

Ocean Sciences Centre

Memorial University

Annual Report 2002-03

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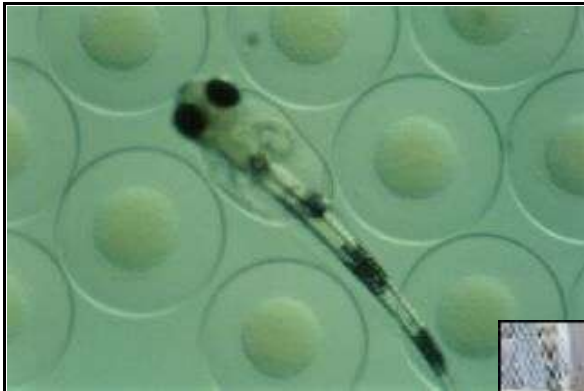




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1. Director's Report

Introduction

I became Interim Director on January 1, 2003. Given that Annual Reports from the OSC have not been common over the years, I would like to take this opportunity to thank my predecessors on behalf of all OSC faculty, students and staff. Dr Bill Driedzic arrived at the OSC at what turned out to be a difficult time. Shortly after his arrival the NSERC MFA grant was reduced and the situation that arose from this required some administrative reorganization. On top of that, AquaNet, a new NCE hosted at the OSC, was funded and Bill took on the duties of Scientific Director. Bill made some significant organizational changes at the OSC of which we are still benefiting and his efforts to increase our MFA funding the following year were successful. He also led AquaNet very effectively until he stepped down in December 2002. Bill also stepped down as OSC Director in December 2001 and Dr. Chris Parrish stepped in as Interim Director from January 2002 - December 2002. Chris's term was marked by putting together a three year MFA proposal which was extremely successful as our funding level increased by over 20%. All of these achievements have made my tenure rather uneventful so far and for that, and the solid footing the OSC now finds itself on, I wish to thank both Bill and Chris.

Activities

As is obvious from the material in this report we had a very good year overall in 2002-2003. External funding levels remained high and the new MFA award allows us to provide support for OSC activities which we would not be able to do on the University Budget. The Aquaculture Research & Development Facility (ARDF) is now self-supporting and will continue to be over the next five years due to a \$4 million dollar Atlantic Innovation Award. The OSC continues to be a host for AquaNet and is one of two core facilities which AquaNet supports. In January 2003, Dr. Driedzic was the recipient of a Tier I Canada Research Chair in Marine Biosciences. Prior to this, Dr. Paul Snelgrove received a Tier II CRC in Boreal and Cold Ocean Systems which he holds jointly between the OSC and the Biology Department.

OSC faculty continue to serve important roles in large Canadian research networks. Dr. Don Deibel is on the steering committee, a Theme leader and an investigator with the Canadian Arctic Shelf Exchange Study (CASES) which was funded in 2002. Dr. Richard Rivkin continued to serve on the steering committee and as an investigator with the Canadian Surface Ocean and Lower Atmosphere Study (SOLAS). As mentioned, Dr. Driedzic stepped down as Scientific Director of AquaNet - a Network Centre of Excellence hosted at the OSC, the end of December 2002. I continued to be a Co-Theme leader and member of the Research Management Committee of AquaNet. Drs. Chris Parrish is a Steering Committee member and Dave Schneider served as Co-Chair within the Coasts Under Stress project which is a Major Collaborative Research Initiative funded by NSERC and SSHRC. A number of OSC faculty had research projects funded by AquaNet and Coasts Under Stress.

The graduate student presence continued to be an integral part of OSC research activities. During 2002-2003, 4 Ph.D students and 7 M.Sc students completed their theses and graduated. Sixty graduate students were supervised by OSC faculty during the past year and the OSC continues to have a high percentage of graduate students in the Faculty of Science. Add to this the 11 Research Associates and Post-doctoral Fellows at the OSC and one can understand why the number of peer reviewed papers, either published or in press, for this year was close to 70. A very impressive number given the faculty compliment.

2. Personnel

Faculty

Dr. Joseph Brown – Professor (Research)- B.Sc. Xavier Univ., M.Sc. Memorial Univ., Ph.D. Queen’s Univ.

Dr. Donald Deibel – Professor (Research)- B.Sc. Bucknell Univ. USA., Ph.D. Univ. of Georgia, USA.

Dr. William Driedzic – Professor- B.Sc. (Hons.) York, M.Sc. Toronto, Ph.D. British Columbia. Canadian Research Chair Tier I- Marine Bioscience.

Dr. Kurt Gamperl – Assistant Professor- B.Sc. (Hons.) Univ. of Guelph., M.Sc. Univ. of Guelph., Ph.D. Dalhousie Univ.

Dr. Chris Parrish – Professor (Research)- B.Sc. Univ. College of Swansea, UK., Ph.D. Dalhousie Univ.

Dr. Richard Rivkin – Professor- B.Sc. City Collage of New York, USA., M.Sc. City Collage of New York, USA., Ph.D. Univ. of Rhode Island, USA.

Dr. David Schneider – Professor- B.Sc. Duke, Durham, NC, USA., Ph.D. SUNY, Stony Brook, Long Island, NY, USA.

Dr. Paul Snelgrove – Professor- B.Sc. Hon. Memorial Univ., M.Sc. McGill., Ph.D. Massachusetts Institute of Technology/Woods Hole Oceanographic Institution. Canadian Research Chair Tier II- Boreal and Cold Ocean Systems

Dr. Raymond Thompson – Professor (Research)- B.Sc. Univ. Bristol, UK., Ph.D. Univ. of Leicester, UK

Dr. Joseph Wroblewski – Professor (Research)- B.Sc. Univ. of Illinois, USA., M.Sc. Florida Univ., USA., Ph.D. Florida State Univ., USA.

Cross- Appointees

Dr. M. Burton – Biology Dept.

Dr. N. Gogan – Chemistry Dept.

Dr. R. Haedrich – Biology Dept.

Dr. H. Helleur – Chemistry Dept.

Dr. W. Montevicchi – Psychology Dept.

Dr. F. Shahidi – Biochemistry Dept.

Adjunct Professors

Dr. John Anderson – Department of Fisheries and Oceans
Dr. Robin Anderson – Department of Fisheries and Oceans (Pending)
Dr. Gary Borstad – President, G.A. Borstad Ltd.
Dr. D. Cote – Terra Nova National Park
Dr. Brian Dixon – Univ. Waterloo
Dr. Vanya Ewart – National Research Council
Dr. Frank Huxter – Senior Engineer
Dr. Steward Johnson – National Research Council
Dr. Cynthia McKenzie – Department of Fisheries and Oceans
Dr. Robert McKinley – University of British Columbia
Dr. J. Morgan – Department of Fisheries and Oceans
Dr. P. Pepin – Department of Fisheries and Oceans
Dr. John Whyte – Department of Fisheries and Oceans- British Columbia

Honorary Research Professors

Dr. Derek Burton
Dr. Larry Crim
Dr. Garth Fletcher
Dr. Rasul Khan

Research Associates

Dr. V. Puvanaendran
Dr. Margaret Shears

Post-Doctoral

Dr. Jon Chamberlin (Deibel/Rivkin)
Dr. Michele DuRan (Parrish)
Dr. Matthew Gollock (Gamperl)
Dr. Michelle Hale (Rivkin)
Dr. Harry Murray (Brown)
Dr. Natércia Joaquim (Gamperl) – Visiting Post-doctoral March to August 31, 2003
Dr. Heum GI Park (Brown/Parrish) – Visiting Post- doctoral June 27/02 to June 27/03
Dr. Piotr Trela (Deibel)
Dr. Ed Yaskowiak (Fletcher)

Research Assistants and Science Technicians

Thamir Alkanani – Research assistant I (Parrish)
Heather Bussey – Research Assistant I (Rivkin)
Juan Casanova – Research Assistant II (Gamperl)
Kathy Clow – Research Assistant II (Driedzic)
Vanessa French – Research Assistant I (Parrish)
Danny Ings – Research Assistant II (Schneider)
Lilia Jackman – Research Assistant II (Thompson)
Daryl Jones – Research Assistant I (Department)
Jonathon Kehoe – Research Assistant I (Parrish)-June /03
Anne Kellett – Research Assistant I – (Brown/ Puvanaendran)
Madonna King – Research Assistant II (Fletcher)
Sing-Hoi Lee – Research Assistant II (Deibel)
Jennifer Long – Research Assistant II (Driedzic)
Paul Matthews – Research Assistant II (Rivkin)
Brenda Oake – Research Assistant I (Snelgrove)
Mike Riehl – Research Assistant II (Deibel) - April 1/03- May 5/03
Connie Short – Research Assistant II (Driedzic/Department)
Jeanette Wells – Research Assistant I (Parrish)
Jessica Anderson – Science Technician I (Schneider) – May 5/03 – Aug 29/03
Lori Morgan – Science Technician II (D. Jones) – Aug 22/03
Diane Mooney - Science Technician II (Rivkin) – April 24/03-Oct31/03
Andrew Rosenberger- Science Technician II (Rivkin)- June 2003
Jennifer Ryan – Science Technician II (D. Jones)
Marine Thistle – Science Technician I (Schneider) May 19/03- Aug 29/03
Christine Vickers – Science Technician III (Deibel)

Administrative and Computer- Support Staff

Trevor Avery – Research Computer Specialist
Fiona Cuthbert – Secondment to Bonne Bay Marine Station
Maureen James – Intermediate Clerk Steno
Danielle Nichols – Research Marketing Manager
Trevor Snow – Computer Support Technician
Winnie Sparkes – Intermediate Secretary
Delores Wheeler – Administrative Staff Specialist II

AquaNet- Administration

Joan Atkinson – Network Manager,
Nicole Budgell – Computer Support – April/03
Brenda Lye – Administrative Officer
Catherina Murphy – Computer and Administrative Support
Michael Riehl – Information Officer – March/03
Melissa Struthers – Education Officer

Aquaculture Research Development Facility (ARDF)

Danny Boyce – Business Manager
Darrell Green – Science Technician III
Francine Godden – Science Technician III
Rodney Healey – Research Assistant II
Jennifer Monk – Science Technician III
Denise Tucker – Science Technician III
Lori Thorne – Research Assistant I
Cathy Williams – Science Technician III

Pools Cove Cod Grow-out Site

Shawn Hickey – Science Technician III
Daniel May – Science Technician I
Sheldon Perham – Science Technician I
Courtney Williams – Science Technician I

Field Services

Renee Boland – Dive Technician
Robert Guest – MUN Safety Diving Officer
Roberts O' Donnell – Dive Technician II
Philip Sargent – Research Assistant /Dive Technician

Laboratory and Technical Services

Danny Au – Laboratory Facility Technician I
Randy Cahill – Facility Custodian
James Devereaux – Laboratory Services Supervisor
Edward Downton – Electronics – Retired June/03
Jerry Ennis – Laboratory Facility Technician I
Jim Fowler – Deliveryman
Terrance Harris – Electronics
Jim Hopkins – Facility Custodian
Wayne Morris – Facility Custodian
Paul Smith – Facility Custodian
Damien Whitten – Laboratory Facility Technician II
Wayne Morrissey – (Secondment to Printing Services)

Facilities Management

Donald Bowering, Terry Conway, Dennis Furlong, William Kilfoy, John Mallard, George Walsh

NSERC Students

Catherine Barry (Driedzic)

Student Assistants,

Amanda Burry (Schnieder)
Lisa Cary (D.Nichols /Tours)
Corrine Conway (D.Boyce /ARDF)
Paul Doucet (T. Avery)
Francoise Guigne (Mckenzie /Nichols)
Joanne Hoskins (D. Nichols /Tours)
Jennifer Higdon (P. Pepin)
Anne Kellett (Puvanaendran)
Amy Moss (D. Nichols/Tours)
Terri Lynn Pinksen (D. Jones/Seals)
Michelle Quilan (Snelgrove)
Margaret Warren (D. Jones/Seals)
William Walsh (D. Boyce/ARDF)
Martin Lariviere- Bastine (Puvanendran)

MUCEP

Natalie Bonnell (Deibel)
Courtney Hayden (Parrish)
Hong Liu (Rivkin)
Nancy Noordhof (D. Jones/Seals)

SWAP- Students

Melissa Browne

SCP- Students

Megan Carter (Rivkin)
Courtney Hayden (Parrish)

WISE- Students

Falon Gilbert (D. Boyce/ARDF)
Nadine Howell (Schneider)
Mikayla Hynes (D. Jones/Seals)
Nadine Osmond (D. Nichols/Tours)

Volunteers – Seals

Amanda Bourne, Chole Craig, Colette Hicks, Cynthia Mercer, Ashley Noseworthy,
Jennifer Walsh, Shandelle Warford, Margaret Warren

Canada Youth Services Internship – Seals

Megan Drake
Morgan Churchill

3. Administrative Structure, Facilities and Services, Departmental committees

Departmental Administration

Interim Director	Dr. J. A. Brown
Associate Director	Dr. D. Deibel
Intermediate Secretary	Ms. Winnie Sparkes
Administrative Staff Specialist II	Ms. Delores Wheeler
Intermediate Clerk Steno	Ms. Maurren James
Research Marketing Manager	Ms. Danielle Nichols

Facilities and Services

Animal Husbandry	Mr. Daryl Jones
Aquaculture Research and Development Facility	Mr. Danny Boyce
Computing Services	Dr. Trevor Avery
Field Services	Ms. Danielle Nichols
Image Analysis Facility	Dr. Trevor Avery
Laboratory (Workshop) Services	Mr. Jim Devereaux
Marine Public Education Program (MUN Ocean Sciences Research aquarium)	Ms. Danielle Nichols
Seal Research Facility	Mr. Daryl Jones
Technical Services	Mr. Terry Harris

Committees

Promotion and Tenure	Dr. D. Deibel
	Dr. W. Driedzic
	Dr. J. Wroblewski
	Dr. J.A. Brown
	Dr. D. Schneider
Space Committee	Dr. K. Gamperl
	Ms. D. Nichols

Safety Committee	Ms. C. Short
Search Committee	Dr. D. Deibel
	Dr. K. Gamperl
	Dr. R. Rivkin
	Dr. R. Thompson
	Dr. P. Snelgrove
Appointed by the Dean	Dr. C. Bottaro
Executive Committee	Dr. J. A. Brown
	Dr. D. Deibel
	Ms. D. Nichols
	Mr. J. Devereaux
OSC Tours	Ms. D. Nichols
	Mr. D. Boyce(ARDF)

4. Faculty

Dr. J. A. Brown

Research Interests

Dr. Brown's program is composed of both fundamental and applied research. The fundamental area of interest is applying theories of behavioural ecology to studies on larval and juvenile fishes. He is involved in examining the development of foraging and predator-avoidance behaviour using the paradigm of threat-sensitive foraging, and examining the functional significance of kin-recognition in two species of salmonid fishes. The applied area of research is aquaculture. Interests in this area are focused on developing new species for cold-water aquaculture and improving culture techniques for various cold-water species.

Other Activities (Memorial)

- Supervision, graduate students
- Supervision, NSERC student
- Supervision, summer students
- Supervision, honours students
- Supervision, postdoctoral fellowships
- Supervision, research assistants
- Supervision, research associate
- Thesis examiner, graduate students
- Interim Director - OSC
- Member - VP (Academic)'s Dean of Graduate Studies Search Committee
- Chair - MSc (Aquaculture) Programme
- Co-Chair - Cognitive & Behavioural Ecology Programme

External Activities

- Research Management Committee (RMC) - AquaNet, NCE
- Theme Leader - AquaNet
- Aquaculture Steering Committee - Canadian Centre for Fisheries Innovation

Invited Lectures and Conference Presentations

Invited

- "Atlantic cod aquaculture: progress & problems". February 2003. Umea, Sweden
- "Marine fish culture in Canada" March 2003. SFAC. Fortaleza, Brazil

Conference & student presentations;

- Killen, S.; **Brown, J.A.** 2003. Non-lethal effects of predatory threat on the growth and foraging activity of newly hatched ocean pout (*Macrozoarces americanus*). 27th Annual Larval Fish Conference, August 2003. Santa Cruz, Calif.
- Jordaan, A.; **Brown, J.A.** 2003. Are there risks involved in fast growth of larval fish? 27th Annual Larval Fish Conf. August 2003. Santa Cruz, Calif.

- **Brown, J.A.**; Puvanendran, V. 2003. The development of new marine species for aquaculture in eastern Canada. World Aquaculture Meeting. Salvador, Brazil. May 2003.
- Smith, K.M.; **Brown, J.A.** 2003. An experimental investigation of cannibalism in hatchery reared Atlantic cod and fat snook. World Aquaculture Meeting. Salvador, Brazil. May 2003.
- Alves, T.; **Brown, J.A.** 2003. Early weaning of Atlantic cod larvae. World Aquaculture Meeting. Salvador, Brazil. May 2003.
- Robertson, M.J.; Scruton, D.A.; **Brown J.A.** 2003. Seasonal effects of suspended sediment on the behaviour of Atlantic salmon parr. CCFR. Jan 2003. Ottawa, Ont.
- **Brown, J.A.**; Halfyard, L.; Moret, K. 2002. Progress and challenges with Atlantic cod and wolffish culture. Aquaculture Assoc of Canada (AAC) Annual Meeting, Charlottetown, PEI. Sept 2002.
- **Brown, J.A.**; Lush, L.; Wade, J.; Burton, M. 2002. Progress on cod broodstock development and management. AAC Annual Meeting. Charlottetown, PEI. Sept. 2002.
- Lush, L.; **Brown, J.A.**; Burton, M.; Penney, R.; Wade, J. 2002. Preliminary investigation of photomanipulation in Atlantic cod broodstock. AAC Annual Meeting. Charlottetown, PEI. Sept. 2002.
- Puvanendran, V.; **Brown, J.A.** 2002. Growth and survival of Atlantic cod larvae from three latitudinally seperated population in a common garden experiment - preliminary results. AAC Annual Meeting. Charlottetown, PEI. Sept. 2002.
- O'Brien MacDonald, K.; **Brown, J.A.** 2002. Growth, behaviour, and digestion efficiency in Atlantic cod larvae fed three commonly used first feeding diets. AAC Annual Meeting. Charlottetown, PEI. Sept. 2002.
- Smith, K.M.; Cerquera, V.; **Brown, J.A.** 2002. Cannibalism in juvenile cod and juvenile fat Snoike, the role of size variation. AAC Annual Meeting. Charlottetown, PEI. Sept. 2002.
- Widgeon, M.P.A.; Puvanendran, V.; **Brown, J.A.** 2002. Inter-population difference in growth and energy use of juvenile Atlantic cod: Implications for broodstock development. AAC Annual Meeting. Charlottetown, PEI. Sept. 2002.
- O'Brien MacDonald, K.; Ronnestad, I.; **Brown, J.A.** 2002. Differences in cholecystokinin levels and trypsin activity in Atlantic cod larvae before and after weaning: Use of new analytical methods. AquaNet III Meeting, Moncton, N.B. Sept. 2002.
- Smith, K.M.; **Brown, J.A.** 2002. Reducing cannibalism in juvenile Atlantic cod: the role of size grading and stocking density. AquaNet III Meeting. Moncton, N.B. Sept. 2002.
- Vaillancourt, R.; Audet, C.; **Brown, J.A.** 2003. Diet experimentation's in winter flounder larvae. AquaNet III. Moncton, N.B. Sept 2002.

Dr. D. Deibel

Research Interests

Dr. Deibel is a zooplankton ecologist and biological oceanographer who focuses on determination of the role of mesozooplankton in biogeochemical cycles, particularly on the role of copepods and pelagic tunicates in the cycles of carbon, nitrogen and phosphorus in the arctic. Much of his work in the arctic is as part of international, multi-disciplinary research programs into the affects of global climate change on the Arctic Ocean. He has worked in three arctic polynyas (i.e. the Northeast Water, Northwater and St. Lawrence Island polynyas) and this fall will be undertaking a year-long expedition to the Beaufort Sea Shelf. For about 20 years his Discovery Grant work has been focused upon the physiological ecology of the gelatinous suspension feeders known as appendicularian tunicates. This research has provided novel information on the fluid mechanics of particle collection, and lipid storage and on population demographics. This work as evolved in the arctic into an examination of the role of appendicularians in collecting terrestrial source particles originating from rivers.

Other Activities (Memorial)

- Supervision, graduate students
- Co-supervision, graduate students
- Supervision, post-doctoral fellowships
- Supervision, research assistants
- Supervision, science technicians
- Supervision, MUCEP students
- Associate Director, OSC
- Promotion and Tenure Committee member, OSC
- Search Committee member, OSC
- Executive Committee member, OSC

External Activities

- Steering Committee, Canadian Arctic Shelf Exchange Study (CASES), 2000-present
- Theme Leader, Canadian Arctic Shelf Exchange Study (CASES), 2000-present
- Editorial Advisor, *Marine Ecology Progress Series*, 1995- present
- Special issue co-editor, *Appendicularians and Global Change*. NATO Advanced Study Workshop, 2002-present.

Invited Lectures and Conference Presentations

- Mckenzie, C.H.; **Deibel, D.**; Thompson, R.J. (2002). Interannual variation in the species composition of the spring diatom bloom in Conception Bay, Newfoundland, Canada. 17th International Diatom Symposium, Ottawa Canada November 25-31, 2002
- Stacey, J.; **Deibel, D.** (2002). Effects of cold water mussel culture on estuarine zooplankton communities. Annual Meeting of the AquaNet national Centre of Excellence Program. Moncton, October, 2002

Dr. W. Driedzic

Research Interests

Research focuses on the impact of low temperature and lack of oxygen on the physiology and biochemistry of fish. Laboratory experiments reveal how metabolic pathways are activated at low temperature resulting in selective tissue growth and freeze defense mechanisms. Parallel studies articulate means of surviving at low oxygen via increased cellular oxygen transport and activation of glucose metabolism. Experiments will be extended to assess metabolic processes under natural conditions through the use of stable isotopes. Their findings will be of interest to biologists in contributing to our understanding of how animals deal with adverse environments, to the aquaculture industry in optimizing fish growth, and to the biotechnology industry in the development of novel ways to activate the production of compounds that have therapeutic value in animal and human health.

Other Activities (Memorial)

- Supervision, graduate students
- Co-supervision, graduate students
- Supervision, research assistants
- Supervision, NSERC student
- External Ph.D. examiner

External Activities

- Scientific Director of AquaNet, Network of Centres of Excellence to Dec. 31, 2002.
- Member of Department of Fisheries and Oceans, Science Advisory Council.

Invited Lectures and Conference Presentations

- Long, J. R.; **Driedzic, W.R.** (2002) AquaNet - Annual Scientific Meeting. Moncton, Sept. 14-17, 2002. Cloning and characterization of glucose transporters from cod (*Gadus morhua*) heart.
- Treberg, J. R.; **Driedzic, W.R.** (2002) AquaNet - Annual Scientific Meeting. Moncton, Sept. 14-17, 2002. Differential effects of temperature on the rate of protein synthesis in the white muscle and liver of cod (*Gadus morhua*).
- Muise, D. M.; Richards, R.C.; **Driedzic, W.R.**; Ewart, V.K. (2002) AquaNet - Annual Scientific Meeting. Moncton, Sept. 14-17, 2002. Glycerol-3-phosphate dehydrogenase and phosphoenolpyruvate carboxykinase in rainbow smelt (*Osmerus modax*) and their roles in temperature adaptation.
- Muise, D. M.; Richards, R.C.; Short, C.; Liebscher, R; Ewart, K. V.; **Driedzic, W.R.** (2002) Aquaculture Canada, Charlottetown PE, September 17-20, 2002. Glycerol-3-phosphate dehydrogenase and phosphoenolpyruvate carboxykinase in rainbow smelt (*Osmerus mordax*) and their roles in temperature adaptation.
- Treberg, J. R.; Hall, J. R.; **Driedzic, W.R.** (2003) Canadian Society of Zoologists - Annual Scientific Meeting. Waterloo, May 6-19, 2003. Effect of long-term temperature acclimation on protein synthesis capacity in Atlantic cod (*Gadus morhua*).

Dr. K. Gamperl

Research Interests

Dr. Gamperl is a comparative physiologist whose main research interest is to understand how environmental and physiological variables interact to affect fish biology. Central to this research are the role that blood oxygen transport, cardiac function, stress (catecholamines, cortisol, the β -adrenergic system, stress proteins) and humoral and/or biochemical factors play in mediating fish "performance" (swimming ability, growth, reproductive success, metabolic capacity etc.) under varied environmental conditions. He uses a variety of marine and freshwater fishes in his research, and the questions he addresses often have implications for fish ecology and/or aquaculture.

Teaching

- BIOL 3401: Comparative Animal Physiology (Fall 02/03)
 - BIOL 4601: Functional Biology of Fish (Winter 03)
- Dept. of Biology, Memorial University of Newfoundland. These lecture/lab courses were
team taught with one other faculty member.

Other Activities (Memorial)

- Supervision, graduate students
- Supervision, NSERC students
- Supervision, science technician
- Supervision, postdoctoral fellowships
- Committee member, graduate students
- Participant in Shad Valley Memorial 2003.
- Participant in "Green Light" session organized by the Office of Research to investigate collaborative research opportunities between Memorial University and Lotek Engineering Inc. March 2003
- Participant in focus group "Faculty of the Future" organized by the Centre for Institutional Analysis and Planning. November, 2002
- Produced comprehensive Report on Space Use and Availability at the OSC October 2002
- Memorial University Animal Care Committee
- Search Committee member for new director of the Ocean Sciences Centre, Memorial University of Newfoundland.
- Seminar Committee member Dept. of Biology (Memorial University)

External Activities

- Member of the Canadian Society of Zoologists
- Member of the American Fisheries Society, Fish Physiology Section
- Member of the Society for Experimental Biology
- Member of the American Physiological Society
- Conference Organizer for the 7th International Congress on the Biology of Fishes, August 2006, St. John's, Newfoundland.

- Organizer of a symposium for the 6th International Congress on The Biology of Fishes, August 2004, Manaus Brazil. Title: Fish Cardiovascular Physiology: Plasticity in Design and Function.
- Reviewed 2nd draft of the CCAC Guidelines on: The Care and Use of Fish in Research, Testing and Teaching.
- External Reviewer for Grants from the Natural Environment Research Council (UK), and NSERC
- External Reviewer for grants from the Great Lakes Fisheries Commission, NSERC (Discovery Grants), and the Netherlands Organization for Scientific Research

Invited Lectures and Conference Presentations

- Gene, G.; Redneck, kJ; Alkanani, T.; Parrish, C.C.; **Gamperl, K.A.** Food deprivation diminishes myocardial energy status and heart rate, but not overall cardiac function in Atlantic cod (*Gadus morhua*). 42nd Annual Meeting of the Canadian Society of Zoologists, Waterloo, ON. May, 2003.
- Joaquim, N.; Wagner, G.N.; **Gamperl, A.K.** Cardiac Function and Critical Swimming Speed of the Winter Flounder (*Pseudopleuronectes americanus*) at two temperatures. 42nd Annual Meeting of the Canadian Society of Zoologists, Waterloo, ON. May, 2003.
- Jones, D.R.; Braun, M.; **Gamperl, A.K.**; Syme, D.A. Reflecting Alligators. Experimental Biology 2003. San Diego, CA.

Dr. C. Parrish

Research Interests

Dr. Parrish's work focus at the interface of chemistry and biology in the area of aquatic lipid research. Lipids are of particular interest in marine research as they are very important energy sources in ocean (especially cold ocean) ecosystems, and some (e.g., polyunsaturated fatty acids) are essential for normal cellular function. Some lipids are also toxic to marine organisms, and all lipids are potential solvents for lipophilic pollutants like PAHs, PCBs, and DDT. They can thus provide a means of transporting pollutants through the water column and into and through food webs.

Other Activities (Memorial)

- Supervisor, graduate students
- Supervision, MUCEP students
- Supervision, SCP students
- Supervision, research assistants
- Supervision, postdoctoral fellowships
- Comprehensive Examination Committee
- Steering Committee (East Coast), 2000-.Major Collaborative Research Initiatives Project 'Coasts Under Stress'- Arm leader
- Senate Committee on Research, 2000-2003.
- Marine Biology Programme Review Committee, 2000-02.
- Thesis examiner, graduate students

External Activities

- Ad. Hoc. Reviewer: *Aquaculture*, *Aquat. Ecol.*, *Aquat. Living Resources*, *Biochem. Syst. Ecol.*, *Can. Inst. Food Sci. Technol. J.*, *Can. J. Fish. Aquat. Sci.*, *Can. J. Physiol. Pharmacol.*, *Comp. Biochem. Physiol.*, *Deep-Sea Res.*, *Diatom Res.*, *Fish Physiol. Biochem.*, *Geochim. Cosmochim. Acta*, *Hydrobiol.*, *J. Chromatogr.*, *J. Food Lipids*, *J. Lipid Res.*, *J. Mar. Systems*, *J. Phycol.*, *J. Plankton Res.*, *Limnol. Oceanogr.*, *Lipids*, *Mar. Biol.*, *Mar. Chem.*, *Mar. Ecol. Prog. Ser.*, *Mar. Mammal Sci.*, *Oceanol. Acta*, *Org. Geochem.*, *Sci. Mar.*
- NSERC, NERC (UK), Sea Grant (US) and NSF (US) research grant applications.

Invited Lectures and Conference Presentations

- Halfyard, L.C.; **Parrish, C.C.**; (2002). Biochemical analysis of egg quality and first feeding condition of the common wolffish, *Anarchichas lupus*. *Bull. Aquacul. Assoc. Canada* 102-2: 33-36.

Dr. R. Rivkin

Research Interests

Dr. Rivkin has studied various aspects of biological oceanographic processes for over 20 years. During this period, his research interests have evolved and expanded and range from studies on the nutrient metabolism, photoadaptations of photosynthesis, carbon metabolism and cell division of phytoplankton from natural populations in temperate and tropical oceans and in Antarctica to the relationships among primary producers and procaryotic and eucaryotic microheterotrophs, and the regulation of growth and loss processes of bacteria in various cold ocean regions. As part of his individual Research Grant program and a number of large collaborative projects (Canadian Joint Global Ocean Flux Study and International North Water Polynya Program) he has studied these processes in Newfoundland coastal waters, in the Gulf of St. Lawrence, the northeast subarctic Pacific and several sites in the high Arctic. Dr. Rivkin's research is highly interdisciplinary and focuses on addressing large-scale questions concerning the transformation of organic matter in the sea, biogeochemical cycling of biogenic carbon and the role of microbial trophic pathways in regulating the biological pump in the World Oceans.

Other Activities (Memorial)

- Supervision, honour students
- Supervision, graduate students
- Supervision, SCP students
- Supervision, research assistants
- Supervision, postdoctoral fellowships
- Memorial University Faculty Association (MUNFA) Executive Committee
- MUN- MUNFA Joint Occupational Health and Safety Committee
- MUNFA-MUN Collective Agreement Negotiations Committee
- University Radiation Safety Committee
- Promotion and Tenure Committee, OSC
- Directorial Search Committee, OSC

External Activities

- NSERC Scholarships and Fellowships Selection Committee for Earth Science and Ecology (2004-2007).
- Canadian Surface Ocean and Lower Atmosphere Scientific Steering Committee
- SCOR/IGBP Global Analysis, Integration and Modeling Task Team

Invited Lectures and Conference Presentations

- **Rivkin, R.B.** (2002). Coupling of upper and mesopelagic ocean carbon cycling. Integration into global circulation models. Global Integration and Analysis-Green Ocean IGBP. Workshop. October 2002. Villefranche-Sur-Mer, France.
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- Legendre, L. and **Rivkin, R.B.** (2003). Coupling between the upper and mesopelagic ocean: carbon and nutrient fluxes in relation to global change. January 2003,

IGBP/SCOR Ocean Biogeochemistry and Ecosystem Analysis- Open Science Meeting. Paris. France.

- **Rivkin, R.B.** and Legendre L. (2003) Biogenic carbon cycling and remineralization in the mesopelagic. January 2003, IGBP/SCOR Ocean Biogeochemistry and Ecosystem Analysis- Open Science Meeting. Paris. France.
- **Rivkin, R.B.;** Legendre,L.(2003). Metabolic balance in the ocean: are we underestimating primary production? EGS-AGU-EUG Joint Assembly, April 2003. Nice, France
- Legendre, L.; **Rivkin, R.B.** (2003) Coupling between the atmosphere and the mesopelagic ocean in relation to global climate change EGS-AGU-EUG Joint Assembly, April 2003. Nice, France
- **Rivkin, R. B.;** Legendre, L. (2003). Biogenic carbon cycling and remineralization in the mesopelagic. JGOFS Open Science Conference- A Sea of Change. May 2003. Washington, DC.
- Scarratt, M.; Levasseur, M.; **Rivkin, R. B.;** Merzouk, A.; Michaud, S.; Matthews, P.; Hale, M. (2003). The response of DMS(P) production rates to Fe-enrichment in the NE Pacific: A shipboard microcosm experiment. June 2003. Canadian Meteorological and Oceanographic Society- Atmosphere-Ocean Science: Impacts and Innovation. Ottawa, Ontario.
- Hale, M.S.; Matthews, P.; Agawin, N. S.; Li, W. K.W.; **Rivkin R.B.** (2003). Microbial response to a mesoscale Fe enrichment in the Northeast Subarctic Pacific: Growth. June 2003. Canadian Meteorological and Oceanographic Society- Atmosphere-Ocean Science: Impacts and Innovation. Ottawa, Ontario.
- **Rivkin, R.B.;** Legendre, L.; Rassoulzadegan , F. (2003). Deriving ecosystem properties from large-scale distributions of primary biological oceanographic variables. Oceans 2003 Marine Technology and Ocean Sciences Conference. September 2003. San Diego California.
- Legendre, L.; **Rivkin, R.B.** (2003). Do episodic blooms of diatoms in oligotrophic waters export more carbon than would be predicted from stoichiometric export models? Chapman Conference on The Role of Diatom Production and Si Flux and Burial in the Regulation of Global Cycles. September 2003. Paros, Greece.

Dr. D. Schneider

Research Interests

At present the problem of scaling up from surveys and experiments (necessarily at small scales) to questions of regional or global importance is one of the most pressing theoretical issues in ecology. Students are encouraged to develop methods for examining research questions at multiple time and space scales.

Other Activities (Memorial)

- Supervision, graduate students
- Supervision, summer students
- Supervision, MUCEP students
- Supervision, WISE student
- Supervision, science technicians
- Supervision, research assistants
- Supervisory committee, graduate students
- Thesis examiner, graduate students
- Supervisor, B.Sc. honours student.
- Co-Chair (Natural Science), “Coasts Under Stress” Research Project funded by NSERC and SSHRC

External Activities

- Referee: *Ecosystems, BioScience, Marine Biology, Behaviour.*
- Scientific Review Committee, Institute for Environmental Monitoring and Assessment, Happy Valley Goose Bay, Labrador, Canada.
- Scientific Advisory Committee, U.S. Environmental Protection Agency. Multiscale Experimental Ecosystem Research Center, Horn Point, Maryland, USA.
- Environmental Effects Monitoring Advisory Committee Newfoundland Transshipment Facility, Whiffen Head, Newfoundland.
- Reviewer. Grant Proposals: Canada Natural Sciences and Engineering Research Council, New Zealand Foundation for Research and Technology, Norway Natural Resources Institute (NINA), Norwegian Research Council, USA National Science Foundation, USA Sea Grant (Alaska)

Invited Lectures and Conference Presentations

- Schneider, D.C. The scope of power laws in ecology. Lead speaker, Symposium on scaling in landscape ecology, Annual meeting International Association of Landscape Ecologists. Banff, Canada, 4 April 2003.
- Schneider, D.C. Scale, scope, and power laws in the analysis of biocomplexity. Santa Fe Institute, Santa Fe, New Mexico 18 April 2003.
- Schneider, D.C. Scale, scope, and power laws in the analysis of miniature ecosystems. Lead speaker, Symposium on miniature ecosystems. Ecological Society of America, 7 August 2003.
- Schneider, D.C. Scaling theory as it applies to watersheds. Lead speaker, Symposium on managing fish in watersheds. American Fisheries Society, 11 August 2003

Dr. P. Snelgrove

Research Interests

Dr. Snelgrove's interests include marine community ecology, larval ecology of invertebrates and fish, ecology of benthic invertebrates; hydrodynamic effects on benthic communities and populations, deep-sea ecology, coral reef ecology, biodiversity, disturbance and anthropogenic impacts

Teaching

- Fisheries Science 6001 (course in Masters of Maritime Studies) MUN. Fall 2002.
- Co-teaching Biology 2600 (Ecology) MUN Fall 2002
- Co-taught Biol. 3712 (Ecology of Open Waters) Summer 2003

Other Activities (Memorial)

- Supervision, graduate students
- Supervision, summer students
- Supervision, research assistants
- Thesis Committees
- Biology Graduate Studies Committee
- Honours Dissertation Examination Committee (Biology)
- Ph.D. Comprehensive Examination Committee (Biology)
- Ph.D. Internal Examiner

External Activities

- Woods Hole Oceanographic Institution/Massachusetts Institute of Technology Joint Program Alumni Board 1997 – present. Vice President 2002 – present.
- Biodiversity and Conservation - Editorial Board 2000-
- Marine Ecology Progress Series – Staff reviewer
- Referee, *Marine Ecology Progress Series* September 2002; *Limnology and Oceanography* –October 2002; *Marine Ecology Progress Series* –October 2002; *Marine Ecology Progress Series* –October 2002; *Marine Ecology Progress Series* October 2002; *National Science Foundation* October 2002; *Can. Journal of Fisheries and Aquatic Sciences* –November 2002; *Marine Ecology Progress Series* –November 2002; *Biodiversity and Conservation* – December 2002; *Natural Sciences and Engineering Research Council of Canada (NSERC) Discover Grant proposal* – January 2003; *Canada Foundation for Innovation New Opportunities Fund* January 2003; *Marine Ecology Progress Series* –February 2003; *Natural Sciences and Engineering Research Council of Canada (NSERC) Discover Grant proposal* – review February 2003; *National Environment Research Council (NSERC), United Kingdom* – February 2003; *Marine Ecology Progress Series*– February, 2003; *National Science Foundation (USA) – Biodiversity, Surveys and Inventories Program* –March 2003; *Estuarine, Coastal and Shelf Science* – March 2003; *Marine Ecology Progress Series* –April 2003; *Biodiversity and Conservation* –April 2003; *Journal of Marine Systems* – April 2003; *National Science Foundation (Biol. Oceanogr. Program) (USA)* May 2003; *Marine Ecology Progress Series* –May 2003; *Marine Ecology Progress Series* - May 2003; *Marine Biology* –May 2003; *Limnology and Oceanography* –June 2003; *Marine Ecology Progress Series* –June 2003; *Biodiversity and Conservation* June

2003; *Royal Society of New Zealand* – June 2003; *Journal of Shellfish Research* –July 2003; *Alaska Sea Grant Program* –July 2003; *NSERC Strategic Programs* –August 2003

Invited Lectures and Conference Presentations

- SCOPE (Scientific Committee on Problems of the Environment) workshop on “Integrating concepts of biodiversity in soils and sediments: a transdisciplinary assessment of the most critical taxa, functions and habitats for sustainability, their vulnerability and management options”. Invited participant and speaker. Aspen Lodge, Estes Park, Colorado, USA, October 2002.
- Ocean Management Research Network (OMRN) workshop on “Linking Science and Local Knowledge”. Invited participant and speaker. Ottawa, Ontario, October 2002.
- VENUS Canada – Science-Industry workshop participant and invited speaker, Victoria, BC, December 2002.
- International Council of Scientific Unions (ICSU), workshop on “Assessing Impacts of Biodiversity Changes”. Invited participant. Paris, France, January 2003
- International Centre for Living Aquatic Resources/NSERC Workshop on “Demographic Connectivity in the Mesoamerican Reef System”, Akumal, Mexico, January 2003
- European Commission Workshop on Ecological Theory Underpinning Marine Fish and Benthic Communities. Invited panel expert. Ghent, Belgium. April 2003.
- Gordon Research Conference on “Permeable Sediments”. Conference participant. Lewiston Maine, June 2003
- Commission Internationale Pour L’exploration Scientifique De La Mer Méditerranée workshop on “Gaps in Mediterranean Deep-Sea Biology”. Invited panel expert and speaker. Heraklion Greece July 2003
- Consortium of Oceanographic Research and Education (CORE) and Census of Marine Life workshop on “Biodiversity in Deep-Sea Sediments”, Invited workshop participant, Newport, Oregon, August 2003
- *Contributed Talks*
 - 2003 26th Annual Benthic Ecology Meeting
 - 2003 Gordon Research Conference on Permeable Sediments
 - 2003 Tenth Deep-Sea Biology Symposium, Coos Bay, Oregon
- *Invited Talks*
 - 2002 Oceanography Department, University of Hawaii
 - 2003 Biology Department, Woods Hole Oceanographic Institution
 - 2003 School of Marine Sciences, University of Maine, Orono, Maine

Dr. R. Thompson

Research Interests

Dr. Thompson's interests centre on the physiological ecology of marine invertebrates, particularly bivalve molluscs such as mussels and scallops. The major focus is the response of the organism to a food supply that varies both seasonally and over the short-term (e.g., tidal cycles and storm-driven changes). Such variation is reflected in physiological rate processes such as feeding, digestion and respiration, and in the partitioning of available energy between growth and reproduction. Future work will be directed towards more sensitive estimates of the diet, especially qualitative factors that have thus far received little attention. Dr. Thompson is also collaborating with biological and physical oceanographers at the OSC in a study of the formation and fate of the spring bloom in a large Newfoundland bay. Results to date indicate that, in some years, much of the phytoplankton production sinks to the bottom and is available to the benthos, whereas, in other years, pelagic grazers use most of the primary production, so that the organic material reaching the benthos is considerably modified. This presumably influences the nutrition of benthic invertebrates, and he is therefore investigating the energy storage and reproductive cycles of representative infaunal bivalves in order to determine whether or not events in the water column are coupled with those in the benthos.

Other Activities (Memorial)

- Supervision, graduate students
- Co-supervision, graduate students
- Supervision, research assistants
- Ph.D. Comprehensive Examination Committee
- Search Committee member, OSC

External Activities

- Canadian Editor, *Marine Biology*, 1991-present
- Editorial board member, *Canadian Journal of Fisheries and Aquatic Sciences*, 1997-2002
- Participated in a mollusc aquaculture development project, MUN/Universidad Austral de Chile (\$750,000 over 6 years;CIDA Tier II project to A.B Dickerson and R.J. Thompson)-1996-2002
- Participated in a aquaculture development project in Brazil, MUN/University of Victoria/5 partner universities in Brazil (CIDA Tier I project)

Invited Lectures and Conference Presentations

- McKenzie, C.H.; Deibel, D.; **Thompson, R. J.** (2002). Interannual variation in the species composition of the spring diatom bloom in Conception Bay, Newfoundland, Canada. 17th International Diatom Symposium, Ottawa Canada November 25-31, 2002.

Dr. J. Wroblewski

Research Interests

Research interests include fisheries oceanography, global ocean ecosystem dynamics, and physical-biological mathematical modeling. As holder of an NSERC Industrial Research Chair in Fisheries Oceanography from 1989 to 1995, his research is purposely focused on scientific problems of clear interest to the fishing industry of Atlantic Canada. The Chair was an associate member of the Network of Centres of Excellence program called OPEN (Ocean Production and Enhancement).

Teaching

- Teaching during Winter Semester 2003:
Biology 4750 Fisheries Ecology (20 undergraduate students enrolled)
Biology 7551 Fisheries Resource Management (4 graduate students enrolled)
- Teaching during Spring Semester 2003:
Biology 3714 Estuarine Fish Ecology (11 undergraduate students enrolled)
A field course, taught with Dr. Dave Methven of UNB St. John (50% contribution) at the Bonne Bay Marine Station, Norris Point, NF.

Other Activities (Memorial)

- Supervision, graduate students
- Supervision, summer students
- Supervision, MUCEP students
- Supervisory committee, graduate students
- Thesis examiner, graduate students
- Chair position, undergraduate student (Honours)
- Program committee member, Masters of Marine Studies
- Labrador Research Advisory Committee member
- Selection Committee member, National Scholarship in Ocean Studies
- Steering Committee member, Gilbert Bay as a Area of Interest under the Marine Protected Areas Program, Oceans Act, Government of Canada
- East Coast Steering Committee member, “Coasts Under Stress” Research Project funded by NSERC and SSHRC
- Co-Leader (with Dr. Greg Kealey) of Arms 3 and 4, “Coasts Under Stress” Research Project, MCRI, funded by SSHRC and NSERC

External Activities

- Editorial Board member, Journal of the Marine Biological Association of the United Kingdom
- Subpoenaed as an expert on fish biology to witness in the Provincial Court of Newfoundland (Small Claims Division), 17 September 2002
- Judge, Eastern Newfoundland Regional Science Fair, St. John’s, 4 April 2003
- Profiled (Canadians in Biology- Fisheries Oceanographer) on page 273 in the new 2003 textbook for High School Level Biology distributed throughout Atlantic Canada, published by McGraw-Hill Ryerson Ltd. Textbook citation is: McGraw-Hill Ryerson

biology. Don Galbraith et al., McGraw-Hill Ryerson Ltd., Toronto. ISBN 0-07-091676-4.

- Referee, *International Journal of Maritime History*, *Journal of Canadian Nautical Research Society*, *Journal of Deep Sea Research*, *Fish and Aquatic Resources Series*, *American Fisheries Society*

Invited Lectures and Conference Presentations

- Jiao, Y.; Chen, Y.; **Wroblewski, J.** Uncertainty associated with the F0.1 biological reference point for the Atlantic cod (*Gadus morhua*) fishery in NAFO Divisions 2J3KL. Oceans Management Research Network 2002 National Conference, Ottawa, Ontario. October 2002.
- **Wroblewski, J.** Pioneering physical-biological models in oceanography. Invited presentation at the International Symposium on Upper Ocean Circulation and Air-Sea Interaction, Florida State University, Tallahassee, FL. April 2003
- **Wroblewski, J.**; Montevecchi, W.; Chaffey, H.; Gosse, K. More than science: understanding, exploiting and protecting marine animals by coastal communities on the Labrador coast. Invited presentation at the "On the edge" conference, joint meeting of the ACMLA/CAG/CCA/CRSA. Victoria, B.C. May 2003.
- Jiao, Y.; Chen, Y.; **Wroblewski, J.** Evaluating the northern cod fishery status using a composite risk assessment. American Fisheries Society 133rd Annual Meeting, Quebec City, Quebec. August 2003.
- 18 February 2003 presented as a guest lecture in Biology 4650 -Conservation Biology (Dr. Luise Humanutz)
- Workshop Facilitator, Graduate Research Integrity Programme (GRIP), Masters of Marine Studies (Fisheries Resource Management), Marine Institute, 27 November 2002

Emeritus & Honorary Faculty

Dr. D. Burton

Research Interests

Dr. Burton is currently investigating the roles of cellular and intracellular signaling in the regulation of flatfish cryptic patterning.

External Activities

Member of the Society for Experimental Biology
Member of the Canadian Society of Zoologists

Dr. G. Fletcher

Research Interests

Antifreeze proteins and cold adaptation in fish. A number of marine fish produce antifreeze proteins to protect themselves from freezing in a sub-zero, ice-laden marine environment. The research we are carrying out focuses on these antifreeze proteins and their physiological regulation mechanisms of action, diversity, evolution and potential economic value in the field of biotechnology.

Other Activities (Memorial)

- Supervision, summer students
- Supervision, honours students
- Supervision, graduate students
- Supervision, visiting graduate students
- Supervisory committee, graduate students
- Supervision, research assistants
- Supervision, postdoctoral fellowships
- Supervision, research associate

External Activities

- President/CEO & Chair Board of Directors. Aqua Bounty Canada, Inc. and A/F Protein Canada 2000, Inc. NB; Aqua Bounty Canada, Inc., has 38 employees.
- Advisory Board. North Atlantic Biopharma, Inc. St John's NL.
- Board of Directors. BIOTECCanada.
- Advisory Board, Bio-East (Newfoundland Biotech., Working Group).
- Selection Board for the Genesis Centre. Genesis Group, Memorial University.
- Editorial Board, *Canadian Journal of Zoology*.
- Awarded Atlantic Innovation Fund (AIF). Innovative Biotechnology: Enhancing Salmon Disease Resistance, \$600,000 (2003-2008).
- Patents: Fletcher, G.L., C.L. Hew and P.L. Davies. (2002). Microinjection procedures for gene transfer. Canadian Patent pending.

Invited Lectures and Conference Presentations

- **Fletcher, G.L.;** Shears, M.A.; Yaskowiak, E.; Hobbs, R.; Agarwal-Mawal, A.; Murray H.; Goddard, S.V.; Hew, C.L. (2003) Gene Transfer: Potential to Enhance the Genome of Atlantic Salmon for Aquaculture. Proceedings “ Horizons in Livestock Sciences: The Impact of the New Biology” Sea World Nara Resort. Gold Coast Queensland Australia May 25-28, 2003.
- Hobbs, R.S.; **Fletcher, G.L.** (2003) The ocean pout antifreeze protein promoter drives expression of different genes in a variety of tissues. Abstract & Poster presented at “Symposium on Stress Proteins: from Heat Shock to Antifreeze” Bodega Bay Marine Laboratory, California. March 7-10. 2003.
- Evans, R.P.; **Fletcher, G.L.** (2003). Unusual expression patterns of type I antifreeze protein genes in snailfish. Abstract & Poster presented at “Symposium on Stress Proteins: from Heat Shock to Antifreeze” Bodega Bay Marine Laboratory, California. March 7-10. 2003.
- Kirby T.; **Fletcher, G.L.** (2002) Selection of appropriate promoters to produce transgenic fish with improved freeze resistance. In AquaNet II “Proceedings of the 2002 Annual Research Conference of AquaNet” September 14-17 2002 Moncton NB page 41.
- Hobbs, R.S.; **Fletcher, G.L.** (2002) Expression of the ocean pout antifreeze gene in transgenic salmon. In AquaNet II “Proceedings of the 2002 Annual Research Conference of AquaNet” September 14-17 2002 Moncton NB page 42.

Dr. R. Khan

Research Interests

Effects of parasites and pollutants on fish. Studies will focus on the long term-effects of parasites on fish and the interaction between some of these parasites and a variety of pollutants (e.g., petroleum hydrocarbons, pulp and paper effluent, etc.) on fish.

External Activities

- Editorial board, Bulletin of Environmental Contamination and Toxicology
- Membership in the American Society of Parasitologists, Canadian Society of Zoologists
- Elected President, World Federation of Parasitologists

5. Graduate Students

M.Sc. Candidates

- **Tarcisio Alves – Aquaculture – M.Sc. (J.A. Brown)**
Comparative larviculture of Atlantic cod and common snook
- **Jennifer Monk – Aquaculture – M.Sc. (J.A. Brown)**
Fine tuning cod larviculture
- **Kelly O'Brien-MacDonald – Aquaculture – M.Sc (J.A. Brown/J. Anderson-DFO)**
Ontogeny of functional feeding and digestion in larval cod and halibut
- **Anna Olatsdottir – Biology – M.Sc. (J.A. Brown)**
Capelin early life history
- **Nicole Saunders – Aquaculture – M.Sc (J.A. Brown)**
Development of enrichment strategies for Atlantic cod
- **Karen Smith – Biology – M.Sc (J. A. Brown)**
Cannibalism in marine fish larvae
- **Kathryn Smith – Biology – M.Sc. (J.A. Brown/P.Pepin-DFO)**
Comparative Studies of early development in marine larvae.
- **Megan Whitehead – Biology – M.Sc. (J.A. Brown/D.Schneider)**
Multiple predator effects on juvenile Atlantic Cod
- **Manjusir Wijekoon – Aquaculture – M.Sc (J.A. Brown)**
Population differences in Atlantic cod
- **Tara Businski – Biology – M.Sc. (D. Deibel)**
Arctic zooplankton ecology
- **Joy Stacey – Biology – M.Sc. (D.Deibel)**
The impact of mussel (*Mytilus sp.*) on the zooplankton communities of Notre Dame Bay.
- **Lena von Harbou – M.Sc. Non degree visitor (D.Deibel)**
Ingestion of TEP by pelagic tunicates
- **Krista Park – Biology – M.Sc. (W.Driedzic)**
Intrapopulational differences in the protein synthesis rates of Atlantic cod (*Gadus morhua*) juveniles
- **Connie Short – Aquaculture – M.Sc. (W. Driedzic)**
Preliminary investigation into the reproductive biology of the witch flounder, *Glyptocephalus cynoglossus*
- **Rodney Hobbs – Biology – M.Sc. (G.Fletcher)**
Expression of the ocean pout (*Macrozoarces americanus*) antifreeze protein

- **Trina Kirby – Biology – M.Sc. (G. Fletcher)**
Expression of antifreeze construct in Atlantic salmon (*Salmo salar*)
- **Eric Deitch – Biology – M.Sc. (K. Gamperl)**
Cardiorespiratory physiology of transgenic salmon
- **Gaylene Genge – Biology – M.Sc. (K. Gamperl)**
Preconditioning and hypoxia tolerance of the cod heart
- **Geert Van Biesen – Environmental Science – M.Sc. (C. Parrish)**
Lipid biogeochemistry underneath fish cages in Labrador coastal waters.
- **Tara Hooper – Chemistry – M.Sc. (C. Parrish)**
Development of new extraction and analysis procedures for marine lipid classes
- **Matthew Logan – Biopsychology – M.Sc. (C. Parrish)**
Diet and possible influences of anthropogenic hydrocarbons on Leach's Storm-petrels (LHSP)
- **Kimberley Keats – Environmental Science – M.Sc. (R. Rivkin)**
Microbial Dynamics in the Western North America
- **Kelly Carter – Biology – M.Sc. (P. Snelgrove/ P.Pepin-DFO)**
Environmental and biological influences on larval fish diversity
- **Michael Kelly – Biology – M.Sc. (P. Snelgrove)**
Benthic-pelagic coupling: Food supply and macrofaunal diversity
- **Erin Alcock – Environmental Science – M.Sc. (D. Schneider)**
Decadal change in structure of fisheries ecosystem, Newfoundland shelf
- **Ann-Marie Gorman – Marine Biology – M.Sc. (D. Schneider)**
Predation risk in relation to patch size
- **Mark Renkawitz – Biology – M.Sc. (D. Schneider)**
Juvenile cod growth rates in relation to habitat and food supply
- **Lee Sheppard – Biology – M.Sc. (D. Schneider)**
Natural mortality rates in juvenile fish in the coastal zone
- **Ayse Cakiroglu – Biology – M.Sc. (R. Thompson/A. Aksu/R.Hiscott)**
Mollusc shells in cores from the eastern Mediterranean and Western Black Sea
- **Jennifer Ryan – Environmental Science – M.Sc. (R. Thompson)**
Environmental effects of mussel aquaculture
- **Diana Cardoso – Environmental Science – M.Sc. (J. Wroblewski/ B.de Young)**
A modelling study of the effects of the Churchill River watershed on the productivity of coastal ecosystem of Labrador.
- **Ross Wilson – Aquaculture – M.Sc. (L. Crim)**
Moist diet formulation and growth of juvenile yellowtail flounder

- **Lynn Lush – Biology – M.Sc. (L.Crim/J.A. Brown)**
Environmental and hormonal manipulations of yellowtail flounder (*Limanda ferruginea*)

Ph.D. Candidates

- **Jeremiah Chimoka – Biology – Ph.D (J.A. Brown)**
Tilapia aquaculture
- **Martha Hiscock – Biopsychology – Ph.D. (J.A. Brown/D. Scruton-DFO)**
Winter habitat use in Atlantic salmon
- **Alexandre Garcia – Biology – Ph.D. (J.A. Brown/ C. Parrish)**
Marine fish larval nutrition
- **Shaun Killen – Biology – Ph.D. (J.A. Brown)**
Physiology and metamorphosis
- **Ben Laurel – Biopsychology – Ph.D. (J.A. Brown)**
Habitat specific predator risk in juvenile Atlantic cod
- **Paul Winger – Biopsychology – Ph.D. (J.A. Brown/S.Walsh-DFO)**
Behavioural interactions of marine groundfish species to fishing gear
- **Nami Choe – Marine Biology – Ph.D. (D. Deibel)**
Age determination and cohort analysis of *Oikopleura vanhoeffeni* in Logy Bay
- **Tara Connelly – Biology – Ph.D (D. Deibel)**
CASES project
- **Nicole Richoux – Biology – Ph.D. (D. Deibel)**
Lipid and reproductive cycles of hyperbenthic zooplankton
- **Johanne Lewis – Biology – Ph.D. (W. Driedzic)**
Tissue specific changes of protein synthesis rates in hypometabolic fish
- **Tyson MacCormack – Biology – Ph.D. (W. Driedzic)**
Purinergic and ionic regulation of cardiac function in fish
- **Joy Stacey – Biology – Ph.D. (W. Driedzic)**
The physiology of metal accumulation by ascidians
- **Jason Treberg – Biology – Ph.D. (W. Driedzic)**
Nitrogen metabolism in fish
- **Robert Evans – Biology – Ph.D. (G. Fletcher)**
Characterization and evolution of type I antifreeze proteins

- **Juan Casanova – Biology – Ph.D (K. Gamperl/J.A.Brown)**
Metabolic Digestive and Feeding Physiology of Cod and Haddock
- **Paula De Costa Mendonca – Biology – Ph.D. (K.Gamperl)**
Cardiovascular function of flatfishes
- **Lene Hebsgard Peterson – Biology – Ph.D.(K.Gamperl)**
The interactive effects of food deprivation and chronic hypoxia on exercise capacity and cardiovascular function in marine fishes: an inter-specific comparison in north Atlantic fishes
- **Louise Copeman – Biology – Ph.D. (C. Parrish/Snelgrove)**
Lipid biomarkers in coastal food webs
- **Muhammad Khan – Biochemistry – Ph.D.(C. Parrish)**
Lipid nutrition in shellfish
- **Pedro Quijon – Marine Biology – Ph.D. (P.Snelgrove)**
Recruitment of epibenthic predators and its influence on benthic communities in Bonne Bay, NL
- **Ben Lowen – Biology – Ph.D. (R. Thompson/D. Innes)**
Ecological genetics of blue mussels (*Mytilus edulis* and *M. trossulus*)
- **Marcelo Miranda – Biology – Ph.D. (R. Thompson/D.Innes)**
Genetic aspects of the blue mussel (*Mytilus edulis* and *M. trossulus*) hybrid zone in Newfoundland.
- **Sandra Pereda – Biology – Ph.D. (R. Thompson)**
Nutrition of mussels
- **Yan Jiao – Biology – Ph.D. (J. Wroblewski/Y.Chen-Maine, USA)**
Modelling uncertainty in fish population dynamics
- **Anthony Manning – Biology – Ph.D. (L.Crim/M.P.M. Burton)**
Puberty in an early maturing flatfish, the yellowtail flounder, *Limanda ferruginea* (Storer)
- **Marcianna Ptak - Biology- Ph.D. (R. Knoechel)**
Cold ocean marine microbial processes, effects of mixing on marine microbial food web dynamics

Degreed Students

- **Metusulach – Biology – Ph.D. (2002) (J.A. Brown/F. Shahidid)**
Enrichment formulation and yellowtail flounder larviculture
- **Rupika Rajakaruna – Biology – Ph.D.(2002) (J.A. Brown)**
Kin discrimination and the HMC in salmonid fishes

- **Jackie Wells – Biology – M.Sc (2003). (J.A. Brown/D.Scruton)**
Impact of buffer zones on stream fauna in Newfoundland.
- **Joy Stacey – Biology – M.Sc. (2003) (D.Deibel)**
The impact of mussel (*Mytilus sp.*) on the zooplankton communities of Notre Dame Bay
- **Geert Van Biesen – Environmental Science – M.Sc.(2003) (C. Parrish)**
Lipid class and fatty acid composition of plankton and settling particles at a fish enclosure, and of cod (*Gadus morhua*) in Gilbert Bay, Labrador.
- **Laura Halfyard – Aquaculture – Ph.D (C.Parrish/ K. Jauncey- Scotland)**
A biochemical study of egg quality and first feeding diets in common wolffish (*Anarchichas lupus*) aquaculture, University of Stirling, Scotland. (Passed Pending Revision)
- **Jonathan Kehoe – Chemistry – M.Sc.(2003) (C. Parrish)**
Total marine lipid profiling by short column gas chromatography
- **Heather Bussey – Biology – M.Sc. (2003) (R. Rivkin)**
Microzooplankton Herbivory and Bacterivory in the North Water Polynya
- **Guilherme Rupp – Biology – Ph.D. (R.Thompson/ J. Parsons-MI)**
Scallop reproduction and early life history
- **Karen Gosse – Environmental Science – M.Sc. (2002)(J. Wroblewski)**
Brown cod and bay stocks: Science and Fish Harvesters' knowledge of coloration in populations of Atlantic Cod (*Gadus morhua*) in Newfoundland and Labrador
- **Nicole Spencer – Masters of Marine Studies (2003)(J.Wroblewski)**
Marine stock enhancement: A critical review of the past and a look to the future within coastal community based marine reserves.

6. Research Funds

Grants received in the 2002-03 fiscal year

NSERC Operating Grants

J. A. Brown	\$28,900.00
D. Deibel	\$39,000.00
W. Driedzic	\$46,200.00
G. Fletcher	\$60,000.00
K. Gamperl	\$41,890.00
C. Parrish	\$36,000.00
R. Rivkin	\$49,875.00
D. Schneider	\$37,500.00
R. Thompson	<u>\$23,000.00</u>
	<u>\$362,365.00</u>

NSERC Strategic Grant

J .A. Brown / W. Driedzic	<u>\$86,222.00</u>
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NSERC Undergraduate Grant

J. A. Brown	\$4,500.00
K. Gamperl	\$4,500.00
D. Schneider	<u>\$4,500.00</u>
	<u>\$13,500.00</u>

NSERC Equipment Grant

D. Deibel	\$61,750.00
K. Gamperl	<u>\$30,946.00</u>
	<u>\$92,696.00</u>

NSERC MFA Grant

W. Driedzic	<u>\$190,000.00</u>
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NSERC Research Networks

D. Deibel (CASES)	<u>\$38,350.00</u>
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NSERC - SOLAS

R. Rivkin	\$167,403.00
R. Rivkin	<u>\$36,000.00</u>
	<u>\$203,403.00</u>

AquaNet

R. Anderson/D. Deibel/R. Rivkin/R. Thompson	\$137,500.00
J. A. Brown/C. Parrish	\$90,178.00
J. A. Brown/C. Parrish	\$58,000.00
W. Driedzic	\$65,833.00
W. Driedzic	\$35,000.00
W. Driedzic	\$27,495.00
G. Fletcher	\$60,250.00
R. Thompson/C. Parrish/J. Parsons	\$101,433.00
C. Couturier/J. Parsons	<u>\$8,000.00</u>
	<u>\$583,689.00</u>

Other Grants*Internal Awards*

D. Deibel	Dean of Science	\$18,000.00
P. Snelgrove	V.P. Research	\$18,000.00
J. Wroblewski	MUN Research Pool	<u>\$2,400.00</u>
		<u>\$38,400.00</u>

External Awards

D. Boyce	WISE Program	\$1,610.00
J. A. Brown	DFO	\$3,300.00
J. A. Brown	Summer Career Placement	\$932.75
J. A. Brown	ACOA/AIF	\$851,250.00
D. Deibel	WISE Program	\$1,610.00
W. Driedzic	CFI	\$85,795.50
W. Driedzic	ACOA	\$86,158.00
W. Driedzic	Aqua Bounty Canada Inc.	\$16,500.00
W. Dreidzic	CFI	\$93,345.00
K. Gamperl	CFI	\$78,838.00
D. Jones	WISE Program	\$1,610.00
C. Parrish	Lockheed Martin Tech.	\$17,550.00
C. Parrish	Summer Career Placement	\$932.75
C. Parrish	DFO	\$8,000.00
R. Rivkin	DFO	\$12,000.00
D. Schneider	Beaver Fishery	\$7,361.00
D. Schneider	DFO	\$10,500.00
D. Schneider	Summer Career Placement	\$933.00
D. Schneider	DFO	\$39,920.00
P. Snelgrove	CFI	\$97,256.00

P. Snelgrove	CRC	\$7,370.00
R. Thompson	CIDA	\$500.00
R. Thompson	Summer Career Placement	<u>\$932.75</u>
		<u>\$1,424,204.75</u>

Total OSC Research Funding **\$ 3,032,829.75**

7. Publications

Publications appearing in the 2002-03 academic year

Acuna, J.L.; **Deibel, D.**; Saunders, P.A.; Booth, B.; Hatfield, E.; Klein, B.; Mei, Z.P.; **Rivkin, R.** (2002) Phytoplankton ingestion by appendicularians in the North Water *Deep-Sea Research Part II – Tropical Studies in Oceanography* **49** (22-23) 5101-5115

Austen, M.C.; Lamshead, P.J.D.; Hutchings, P.A.; Boucher, G.; **Snelgrove, P.V.R.**; Heip, C.; King, G. Koike, I.; Smith, C. (2002) Biodiversity links above and below the marine sediment-water interface that may influence community stability. *Biodiversity and Conservation* **11** (1) 113- 136

Billiard, S.M.; **Khan, R.A.** (2003) **Chronic** stress in cunner, *Tautoglabrus adspersus*, exposed to municipal and industrial effluents. *Ecotoxicology and Environmental Safety* **55** (1) 9-18

Bradbury, I.R.; **Snelgrove, P.V.R.**; Pepin, P. (2003) Passive and active behavioural contributions to patchiness and spatial pattern during the early life history of marine fishes. *Marine Ecology Progress Series* **257**: 233-245

Broderick, T.L.; Belke, T.; **Driedzic, W.R.** (2002). Effects of chronic caloric restriction on mitochondrial respiration in the ischemic reperfused rat heart. *Molecular Cell Biochemistry* **233**(1-2) 199-125

Choe, N.; **Deibel, D.**; **Thompson, R., J.**; Lee, S.H.; Bushell, V.K. (2003) Seasonal variation in the biochemical composition of the chaetognath *Parasagitta elegans* from the hyperbenthic zone of Conception Bay, Newfoundland *Marine Ecology – Progress Series* **251** 191-200

Connors, K.B.; Scruton, D.; **Brown, J. A.**; McKinley, R. S. (2002) The effects of surgically-implanted dummy radio transmitters on the behaviour of wild Atlantic salmon smolts. *Hydrobiologia* 483 (1-3) 231-237

Copeman, L.A.; **Parrish, C.C.** (2002) Lipid composition of malpigmented and normally pigmented newly settled yellowtail flounder, *Limanda ferruginea* (Storer). *Aquaculture Research* **33** (15) 1209-1219

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Gamperl, A. K.; Rodnick, K. J.; Faust, H. A.; Venn, E. C.; Bennett, M. T.; Crawshaw, L.I.; Keeley, E. R.; Powell, M. S.; Li, H.W. (2002) Metabolism, swimming performance, and tissue biochemistry of high desert redband trout (*Oncorhynchus mykiss* ssp.): Evidence for phenotypic differences in physiological function. *Physiological and Biochemical Zoology* **75** (5) 413-431

Goddard, S.V.; **Fletcher, G.L.** (2002). "Physiological ecology of antifreeze proteins - A northern perspective" in *Molecular Aspects of Fish and Marine Biology* - Volume 1: Fish Antifreeze Proteins. Edited by K.V. Ewart & C.L. Hew. Chapter 2. World Scientific. Singapore.

Gregory, R.S.; Laurel, B.J; Ings, D.W.; **Schneider, D.C.** (2002) Relative strength of the 1999 and 2000-year-classes, from nearshore surveys of demersal age 0 Atlantic cod in 3KL and in Newman Sound, Bonavista Bay. *Canadian Stock Assessment Secretariat Research Document* 2002/87: 1-20.

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MacCormack, T.J.; **Driedzic, W.R.** (2002) Mitochondrial ATP-sensitive K⁺ channels influence force development and anoxic contractility in a flatfish, yellowtail flounder *Limanda ferruginea*, but not Atlantic cod *Gadus morhua* heart. *Journal of Experimental Biology* **205** (10) 1411-1418

MacCormack, T.J.; McKinley, R. S.; Roubach, R.; Almeida-Val, V.M.F.; Val, A.L.; **Driedzic, W.R.** (2003). Ventilatory, metabolic and behavioural changes, but not bradycardia contribute to hypoxia survival in two species of Amazonian armoured catfish. *Canadian Journal of Zoology*. **81** 272-280.

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Snelgrove, P.V.R.; Smith, C.R. (2002) A riot of species in an environmental calm: The paradox of the species-rich deep-sea floor. *Oceanography and Marine Biology* **40** 311-342

Stead, R.A.,; **Thompson, R.J.**; Jaramillo, J.R. (2003) Absorption efficiency, ingestion rate, gut passage time and scope for growth in suspension- and deposit-feeding *Yoldia hyperborea*. *Marine Ecology- Progress Series* 252 159-172

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Treberg, J. R.; Lewis, J.M.; **Driedzic, W.R.** (2002) Comparison of liver enzymes in osmerid fishes: Key differences between a glycerol accumulating species, rainbow smelt (*Osmerus mordax*), and a species that does not accumulate glycerol, capelin (*Mallotus villosus*). *Comparative Biochemistry and Physiology Part A* **132A** (2) 433-438

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Fletcher, G.L.; Shears, M.A.; Yaskowiak, E.; King, M.J.; Goddard, S.V. (2003). Gene Transfer: Potential to Enhance the Genome of Atlantic Salmon for Aquaculture. *Australian Journal of Experimental Agriculture*. (Submitted May 2003).

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Gamperl, A.K.; Faust, H.A.; Rodnick, K.J. (in press) All trout are not created equal: intra-specific variation in cardiac hypoxia tolerance. *Journal of Experimental Biology* Accepted with minor revisions Aug. 8th, 2003.

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8. Aquaculture Research and Development Facility (ARDF)

The Aquaculture Research and Development Facility (ARDF) provides state-of-the-art facilities designed to support research, training, pre-commercial production, and small-scale commercial trials, on alternative species for marine aquaculture. A critical component of the new 1400m² facility is a seawater system designed to deliver high quality, temperature controlled, flow through and re-circulating water. Separate tanks and rooms are available for broodstock conditioning, hatchery and nursery operation, first-feeding, and grow-out. Live food production can deliver 1000L algae, 1 billion rotifers, and 500 million *Artemia* daily.

The ARDF carries out research in collaboration with industry partners. The aquaculture potential of various finfish species is being evaluated through the study of broodstock biology and the development of larval rearing techniques. Currently, Atlantic halibut, Atlantic cod, and Atlantic salmon are under investigation.

Research and Development Initiatives 2002-2003

(1) Commercialization of Atlantic Cod and Support for the Atlantic Halibut Aquaculture Industry- Atlantic Canada Opportunities Agencies "Atlantic Innovation Fund"-AIF
http://www.osc.mun.ca/research/awards_funding.html

MUN's Ocean Sciences Centre is working closely with its industry partners Northern Cod Ventures Limited, Long Island Resources Ltd., and the Newfoundland Aquaculture Industry Association) to perform practical, timely and pertinent research to develop an economically viable aquaculture industry. Research and development work with Atlantic cod is addressing challenges related to broodstock, stock selection, larval production, weaning, cannibalism, juvenile growth, stocking density, on-growing at cage sites, cage husbandry, early maturation, fish health and disease. Hatchery production and research is currently taking place at the Aquaculture Research and Development Facility of the Ocean Sciences Centre while on-growing is taking place at a demonstration cage site (<http://www.osc.mun.ca/ardf/cagesite.html>) in Hermitage Bay and Pool's Cove, Newfoundland. The second part of the this AIF project is to assist in the continued development of the Atlantic halibut aquaculture industry in Atlantic Canada. The main areas of research will focus on broodstock, egg quality issues, and pedigree studies.

*(2) DFO's Aquaculture Collaborative Research and Development Program-ACRDP
Atlantic Cod Broodstock Development Program*
<http://www.osc.mun.ca/ardf/research/research1.html>

The Federal Department of Fisheries & Oceans (DFO, Newfoundland & Labrador Region), in conjunction with an industry partner, Newfoundland Aqua Ventures Ltd. (NAV), and in collaboration with the Ocean Science Center (OSC) of Memorial University, are engaged in a cod broodstock research & development project at the Aquaculture Research and Development Facility (ARDF). Funded by DFO's new

Aquaculture Collaborative Research and Development Program (ACRDP) the four-year project is designed to further advance cod aquaculture in Newfoundland. Research is focused on photo manipulation of broodstock to promote production of high quality eggs beyond the natural spawning season, and the improvement of husbandry techniques to develop a top condition broodstock. Research results from the project will contribute to broodstock management protocols intended for use by Northern Cod Ventures Limited at their new commercial hatchery presently under construction at Bay Roberts, Newfoundland.

Results from the first year of the project have been very encouraging. The project has also begun experiments on broodstock husbandry practices as a means to optimize future broodstock management procedures and condition of resulting eggs and larvae.

(3) AquaNet- Canada's federal Network of Centres of Excellence (NCE) in aquaculture.

NCE's are unique partnerships among industry, university and government. This nation wide network connects excellent research with industrial know-how and practical investment. The Ocean Sciences Centre is proud to be the hub where the administrative offices for AquaNet are located. AquaNet funded Atlantic Cod projects at the OSC include:

The Effects of Optimization of Larval Feeding and Digestion

Marine finfish aquaculture in Canada is based primarily on the farming of Atlantic salmon (>95% of production) and some chinook and rainbow trout. However, strong global competition has resulted in reduced market values for salmon and this, coupled with the decline in the wild fisheries, has made the aquaculture production of non-salmonoid species an attractive alternative. A major bottleneck in the mass production of all these species is the high mortality associated with the larval period. These studies will lead to innovative solutions to the bottleneck of juvenile production of these important new species for aquaculture.

Optimizing Metabolic Design for Growth of Cod at Low Temperatures

This project involves determining how to manipulate the metabolism and growth of coldwater fish at low environmental temperature. Seasonal shifts in metabolism may limit fish growth and our research is leading to a much better understanding of muscle growth, ultimately leading to the enhanced growth of fish.

(4) *Natural Sciences and Engineering Research Council of Canada NSERC-Cod Strategic.*

The aim of this project is to study the population differences of Atlantic cod (*Gadus morhua*) involving cod stocks from 4X, 4T, 3Ps and 3K area.

Morphological, physiological and genetically differences exist among latitudinally separated animal populations. Conover and Present (1990) proposed Counter-gradient variation (CGV) hypothesis which predicts that within a species across the latitudinal gradient genetic capacity for growth is inversely related to the length of the growing season. Thus, the northern fish population should have a higher genetic capacity for growth than their southern counterparts and when northern and southern fish populations are reared in common temperature(s), the northern populations should outperform the southern counterparts at all temperatures. Atlantic cod (*Gadus morhua*) has a widespread distribution in Atlantic Ocean from Greenland in the north to Rhode Island in the south and a good candidate for studies involving latitudinal differences.

To test this hypothesis, we are carrying out common garden experiments at on cod originating from four regions in the North Atlantic 3L (Bonavista Bay, NF.); 3PS (Placentia Bay, NF. 48⁰ N; 54⁰ W); 4T (Northumberland Strait, PEI 46⁰ N; 64⁰ W) and 4X (Scotian Shelf, NS. 44⁰ N; W) using morphological, genetically, physiological and behavioural techniques. Objectives of this study are two fold, scientific and technical. The scientific objectives are to determine the genetic and environmental basis of phenotypic variation among populations of Atlantic cod, to test the hypothesis of counter-gradient selection and to identify phenotypic and genetic correlates of individual variation in Atlantic cod reproductive success. The technical objectives are to identify the better broodstock for aquaculture and to refine the mass rearing hatchery protocols.

The degree to which Atlantic cod population variability can be attributed to genetic and environmental factors is of critical importance to Canada's aquaculture industry. For example, the existence of genetically based differences in population survival, development, and growth will significantly affect industry's choice of broodstock, particularly from a local perspective. Our common-garden experiments will identify populations possessing those characteristics most desired by the industry, *e.g.*, high survival, efficient rates of protein synthesis, rapid growth. Our spawning studies will allow us to identify the factors having the greatest influence on reproductive success, ensuring that aquaculture stocks are represented by as many genotypes as possible. We will also be able to provide advice on the optimal requirements for spawning facilities and for successful production of larval and juvenile cod.

Other Projects:

- Atlantic Canada Opportunities Agency (ACOA)

ACOA's contribution of \$200,000 has helped with a sea water enhancement system designed to deliver controlled filtered, Ultraviolet Irradiated, heated and chilled seawater to research areas. I am delighted to say that the project is completed and it has helped improve our research capacity.

- Canadian Foundation for Innovation (CFI)

The infrastructure has provided production equipment (broodstock, start-feeding, and live feed enrichment tanks, hatchery incubators, silos, platforms, and plumbing) for Memorial's recently completed Aquaculture Research and Development Facility (ARDF). In addition, the infrastructure has enhanced the quality of seawater for the OSC/ARDF, by providing a system designed to deliver temperature controlled flow-through and re-circulating water. It has also provided equipment to support research in marine physiology and behaviour, fish nutrition, molecular biology, genetics, and fish health.

- National Research Council of Canada (NRC) Funded Project

Digital image analysis techniques for measuring larval growth:

In 2003, began using an image analysis system to monitor growth rates for each group (tank) of larval cod. A catalogue of information will be gained by using this system whereby measurements of standard length, total length, gut length, head depth-post eye, body depth at anus, total depth at anus and total depth-end of notochord will be recorded. Pictures of digestive systems and prey consumption (gut fullness) will also be recorded.

Pixera digital cameras coupled to an Optem zoom lens will allow digital capture of cod larvae. Cod will be digitised by coupling the Pixera or other CCD cameras to stereo or inverted microscopes. Once in digital format, images can be analysed with various image and video analysis software applications such as Matrox Inspector, SigmaScan Pro or Image Pro Plus.

To improve and increase the importance of fish health techniques:

As an improved means of providing healthy juveniles to industrial partners for grow-out we initiated a fish health-screening regime for the 2003 year-class of cod. We screened for early detection of parasitic infection and prevention of secondary infections. We implemented a screening regime whereby cod over 1.0 grams will be screened biweekly for parasites. We have also set-up a fish health testing protocol for bacteriology, virology and parastology. Samples are randomly collected by fish health authorities.

9. Public Education Program

Since 1988 the Ocean Sciences Centre has organized and played a continuous role in public awareness in marine sciences through public and marine science programs. The current public education program is a complimentary interactive and interpretive outdoors activity for tourists, school children and local visitors. Features of the program include an outdoor touch tank, where visitors can experience a never-ending variety of local marine life; an out-door observation platform for viewing our captive population of harp and harbour seals; and marine interpreters (MUN summer students) to answer questions and explain current research initiatives at the facility. The program operates seven days a week from June 1st to Labour Day weekend. This past summer the program successfully welcomed over 18,000 visitors, which included individuals, groups (i.e. school children, daycare kids, summer camps and bus tours), and organized educational programs (i.e. PEEL and Shad Valley).

The OSC has also been directly involved in marine science programs offered to high-school students across Canada. PEEL Summer Academy visited the Marine Institute and the OSC again this summer, bringing with them high-school students from Ontario interested in learning about the marine ecosystem. In addition, Memorial hosted Shad Valley International during June and July 2003. As part of their program at Memorial, the students were given the opportunity to spend a few days exploring the Ocean Sciences Centre and our local marine environment. Students from both PEEL Academy and Shad Valley were exposed to field and sea activities designed to introduce them to oceanographic and biological sampling, navigation techniques and harvesting technology. Furthermore, students learned the importance of the fishery to the province, the development of aquaculture, and the historical, biological and political aspects of the seal fishery.

Although the current public education program successfully attracts visitors to the OSC, we hope to provide a new and expanded public education program in the near future through the Memorial University Ocean Sciences Research Aquarium. With support from Memorial University, government agencies and private industry, the establishment of a permanent interpretive program within the Ocean Sciences Centre will showcase marine biological and aquaculture research being conducted at Memorial University. In doing so the uniqueness of our cold, ocean environment and its flora and fauna will be evident.

10. Seal Research Facility

The research training program has resumed with the Match to Sample Training this summer. This allows the seals to select objects which are the same, which will allow us to research the perceptual (colour vision, visual acuity under and above water, hearing ability for detection of prey and predators) as well as the cognitive abilities of the harp seals. The study on the impact of environmental enrichment on stereotypy and stress of captive harp seals (blood cortisol levels) still requires some data analysis.

Stephanie Walsh completed her research for her M.Sc. (Cognitive and Behavioural Ecology Programme) in the spring, and will convocate this fall. Kerstin Bilgmann's M.Sc. research on thermoregulation in seals (Universität Köln, German) was published in the May 2003 issue of the Journal of Experimental Biology.

Other research projects include the profile of vibrissae loss and re-growth during moulting in harbour and harp seals, and on-going annual hormonal profiles of the harp seals. Harp seal blood samples were supplied for Biology teaching labs (Animal Physiology) again this year.

Potential research projects include the lipid utilization in harp seals with Dr. Phil Davis (Biochemistry), radio-tracking of released wild harp seals with Dr Gary Stenson, DFO, and the development and assessment of methods to deter seals from salmon rivers (and possibly seal exclusion from cod spawning grounds) with Dr. Becky Sjare, DFO.

The training of the seals and these research initiatives has been achieved by the ongoing participation in experiential learning programs and with the help of volunteers, (High school co-operative programs, Women In Science and Engineering, Youth Services Canada internships, Virginia Park Community Centre, and Memorial's Undergraduate Career Experience Program, MUN). The existing Seal Volunteer Program continues, with volunteers providing seal care and feeding on week-ends, and has been expanded with volunteers assisting with week-day training and husbandry during the summer.

Our ongoing participation in extension and education included the development of scripts and training of the Marine Interpreters for the Public Education Program, as well as responding to the varied requests from the media and the general public. Seal biology and research was one facet of the enrichment programs (Peel, Shad Valley, Marine Pursuits) this year.

11. Field Services Unit

Throughout the past year the Field Services Department of the Ocean Sciences Centre has provided a variety of services to researchers, students, visitors and industry partners. Field Services has regularly provided collections of marine fish and invertebrates for teaching purposes for the laboratory component of several Memorial biology courses and for continuing research projects for faculty and graduate students. Field services frequently provides assistance to students and visitors in conducting field work, including plankton tows, CTD casts and water collections in Conception Bay and the collection of sediment samples beneath mussel farms in Notre Dame Bay. During summer months the unit collects small marine invertebrates, fish and plants for a touch tank that is assembled for the OSC outdoor public education program. Field Services also collects specimens for teaching and research purposes at the Marine Institute, as well as making regularly deliveries of seawater for their aquaculture facility. In addition, the unit was called upon by the Centre for Sustainable Aquatic Resources (CSAR) at the Marine Institute to dive in their flume tank to calibrate some cameras for a model oil platform. These models were used for the evaluating the effects of wave action on oil platforms.

Our unit also provides services to external institutions, industries, and government agencies. Field services has collected wild salmon for broodstock for the privately owned aquaculture company AquaBounty Canada Inc., who also occupy research space at the OSC. We have on two separate occasions transported juvenile salmon from AquaBounty's hatchery in PEI back to the OSC for research and grow-out. The unit has collected and shipped organisms to the Ontario Science Centre for a saltwater aquarium display. This past summer visiting scientist Miguel Maduriera from Portugal joined our unit for approximately six weeks to gain work experience in cold water research diving. Visiting scientists from the Institute for Nonlinear Science, University of California, San Diego returned again this summer to conduct research on the sea butterfly, *Clione limacina*, and used the field services extensively for collection of these animals. The unit also collected sea butterflies to ship to another group of researchers from the Arizona State University. Most recently, Field Services were asked to collect and transport organisms for a touch tank display at a Newfoundland Agri-foods show for the provincial Department of Fisheries and Aquaculture (DFA).

The Field Services Department at the Ocean Sciences Centre will continue to provide the aforementioned services to Memorial University, the Marine Institute and outside researchers and interested parties but we wish to expand and grow with the changing needs of the research community. We hope in the future to work more closely with researchers to assist their work and hope to be able to conduct some independent research within the department itself having already collected some preliminary data with plans of more work in the near future.

12. AquaNet



AquaNet is Canada's research network in aquaculture and a unique collaboration of universities, industry, government and non-government organizations. The Network of Centres of Excellence in Aquaculture, is hosted by Memorial University of Newfoundland, and supported by an annual grant of \$3.6 million from the Government of Canada, along with substantial contributions from its industrial and institutional partners. Its Administration Centre is located at the Ocean Sciences Centre.

AquaNet is well positioned to address the diverse production, environmental and social and economic research needs from coast to coast with its two core facilities at Memorial University of Newfoundland's Ocean Sciences Centre and The University of British Columbia's Centre for Aquaculture and the Environment, and affiliate universities and research laboratories across Canada.

MISSION

To foster a sustainable aquaculture sector in Canada through high quality research and education.

VISION

To help achieve the long term viability and sustainability of the aquaculture sector by significantly contributing to:

- Diversified aquaculture based on businesses that are drivers of innovation and economic growth,
- Harmonization of the aquaculture sector with other aquatic resource users, and
- Integration with other aquatic industrial sectors under a management framework that has widespread Canadian public support.

PRIORITIES

The renowned Canadian and international scientists involved with AquaNet specialize in a range of science fields at 21 universities / colleges and collaborate with network partners to pursue the following strategic priorities:

- Advancing high quality, interdisciplinary research that addresses sector needs,
- Increasing the recruitment and retention of highly qualified personnel,
- Establishing effective networking and partnerships,
- Effectively transferring findings to the aquaculture sector, and
- Helping to build a consultative environment where Canadians are informed about aquaculture.

PRINCIPLES

Activities of AquaNet reflect a commitment to the following underlying principles of sustainable, socially acceptable aquaculture:

- Evidence-based management of risk,
- Promotion of innovation, and
- Respect for traditional and local knowledge.

13. OSC Visiting Researchers

Visiting Scientists

Dr. Ronan Browne University of Ireland Galway MRI Laboratory CARNA CARNA Galway, Ireland	Working in collaboration with in National ARDF staff Cod and Halibut Aquaculture March 2003
Dr. Rafael Levi, Dr. Yura Arshavsky, Dr. Pablo Varona University of California, San Diego	Dynamics of spatial orientation of Clione limacina during hunting Institute for Non-Linear Science behaviour June – July, 2003
Miguel Madureira Faculty Marine & Environmental Sciences University of Algarve, Portugal	Cold water research diving June –July , 2003
Dr. Dra.Paz Herraiez Ortega, Vanesa Robles Rodrigues (Ph.D. Student), Dr. Elsa Cabrita University of Leon, Spain	Collabrative work with Dr. Garth Fletcher’s Lab May- June, 2003

Visiting Post-Doctoral Fellowships

Natercia Joaquim Universidade do Algarve, Portugal	Physiology of North Atlantic flatfishes Dr. K. Gamperl May- August, 2003
Heum GI Park Faculty of Marine Bioscience & Technology Kangnung National University, Korea	Development of larviculture protocols for cold marine fish Dr. J.A.Brown/Dr. C Parrish June 2002- June 2003
Patricia A. Saunders Assistant Professor Department of Biology Ashland University Ashland, OH 44805, U.S.A.	Sample analysis and manuscript writing Dr. D. Deibel June 20 to July 11, 2003

Visiting Students

Stacey Evans MI - Marine Environmental Technology	Work-term Student ARDF June-July, 2003
Adrian Jordan Ph.D. Candidate University of Maine	Dr. J.A. Brown January, 2003

Haude Leveques University of Ottawa	Dr. W. Driedzic AquaNet Project March, 2003
Isabel Costa Undergraduate Marine Biology University of Algarve, Portugal	Dr. K. Gamperl March- August, 2003
Mr. Eric Lapierre University of Montpellier II, France	Mr. Danny Boyce/ARDF March-August, 2003
Haude Levesque Ph.D. Candidate University of Ottawa	Dr. Garth Fletcher Fish Muscle Cell Culture June- July, 2003

14. OSC Seminars

Guest Speakers

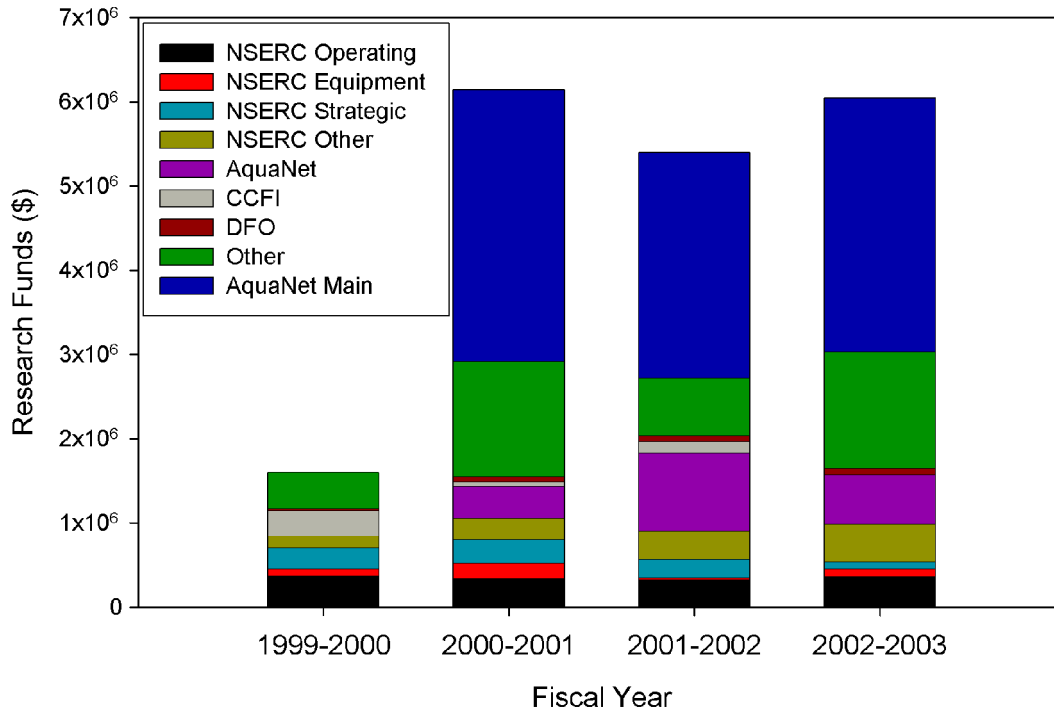
Dr. Grant Brown Dept. of Biology Concordia University, Montreal, PQ	The Phylogeny of fear: Evolutionary conservation of the <i>Ostariophysan</i> alarm pheromone system September 26, 2002
Dr. Dave Schneider OSC, MUN	Model-based Statistics in Biology October 4, 2002
Dr. Chris Glass Director, Division of Marine Fisheries Manomet Center for Conservation Science, Manomet, USA	Fish behaviour and fishing gear: How an understanding of fish behaviour can lead to more selective fishing practices October 22, 2002
Dr. Mark Hartl Project Manager, BIOMASSTOX Dept. of Zoology and Animal Ecology, University Collage Cork, Cork, Ireland	Sediment-associated pollutants and hydromineral regulations of benthic fish. November 21, 2002
Juan Carlos Perez Casanova NRC-IMB, Halifax	Ontogeny of Digestion in Larval Cod and Haddock November 28, 2002
Dr. Chris Glass Director, Division of Marine Fisheries Manomet Center for Conservation Science, Manomet, USA	Fish behaviour and fishing gear: How an understanding of fish behaviour can lead to more selective fishing practices March 6, 2003
Ben Laurel, Ph.D. Candidate OSC, MUN	The role of predators and habitat on the behaviour and distribution of juvenile cod March 21, 2003
Dr. Kraan and Mr. J. Morrissey Martin Ryan Institute at the National University of Galway, Ireland	R & D in Irish Seaweeds- New Projects and Novel Applications May 8, 2003
Lena von Harbour (M.Sc. Non degree visitor) OSC, MUN	Do tunicates graze on transparent exopolymer particles (TEP): New aspects in feeding ecology for pelagic and benthic food webs? July 9, 2003
Dr. K. Alexandra Curtis Scripps Institution of Oceanography California, USA	Eggs in Space: The Distribution of Small Pelagic Fish Eggs in the California Current Region July 10, 2003

OSC Graduate Student Seminar Series

Kelly O'Brien-McDonald Aquaculture M.Sc.	Growth, behaviour and digestion efficiency in Atlantic cod (<i>Gadus morhua</i>) larvae fed three first feeding diets September 4, 2002
Karen Smith Aquaculture M.Sc.	Cannibalism in juvenile Atlantic cod (<i>Gadus morhua</i>) and juvenile fat snook (<i>Centropomus parallelus</i>): the role of size variation. September 4, 2002
Manju Wiejkoon Aquaculture M.Sc.	Inter population difference in growth, and energy used of juvenile Atlantic Cod (<i>Gadus morhua</i>); Implication for brood stock development. September 4, 2002
Paula de Costa Mendonca Biology Ph.D.	Effects of Vanadate on the Histology and Function of the Lusitanian Toadfrog Heart. September 11, 2002
Ben Laurel Biopsychology Ph.D.	Mechanisms of differential habitat use in age 0 juvenile cod (<i>Gadus</i> spp.). September 18, 2002
Stephanie Walsh Biopsychology M.Sc.	Habituation and Visual Discrimination in Harp Seals September 25, 2002
Martha Hiscock Biopsychology Ph.D.	Activity patterns of juvenile Atlantic salmon in winter. October 2, 2002
Matt Logan Biopsychology M.Sc.	Dietary aspects of Leach's Storm-Petrel. October 10, 2002
Joy Stacey Biology M.Sc.	The impacts of shellfish aquaculture. October 16, 2002
Geert van Biesen Environmental Science M.Sc.	Lipids as biomarkers for the environmental distribution of organic waste from fish cages October 23, 2002
Marcelo Miranda Biology Ph.D.	Blue mussels as a model to understand evolution October 30, 2002
Krista Park Biology M.Sc.	Inter-population differences in the rates of protein synthesis in Atlantic cod juveniles November 13, 2002

Appendix

OSC Research Funds



OSC Graduate Student Population

