-building serpulid tubeworm

Brian Paavo: Effect of dredge spoil disposal on invertebrate benthos

Hadi Poorbagher
Life-history ecology of echinoderms with planktotrophic larvae

Will Rayment
Distribution and movements of Hector's dolphin: implications for protected area design

Natalie Robinson
Seasonal variation in ocean density stratification beneath Antarctic sea ice

Peter Russell
Secondary circulation generated by headlands

Silvia Scali
Use of harbours on the North Island west coast by the critically endangered Maui's dolphin

Kareen Schnabel
Systematics and phylogeography of Galatheoidea of New Zealand and adjacent waters

Severin Theibaut
Formation and development of large headland eddies

Anna Wood
The effect of frame-building bryozoans on biodiversity

MSc
Chelsie Archibald
Reef fish in Fiordland: using physical and biological data to determine spatial and temporal patterns

Peter Bell
A comparison of techniques to induce Paua (Haliotis iris) to release from an artificial substrate

Michelle Beritzhoff
Blue cod (Parapercis colias) measurements obtained using a visual underwater method, and its future application

Hamish Bowman
Flow dynamics over the Doubtful Sound entrance sill

Kimberley Capone
Comparison of juvenile flatfish growth between seagrass and non-seagrass habitats

Dana Clark
The effect of CO2 and ocean acidification on sea urchin larvae

Rochelle Dewdney
Biological effects of UV radiation (UV-R, 290-320 nm), in situ, on the marine macroalgae of the southern New Zealand region over an annual cycle

Céline Dufour
Distribution and abundance of macrofauna on Otago sandy beaches

Reid Forrest
Trace metal accumulation in the Motueka River plume

Keira Heggie
Comparison of bivalve growth rates and stable isotopic values in estuaries with different nutrient loads

Rebekah Hooper
A classification of southern New Zealand estuaries and inlets

Nikolas Isely
Temperature adaptation and expression of the photolyase enzyme in echinoderm larvae

Josephine Jackson
Gregariousness in a nascent breeding population of New Zealand sea lions at Otago

Rowan Keys
Reproduction and recruitment of Evechinus chloroticus in the SUR 5 fishery

Samuel Koenig
A novel approach to pollution monitoring: the use of multiple biomarkers to assess the health status of coastal ecosystems in New Zealand

Anna Lewis
Spatial dynamics of sea perch (Helicolenus percoides) in Fiordland and Otago

Kathryn Lister
Oxidative stress in Antarctic and non-Antarctic sea urchin larvae: an assessment of molecular techniques

Mara Macklé
Sediment macrobenthos of Ulva Island/Te Wharawhara Marine Reserve, Stewart Island

Alaric McCarthy
Effects of sunscreen compounds on Antarctic and non-Antarctic sea urchin larvae along a latitudinal gradient

John Neilsen
Heavy metals in Otago Harbour sediments

Poasi Ngaluafe
Reproductive biology of sandfish Holothuria scabra, tigerfish Bohadschia argus, Watty Selenkas, sea cucumber Stichopus horrens and prospective management options for sea cucumbers fisheries in Tongan coastal waters

Natalie Nolan
Histological effects of post-harvest processing techniques on the roe of the sea urchin Evechinus chloroticus

Janet Osmand
Behavioural thermoregulation of New Zealand sea lions

Derek Richards
Environmental influences on rocky reef habitat, kelp forest productivity and paua/kina populations

Undine Riemer
Photo-protective compounds (MAAs and carotenoids) of krill (Nyctiphanes australis) and marine phytoplankton off the Otago coast

Lucy Rowe
Dorsal fin morphometry of Fiordland bottlenose dolphins

Susanne Schuller
Spatial and temporal distribution of diatoms in the sediment of Doubtful Sound, Fiordland

Anama Solofa
Reproduction and regeneration of Stichopus horrens in Samoa

Michelle Taylor
Hydrographic effects on the distribution of plankton at the deflection point of the Blueskin Bay Eddy

Miranda van der Linde
Development of an integrated digital catalogue and database for Kaikoura sperm whales, and mark-recapture assessment of their abundance

Trudi Webster
Age, sex and associations of Hector's dolphins at Banks Peninsula

Shannon Williams
Breeding migration of adult male New Zealand sea lions resident in Otago

Youjia Zou
The potential links between the polar regions and ENSO

Erin Zydervelt
Predation, growth, and nutrition of (Mytilus edulis galloprovincialis, Perna canaliculus and Aulacomya maoriana) below the low salinity layer in Doubtful Sound, Fiordland

University of Otago

Physics

SNOW AND ICE RESEARCH IN NEW ZEALAND

New Zealand recently became the newest regional branch of the International Glaciological Society (website www.sirg.org.nz). Snow and Ice research in New Zealand covers all topics from sea ice and avalanche research to glaciology and hydrology.

Important groups are based at the major universities (Otago, Canterbury, Victoria, Massey, Lincoln and Auckland) as well as the national (crown) research institutions including the National Institute for Water and Atmospheric Research (NIWA), Institute of Geological and Nuclear Sciences (GNS Science) and Industrial Research Limited (IRL).

The abstracts below provide a sample of recent activity, but they do not cover the full range of topics. They are mostly from our annual Snow and Ice Research Group meeting, which will be held from February 4-6th 2008. Further reports from New Zealand will hopefully correct this bias and include more Antarctic glaciology and sea ice research.

Platelet ice growth during winter: McMurdo Sound, Antarctica

Greg Leonard, Pat Langhorne, Craig Purdie, Ross Vennell, Russell Frew, David Dempsey (UO); Tim Haskell (IRL); Mike Williams, Craig Stevens, Natalie Robinson (NIWA); Mark McGuinness, Jonathan Crooks, (VUW)

Platelet ice is the name given to ice crystals that nucleate in the ocean and grow either at depth or loosely attached to the ice-water interface. Linked to the proximity of ice shelves, it is known to form in supercooled sea water. This project began in 2002, and has conducted observations on and below the land-fast sea ice of McMurdo Sound during the austral winter of 2003. A key finding is that the presence of platelet ice in the sea ice cover is conclusively linked to the time history of the appearance of ice crystals in the water column, monitored using the strength of the backscattered signal from an acoustic Doppler current profiler as a proxy.

Formation and structure of refrozen cracks in sea ice

Chris Petrich (now at Geophysical Institute, University of Alaska, Fairbanks, USA), Pat Langhorne; Tim Haskell

This study characterizes the healing process and structure of undeformed, linear, parallel-sided, flooded cracks in land-fast sea ice. Field investigations and refreezing experiments were performed in McMurdo Sound, Ross Sea, Antarctica, between 1998 and 2002. Data from a two-dimensional thermistor array are used to show that the ice-water interface of freezing cracks is arch-shaped due to bidirectional heat flow to the surrounding ice cover and to the atmosphere. Ice growing laterally into the crack is found to desalinate over a prolonged period of time, until the isotherms are approximately horizontal. Superposition of heat flow to the atmosphere and to the host sea ice sheet allows the refreezing progress to be modeled analytically. Close to the ice–air interface, the salinity is higher at the sides of wide refrozen cracks than it is at the center. However, deeper down and in narrower cracks in general, the salinity is higher at the center than at the sides. A finite volume, computational fluid dynamics (CFD) model reproduces the generally arch-shaped alignment of brine pockets. This pattern is attributed to convection in the mushy layer. Crystals are found to grow upstream into the crack due to a salinity gradient in the buoyant convective flow.

Preferred crystal orientation in freshwater ice

Marc Mueller-Stoffels (now at Geophysical Institute, University of Alaska, Fairbanks, USA), Pat Langhorne

Crystal orientations in lake ice have been the subject of considerable attention due to their influence on albedo and stability during melt season. It has been reported in the literature that ice sheets on freshwater bodies develop preferred crystal orientations. In some ice sheets c-axis vertical crystals become dominant, in others, c-axis horizontal dominate. However, the reason for these differences is unclear, and it has been suggested that the preferred orientation depends either on the thermal characteristics of the water body or on whether the ice is seeded. Experiments have been conducted which confirm that in seeded fresh water ice sheets the favored c-axis orientation is horizontal, regardless of the bulk temperature gradient in the water column. However, these experiments also suggest that the temperature gradient close to the interface is influenced by seeding. We propose that the partial melting of seeds prior to freezing of seeded ice sheets creates conditions favorable to the growth of c-axis horizontal crystals. Alternatively unseeded ice sheets, grown under the same conditions, develop a preference for c-axis vertical crystals.

Modelling the salinity of growing sea ice

Chris Petrich, Pat Langhorne, Hajo Eicken (Geophysical Institute, University of Alaska, Fairbanks)

Desalination of sea ice under quiescent conditions has been modelled with a two-dimensional continuum computational fluid dynamics (CFD) model and with an explicit analytical model. The governing equations of the CFD model are solved with the finite volume method. The analytical model assumes gravity-driven convection as the only desalination process. Both models predict that the quasi-steady, stable salinity profile of sea ice can be parameterised by the growth rate, independent of the oceanic heat flux. The relationship approximates a power law for growth rates above 1 cm per day, which is consistent with field data. The results are consistent with an earlier desalination model. Sensitivity studies of CFD simulations show that the modelled stable salinity appears to depend little on the permeability at high porosities. However, increased permeability at high porosities reduces the appearance of scatter in the salinity distribution. Simulations with anisotropic permeability suggest that the stable salinity depends on the geometric mean of the lateral and vertical permeability components. Assuming a critical porosity, below which no fluid motion is possible, is not necessary to produce a stable salinity profile.

Victoria University of Wellington

Victoria University of Wellington is home to a thriving community of established marine scientists and students. Currently, the marine biology group consists of 7 academic staff, and about 50 postgraduate students. VUW houses The Centre for Marine Environmental and Economic Research (CMEER), which is headed by A/Prof. Jonathan Gardner. The major focus of our research is coastal ecology, with our academic staff having research programmes in temperate, tropical and polar systems. In particular, we have strengths in areas such as marine conservation, inter-tidal and sub-tidal ecology, coral reef biology, Antarctic sea-ice biology, population genetics, larval ecology, marine microbiology, algal taxonomy and physiology, fish ecology, marine symbiosis and aquaculture.

DEPARTMENT AND RECENT NEWS

Victoria University's Coastal Ecology Lab at Island Bay (VUCEL: www.vuw.ac.nz/vucel) received CAPEX approval in late 2006 to completely rebuild its facilities to accommodate recent growth in marine biology and coastal ecology research programmes. The new facility will provide new wet and dry lab space, offices for students and academics, and a high quality staging facility to support both marine and terrestrial research programmes. VUCEL is currently under construction with completion planned for late 2008.

DR. JAMES J. BELL

PhD students

Pelayo Salinas
Connectivity in coastal marine ecosystems

Alejandra Perea
Functional diversity of subtidal ecosystems.

Jade Berman
Inter-ocean variability in sponge assemblages

Tamsen Byfield
Habitat mapping and the development of MPA monitoring tool

Abigail Powell
The effect of environmental degradation and climate change of coral-sponge interactions

Ingrid Knapp
The ecology sponges at Palmyra Atoll.

Urusla Rosar
Effectiveness of Marine Reserves in NZ

Daniela Diaz
Economic impacts of marine reserve designation

Tyler Eddy
Marine Reserves as Conservation and Management Tools in New Zealand

Celine Reisser
Genetic isolation of Island marine populations

MSc students
Heather Murray
Sponge bleaching

Jennifer VanderVeur
The ecology of Austrolittorina cincta and A. antipodum

Lauren Fletcher
Larval dispersal ecology of ascidians

Nick Ward
Sponge morphological variability

DR. SIMON K. DAVY
Research during 2007 concentrated on mechanisms of cell recognition in cnidarian-algal symbioses, in collaboration with Prof. Virginia Weis of Oregon State University. They were awarded an NSF grant to organise an international workshop on this topic; this took place at Heron Island Research Station in early 2007 and was attended by about 50 leading researchers from Australasia, the USA and Europe. Other major projects in 2007 studied the photo-physiology of corals at isolated and high latitude locations (namely Lord Howe Island, the Kermadec Islands and Palmyra Atoll) and the prevalence and ecological impacts of coral disease in the Central Pacific (Palmyra Atoll and Hawaii) in collaboration with Dr. Greta Aeby of the University of Hawaii. The lab has just begun a project looking at the effects of elevated CO2/ocean acidification on the photo-physiology of corals and other symbiotic invertebrates, in collaboration with Prof. Denis Allemand of the Centre Scientifique d'Europeen in Monaco. November saw the continuation of the Antarctic sea-ice research programme with Ken Ryan of VUW.

PhD students:
Jade Berman
Temporal variability in sponge assemblages

Emily Dicks
Cellular events during the onset of cnidarian-algal symbiosis

Eileen Koh
The ecology of phototrophic microbes in Antarctic sea ice

Daniel Logan
Cell-cell recognition in mutualistic cnidarian-dinoflagellate symbioses

Michael Page
Chemical ecology and aquaculture of the symbiotic sponge Mycale hentscheli

Alejandra Perea
Functional diversity of subtidal ecosystems

Meghana Rajanahally
The photophysiology of Antarctic microalgae

Laura Wicks
Ecology and symbiont diversity of high latitude scleractinian corals

Gareth Williams
The prevalence and ecological impacts of coral disease at Palmyra Atoll, Central Pacific

Recently Completed PhD

Dr. Phil James

Husbandry techniques and the effects of season and reproductive cycle on roe enhancement of the New Zealand sea urchin, Evechinus chloroticus

MSc

Shyam Morar

Nitrogen uptake and metabolism in the common mudflat anemone Anthopleura aureoradiata (submitted March 2008)

Tiffany Bock

The control of carbon flux in a temperate cnidarian-algal symbiosis (submitted March 2008)

Milena Palka

The impacts of salinity and temperature on the photophysiology of a temperate zooxanthellate sea anemone

Scott Lawrence

The bacterial endosymbionts of New Zealand's echinoderms

Christopher Gibbons

The influence of habitat and seasonality on phototrophy in the temperate zooxanthellate sea anemone Anthopleura aureoradiata

Michael Doherty

The impacts of CO2 elevation and ocean acidification on coral photophysiology

Heather Murray

The photobiology of coral reef sponges

William Arlidge

Viral communities of corals at Palmyra Atoll

Michael Cowlin

Osmoregulation in cnidarian-algal symbiosis

DRS. JEFF SHIMA AND NICOLE PHILLIPS

Dr. Nicole Phillips

The broad context of Dr. Phillips' research is the population and community ecology of benthic marine organisms. Her recent work has been primarily focused on the ecology of reproduction and early life-history stages of marine invertebrates, particularly as they relate to recruitment dynamics and life history theory. She is especially interested in how factors or stresses that influence one life stage may have cascading effects on subsequent life stages, and maternal effects. Dr. Phillips generally works across several fields of research encompassing rocky reef/intertidal ecology, nearshore oceanography, dispersal, larval ecology, and invertebrate biology.

Research in 2007 focused on a project funded by a Fast-Start grant from the Marsden Fund, and in collaboration with Dr. Cathy Pfister from the University of Chicago. This work examined how spatial variability in food availability and habitat quality translates into variability in maternal investment for a suite of intertidal gastropod whelk species with life history and feeding strategies. A preliminary project on the life history strategies and reproduction of vermetid gastropods in Moorea, French Polynesia (in collaboration with Dr. Jeff Shima from VUW) was also undertaken, and will be further explored in 2008.

An on-going theme of projects in Dr. Phillips' lab is to examine how variability in larval condition or quality originates in the pelagic environment and the role such variability plays in determining recruitment success of individuals and cohorts under different benthic environmental conditions.

Dr. Jeff Shima

Dr Shima's primary research interests are in population and community ecology of organisms with stage-structured populations. Dr Shima's research uses a variety of quantitative methods to explore the processes that control distribution, abundance, and dynamics of marine organisms (mainly marine fishes and invertebrates).

In 2007, Dr Shima initiated a new programme of Marsden-funded research directed at the role of marine "landscapes" (i.e., metapopulation "matrix effects") on patterns and mechanisms of larval fish dispersal. This work targets larvae and recently settled recruits of the common triplefin, Forsterygion lapillum, and Dr Shima's research in 2007 examined larval dispersal and hydrographic features around Kapiti Island and the greater Cook Strait region. This project, led by Dr Shima, is a collaboration with investigators at NIWA (Dr Steve Chiswell and Dr Craig Stevens) and the University of Melbourne (Dr Steve Swearer).

In addition, in 2007 Dr Shima completed a 5 year study of recruitment dynamics of coral reef fish on island of Moorea (French Polynesia). This work is part of an ongoing collaboration with Professor Craig Osenberg of the University of Florida, and was funded by the US National Science Foundation and supplemental awards from the Royal Society of New Zealand's ISAT Linkage fund. Key findings of this work include observations of habitat degradation that appear to be associated with high densities of the tube-forming vermetid gastropod, Dendropoma maxima. New research was initiated in 2007 to explore interactions between vermetid gastropods, corals, and reef fishes.

Through his long-term association with the research community in French Polynesia, Dr Shima continues as a founding member of an international consortium of researchers tasked with the design and implementation of assessments of marine protected area networks of French Polynesia.

Finally, Dr Shima was on a 10 month sabbatical for most of 2007, which took him to several overseas venues (Australia, French Polynesia, and the US) for productive, extended interactions with overseas colleagues, and participation at two international conferences (Annual meetings of the American Society of Limnologists and Oceanographers, and the Ecological Society of America).

POSTGRADUATE STUDENTS

PhD

Nicolai Truemper

Life history trade offs and spatial dynamics of an aggregating species, Petrolisthes elongatus

Trade-offs in ecological considerations are commonly regarded as a key to understand the evolution of life history characteristics. In aggregating species, there is likely a trade-off between positive effects of aggregation and negative effects of density-dependence. The New Zealand porcelain crab Petrolisthes elongatus is highly abundant on intertidal boulder fields and cobble beaches. This species shows a highly aggregated, "clumped" pattern on a small scale (tens of centimetres) with high density patches under larger rocks. Thus, P. elongatus is a suitable model organism to address particular and general questions concerning life history trade-offs and spatial dynamics of an aggregating species. Nicolai is particularly interested in characterizing the trade-offs between aggregation and density-dependence on growth and reproduction, and how these trade-offs may be mediated by habitat quality.

Lesley McLeod

Factors influencing the larval behaviour of NZ's economically and culturally important coastal marine species

Lesley is conducting her research on larval behaviour of marine invertebrate species that are of economic and cultural importance: kina (the urchin Evechinus chloroticus), paua (the abalone Halitois iris), and koura (rock lobster Jasus edwardsii). Lesley is investigating factors that drive variability in larval behaviour for these species, including parental effects and larval quality, across a variety of physical conditions in the water column. Ultimately, Lesley is interested in how this variability influences the outcome of hydrodynamic models developed to predict larval dispersal. The results from this research will help enhance the predicative capabilities of dispersal models (which are currently under development by NIWA) and in the long-term help optimise management strategies for these important species.

Bionda Morelissen

Influence of increased nutrients on invasive marine algae and intertidal communities

The introduction of non-native species into the marine environment is considered a major threat to marine ecosystems, and non-native species often thrive in disturbed sites. A major cause of coastal anthropogenic disturbance is the alteration of nutrient regimes in aquatic environments (e.g, by sewage outflows or run-off). Bionda's research examines how increased nutrient concentrations in the nearshore influence the effects of the introduced seaweed species Undaria pinnatifida and Colpomenia bullosa on native rocky intertidal algal communities. Understanding the effects of increasing nutrient concentrations on invasive species will give insight in the consequences of our anthropogenic impacts on the rocky intertidal zone and can help to set up appropriate environmental management and conservation strategies.

Shane Geange
An Evaluation of Competitive Co-occurrence within a Guild of Coral Reef Fish Recruits

Many reef fish settle in asynchronous pulses around the new moon, producing interspecific variability in the sequence (which species arrives first) and timing (by how much) of arrival. Shane's research examines patterns and mechanisms of competitive interactions that shape variation in recruitment of a guild of coral reef fish. His research is conducted from the UC Berkeley Gump Research Station on the island of Moorea (French Polynesia), and his recent experiments conducted in 2007 test the role of "priority effects" on survivorship of juvenile coral reef fish. In 2007, Shane also spent 6 months as a Fulbright Fellow hosted by the University of Florida.

Sonja Miller
A quantitative evaluation of traditional marine resource management: assessing effects ra'ui of the Cook Islands (Rarotonga)

Sonja is nearing completion of her PhD research, which develops and implements a novel quantitative framework to assess the effects marine protected areas (ra'ui) on a wide range of species inhabiting the island of Rarotonga (Cook Islands). Sonja's work incorporates measures of habitat preference and variability, to provide more robust estimates of MPA effects that statistically control for spatial heterogeneity.

Bruce Dudley
Better quantitative impact assessments using natural abundance carbon and nitrogen stable isotope signatures

Bruce's work explores physiological mechanisms that underlie the uptake of stable isotopes in marine algae. He has used a combination of lab and field experiments and surveys to assess the impacts of nutrient enrichment from a sewage outfall on the performance of macroalgae. Bruce handed in his PhD thesis in 2007.

Anna Smith
Relative importance of macroalgal nursery habitats for recruitment of the common triplefin (Forsterygion lapillum)

Anna's work examine the role of macroalgae structure and composition as a nursery habitat for juvenile reef fish. She uses experiments and surveys, coupled with analyses of otolith microstructure to identify important sources of variation in "habitat quality" as provided by temperate reef macroalgae.

Alejandro Perez-Matus
Effects of macroalgal habitats on the community and population structure of temperate reef fishes

Ale's research examines the effects of macroalgae on the distribution and abundance of reef fishes. His research also targets direct and indirect "multiple predator effects" on abundance of mesograzers and the performance of key species of marine algae. Finally, Ale is undertaking a spatial comparison of reef fish community structure across multiple temperate reefs in the southern hemisphere (South America, New Zealand, and Australia).

Philipp Neubauer

Reproductive output and larval connectivity in a reef fish metapopulation

Philipp began his PhD studies at VUW in late 2007. He has been undertaking a spatially stratified sampling of nests of the common triplefin, Forsterygion lapillum. From these sampled eggs, Philipp will examine patterns of trace element microchemistry recorded within hatchling otoliths. From these patterns, Philipp will explore scales and sources of variation in natal otolith signatures, which can be used to infer patterns of connectivity in a reef fish metapopulation.

MSc

Rahul Demello

Processes influencing intertidal barnacle populations in the Wellington region

Barnacles in the Wellington region have distinctly different species-specific patterns of distribution. Overall densities of barnacles are orders of magnitude greater in Wellington Harbour, where the predominant species is the small honeycomb barnacle Chaemosipho columna, compared to the nearby South or Cook Strait coast, where populations are sparser and consist predominantly of the larger species Chaemosipho brunnea. Rahul's research examined causes of these differences with a particular focus on potential regional differences in environmental stress, settlement, competition and predation.

John Van Der Sman

Reproductive allocation and maternal investment in intertidal whelks

Whelks lay benthic egg capsules in the intertidal, and different species use different strategies, i.e. use of nurse eggs, one vs. many embryos per capsule. Whelks therefore are an ideal model system to examine the causes and consequences of variability in maternal investment for offspring. John's research examines how the maternal environment influences trade-offs between offspring size and number, and how these trade-offs may vary among species with different reproductive strategies. Additionally, John has examined the potential cascading effects of variability in maternal investment both on the performance of juvenile whelks in terms of growth and survival.

Janine Russell

The Effect of Ultraviolet radiation and other environmental stressors on the development of mollusc embryos in New Zealand

Because of human-induced changes to the atmosphere, New Zealand is experiencing increased levels of ultraviolet radiaton (UV), which may have important ramifications for many species and ecosystems. Many species of marine molluscs lay egg masses in the intertidal or shallow subtidal, where the embryos develop. These embryos may be particularly vulnerable to increasing levels of UV, in addition to other environmental stresses from desiccation, increased water temperature, and salinity changes. Janine examined the combined and separate effects of UV and these other environmental stressors on the development and survival of a variety of species of intertidal molluscs that lay benthic egg masses (e.g. pulmonate limpets Siphonaria australis, Benhamina obliquata, and bubbleshell Haminoea zelandiae.

DR. KEN RYAN
FRST funded Research

- Determine total biomass, biodiversity and metabolic activity of algae and bacteria at Terra Nova Bay, including contributions from the sea ice and the water column. Assess relative productivity of various fractions within the Sea ice microbial community. Collect samples of algae and bacteria for analysis by DNA fingerprinting techniques in NZ. Relate the results to the effect of global warming on primary productivity in ice covered marine ecosystems.

- Determine the physical parameters (temperature, light, salinity) that govern algal growth in sea ice for use in biophysical modelling.

- Assess distribution, taxonomy, physiology, and feeding habits of pelagic amphipods.

A successful research field trip was undertaken to Gondwana Station (75°S) in the Ross Sea, in Nov – Dec 2007.

Brief summary of staff members/research interests and projects over the past year:

Dr Ken Ryan
Dr Simon Davy
Dr Ronan O'Toole

Focus of research : Sea ice microbial ecophysiology and biodiversity
Principal projects : FRST funded DNA Barcodes of sea ice micobes

POSTGRADUATE STUDENTS
PhD

Andrew Martin
Sea ice bacteria and the microbial loop

Eileen Koh
Prokaryote Biodiversity in Sea Ice

Ed Abdool
Productivity modelling of sea ice ecosystems

Meghana Rajanahally
Physiological responses of sea ice communities to environmental change

MSc
Lisa Bryant
Sea ice amphipod taxonomy and physiology

DR. JOE ZUCCARELLO
Focus of research: Evolution of algae, Systematics of algae, connectivity of algal populations.

Principal projects: The evolution of actin genes in the Stylonematales.

POSTGRADUATE STUDENTS
PhD

Joseph Buchanan
Molecular ecology and evolution of New Zealand fucoid algae

Erasmo Macaya
Phylogeny, connectivity and dispersal patterns of the giant kelp *Macrocystis* spp

Peter Martin
Taxonomic relationship and phylogeography of *Lessonia* species around New Zealand and the subantarctic islands

MSc
Fiona Hodge
Title of project: Hybrids, and hybrid zones in the brown seaweed Carpophyllum

RECENT PUBLICATIONS

Auckland University of Technology

RECENTLY COMPLETED THESES

Steve Pohe
Macro-invertebrate distribution within streams feeding into estuaries.

Jens Horstkotte
The systematics and ecological role of Histioteuthis squid (Cephalopoda: Histioteuthidae) in New Zealand waters.

RECENT (REFEREED) PUBLICATIONS, 2007 – PRESENT

Alfaro AC, Webb S, Phipps C. (In press). Variability of growth rates, health, and population turnover within mussel beds, Perna canaliculus, in northern New Zealand. *Marine Biology Research*.

Alfaro AC (In press). Dietary preferences of Littoraria scabra, while vertically migrating on mangrove trees: gut content, fatty acid, and stable isotope analyses. *Estuarine, Coastal and Shelf Science*.

Alfaro AC, Zemke-White L, Nainoca W (In press). Faunal composition within algal mats and adjacent habitats in Likuri, Fiji Islands. *Journal of Marine Biological Association of the United Kingdom*.

Alfaro AC (In review). Food preference of the pulmonate gastropod, Onchidella nigricans, within a New Zealand rocky shore intertidal. *Animal Biology*.

Alfaro AC (In review). Effects of mangrove removal on benthic communities and sediment characteristics at Mangawhai Harbour, northern New Zealand. *Estuarine, Coastal and Shelf Science*.

Beatson E 2007. The diet of pygmy sperm whales, Kogia breviceps, stranded in New Zealand: implications for conservation. *Reviews in Fish Biology and Fisheries* 17: 295-303.

Beatson E, O'Shea S, Shortland T, Stone C 2007. Notes on New Zealand mammals 6. Second report on stomach contents of long-finned pilot whales, Globicephala melas. *New Zealand Journal of Zoology* 34: 359-362.

Beatson E, O'Shea S, Ogle M. 2007. First report on the stomach contents of long-finned pilot whales, Globicephala melas, stranded in New Zealand. *New Zealand Journal of Zoology* 34: 51-56.

Bollard-Breen B, Breen D (In press). Quantifying community perceptions of marine environments for Marine Protected Area planning: When is the Reef too crowded? *Tourism in Marine Environments*.

Bolstad KS (In review). Two new species and a review of the squid genus Onychoteuthis Lichtenstein, 1818 (Oegopsida: Onychoteuthidae) from the Pacific Ocean. *Bulletin of Marine Science*.

Bolstad KS 2008. A global revision of the hooked squids, family Onychoteuthidae. *The Malacologist* 50: 17-18.

Bolstad KS 2007. Systematics and distribution of the New Zealand onychoteuthid fauna (Cephalopoda: Oegopsida), including a new species, Notonykia nesisi sp. nov. *Reviews in Fish Biology and Fisheries* 17: 305-335.

Campbell KA, Peterson D, Alfaro AC 2008. New occurrences of Retiskenea? (Gastropoda: Neomphalidae) from Cretaceous hydrocarbon seep carbonates from northern California. *Journal of Paleontology* 28: 140-153.

Clements KD, Zemke-White WL 2008. Diet of subtropical herbivorous fishes in northeastern New Zealand. *New Zealand Journal of Marine & Freshwater Research* 42: 47-55.

Cummings V, Vopel K, Thrush S (In review): Effects of terrigenous deposits on pore water solutes in coastal marine habitats: explaining post-settlement colonist behaviour. *Submitted to Marine Ecology Progress Series*.

Ellwood MJ, Wilson P, Vopel K, Green M (In review): Trace metal cycling in the Whau Estuary, Auckland. *Submitted to Marine Chemistry*.

Jones MRL (In review). The diets of Coryphaenoides subserrulatus and Etmopterus baxteri from the Puysegur region, southern New Zealand, with notes on the diets of 12 other fish species. *New Zealand Journal of Marine and Freshwater Research*.

Jones MRL (In review). The food and feeding of eight fish species from the upper slope off the Wairarapa Coast, North Island, New Zealand. *New Zealand Journal of Marine and Freshwater Research*.

Jones MRL, Leschen RB (In press). The occurrence of beetles in the diet of six species of deep-sea fish. *New Zealand Journal of Zoology*.

Jones MRL 2008. Dietary analysis of Coryphaenoides serrulatus, C. subserrulatus and several other species of macrourid fish (Pisces: Macrouridae) from northeastern Chatham Rise, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 42: 73–84.

Jones MRL 2007. Historic trawl data and recent information infers temporal change in the occurrence of squid in the diet of orange roughy (Hoplostethus atlanticus Collett) in New Zealand. *Reviews in Fish Biology and Fisheries* 17: 493–499.

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CONFERENCE PRESENTATIONS

Gonsior, M., Peake, B. M,Cooper, W. J., Cooper, W. Characterisation of dissolved organic matter along a mixing gradient using electrospray ionisation Fourier Transform Cyclotron Resonance mass spectrometry. Presented to *ASLO 2007 Aquatic Science Meeting*, Santa Fe, New Mexico (February 4-9,2007)

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