

INSIDE THIS ISSUE

- ◆ New Technologies in Aquaculture: Improving production efficiency, quality and environmental management 1
- ◆ On Scientists discomfort in fishery advisory science... 2
- ◆ Valentia Scallop Project 2
- ◆ Molecular-Based Dietary Analysis of Marine Organisms 3
- ◆ SUSFISH: Shellfish Productivity in the Irish Sea: Working Towards a Sustainable Future 3
- ◆ Ecotoxicology of Marine Biotoxins in *Mytilus edulis* and *Tapes semidecussatus* 4
- ◆ AQUATT is a success story 4
- ◆ Forthcoming projects 4
- ◆ New Appointments 4

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WELCOME

This is the first in a series of bi-annual Aquaculture & Fisheries Development Centre (AFDC) newsletters produced for project and information dissemination about the AFDC. We hope that individuals will be inspired to contribute to future issues and share the fruits of their research with their colleagues. We'd also like to draw your attention to the newly update AFDC website (<http://afdc.ucc.ie>), which includes staff profiles and information on research group expertise within the AFDC.

Dr Maria O'Mahoney (Manager, AFDC) & Dr Sarah Culloty (Director, AFDC)



New Technologies in Aquaculture: Improving Production Efficiency, Quality and Environmental Management

Edited by Gavin Burnell, University College Cork, Ireland and Geoff Allan, NSW Department of Primary Industries, Australia

Woodhead Food Series No. 178

With wild stocks declining due to over-fishing, aquaculture will have a more significant role to play in meeting future demand for fresh fish. Developments in research continue to lead to improvements in aquaculture production systems, resulting in increased production efficiency, higher product quality for consumers and a more sustainable industry. *New Technologies in Aquaculture* reviews essential advances in these areas.

Part one focuses on the genetic improvement of farmed species and control of reproduction, with chapters on genome-based technologies in aquaculture research, selective breeding and the production of single sex and sterile populations, among other topics. Parts two and three review key issues in health, diet and husbandry, such as the control of viral and parasitic diseases, diet and husbandry techniques to improve disease resistance, advances in diets for particular fish species and the impact of harmful algal blooms on shellfisheries aquaculture. Chapters in Parts three and four then examine the design of different aquaculture production systems, including offshore technologies, tank-based recirculating systems and ponds, and key environmental issues, such as the prediction and assessment of the impact of aquaculture. Concluding chapters focus on farming new species.

With its well-known editors and distinguished international team of contributors, *New Technologies in Aquaculture* is an essential purchase for professionals and researchers in the aquaculture industry.

Geoff and Gavin are about to team up again with Woodhead Food Series to edit a new book on Advances in Hatchery Technology. The plan is to cover all aspects of production from live food to recirculation with case studies on difficult species such as eel, tuna and scallops. If all goes to plan this book should be in publication by early 2011.

Prof. Gavin Burnell is PI and ex-Director of the AFDC. He is also Associate Professor with The Department of Zoology, Ecology & Plant Science (ZEPS), UCC.



On Scientists discomfort in fishery advisory science...

Sarah Kraak & Emer Rogan

A current debate in Fisheries Science is whether fisheries advice should be produced by an auto-pilot process that, after its scientific design, can be applied without circumspection, or rather by a dynamic and iterative process of expert judgment, incorporating separate parallel lines of scientific evidence and factual knowledge. Sarah Kraak, Emer Rogan and colleagues recently published a paper advocating the latter. The opposing views are sometimes referred to as "the Vatican model" and "the Socrates model"* , respectively (see pictures). In the past, scientists predicted stock levels, and once a harvest rate was agreed, it was just a matter of applying the latter to the former to arrive at advice on how to harvest the stock. Currently it is acknowledged that there is uncertainty in the system, and we have to find ways to deal with this uncertainty in the face of management objectives, including biological, societal and economic objectives. The debate centers on the evaluation of proposed Harvest Control Rules against the precautionary principle and management objectives. Where the fisheries man-

agement institutions hope for simple answers from the scientists, giving a 'green/red light' to a proposed management strategy, the scientists are forced into a split position between satisfying the demands of their advisory role and living up to the standards of scientific rigour. We argue against the mechanization of scientific advice that aims to incorporate all relevant processes into one big model algorithm. Instead we encourage that fisheries advice should be a dynamic process, incorporating evidence from quantitative and qualitative modelling exercises and factual knowledge of the biology and the fishery dynamics. This process can be formalized to a certain degree and can easily accommodate stakeholder viewpoints.

* These terms were coined by Poul Degnbol, Scientific Adviser in the European Commission DG Fisheries and Maritime Affairs

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in management strategy evaluation: fundamental problems or misinterpretations? *ICES Journal of Marine Science*, 67: in press.



The Vatican Model.

White smoke appears when scientists have reached the final verdict.



The Socrates Model. An ongoing dialogue takes place among scientists with different strands of evidence and stakeholders.

Dr Sarah Kraak is a ZEPS/AFDC post-doctoral researcher currently based at the Marine Institute, Co. Galway.

Dr Emer Rogan is PI with the Marine Mammals and Fisheries Research Group at the AFDC. She is also a Senior Lecturer with ZEPS, UCC.

Valentia Scallop Project

Gavin Burnell

The South West Scallop Fishermans Cooperative has developed a business plan to put the scallop fishery in Valentia Harbour on a sustainable footing. Prof. Gavin Burnell has been invited to advise the group as a molluscan shellfish expert. So far they have re-seeded over one million scallop spat from Mulroy Bay after growing them in intermediate culture for 12 months. During this time the juvenile scallop grew from 20 – 50mm. At this size they are



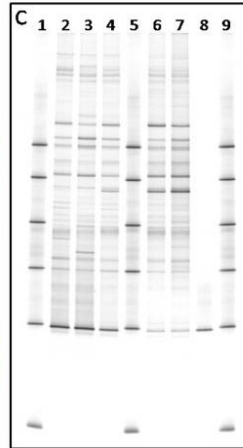
more resistant to predation and after a further 12 months on the seabed have now reached 80 – 95mm. Previous work by Bord Iascaigh Mhara had demonstrated that this area could potentially be self-recruiting as the hydrography is conducive to larval retention. Over the next 12 months the Coop plan to supplement wild caught seed from Mulroy Bay with seed produced from their own broodstock. These will initially be produced by Dr Julie Maguire's (previous AFDC Manager) team at the Daithi O'Murchu Marine Research Station in Bantry Bay. Prof. Burnell sees this project as a good opportunity to put the "Ecosystem approach to fisheries management" ethos to the test (currently funded under the Beaufort Programme; NDP administered by MI). Another useful by-product of this new collaboration is that several of the MSc Marine Biology students will be able to carry out mariculture related projects, based within the AFDC & ZEPS, in Bantry and Valentia.



Molecular-Based Dietary Analysis of Marine Organisms

Aaron Maloy

Marine food webs form the basis through which we describe ecosystem structure and serve as a heuristic template from which management tools such as carrying capacity models are developed. Food webs are defined through the strength and frequencies at which various organisms interact; interactions that determine the fate and flux of every population within the ecosystem. Assessment of these interactions is severely limited in many marine organisms, especially those with cryptic feeding ecologies or small pelagic larvae. In a collaborative project between the Letterkenny Institute of Technology's Centre of Applied Marine Biotechnology (CAMBio) and the University College Cork's Aquaculture & Fisheries Development Centre, we are developing novel approaches to assess the diet



A. Native clams harvested for sampling. **B.** Ethanol is injected into the digestive gland of each clam to stop DNA degradation. **C.** DNA is extracted, PCR amplified and products separated using denaturing gradient gel electrophoresis. Each band represents DNA from a different organism. Lane 1, 5, 9: Migration standards; Lanes 2-4, 6-7: Gut contents from five individual clams; Lane 8: DNA from the clam adductor muscle as a control.

of adult bivalve populations and their larvae. Initial work with adults has been based on PCR and denaturing gradient gel electrophoresis (DGGE). The PCR-DGGE approach has proven extremely useful detecting differences in the dietary diversity between sympatric species of bivalves (Mar Ecol Prog Ser; 381:109-118). This approach is being further developed and, in conjunction with Queen's University, Belfast, evaluated against traditional methods such as stable isotope analysis. Developing methods for larval bivalves has posed

additional challenges due to their extremely small size. Generally less than 350µm in shell height, larvae possess trace amounts of gut content material relative to bivalve tissue which confounds the molecular techniques being used. Initial efforts to isolate relatively pure gut contents from larvae were focused on laser capture microdissection (LCM). Though success was limited with bivalve larvae, through a partnership with the Martin Ryan Marine Science Institute at the National University of Ireland, Galway, the effectiveness of an LCM approach for dietary work with larval finfish has been demonstrated. Continuing work with bivalve larvae is focused on the isolation of higher quality DNA from their gut contents while also exploring ways to eliminate amplification of bivalve DNA in the initial PCR step. Through this multi pronged approach and use of collaborative expertise, transferable techniques for the molecular assessment of dietary diversity in a wide range of organisms are being developed.

Aaron Maloy is a PhD student working with Dr John Slater of Letterkenny Institute of Technology (LIT) and Dr Sarah Culloty (AFDC & ZEPS)

SUSFISH: Shellfish productivity in the Irish Sea: working towards a sustainable future

Sharon Lynch & Sarah Culloty



The SUSFISH project is an ERDF funded (IRELAND WALES INTERREG 4A Programme) three year collaborative project between University College Cork, and Bangor, Swansea and Aberystwyth Universities in Wales. The team in UCC is led by Dr Sarah Culloty. A Postdoctoral researcher, Dr Sharon Lynch, and two PhD students, Maud Cross and Emer Morgan (who will be supervised by Dr Culloty and Dr Ruth Ramsay), constitute the research team and will work closely with partners at the other collaborat-

ing institutes.

The research carried out at UCC will focus on laboratory and field based trials investigating the biological and environmental impacts of climate change in several shellfish species in the Irish Sea. The Pacific oyster, *Crassostrea gigas*, the European flat oyster, *Ostrea edulis*, the soft shell clam, *Mya arenaria*, the razor clams *Ensis siliqua* / *E. arcuatus*, the edible cockle, *Cerastoderma edule*, and the edible mussel, *Mytilus edulis* (wild and cultured stocks) will be studied.

The influence of several aspects of climate change such temperature, salinity and acidification, and their influence on bivalve physiology and particularly disease will be investi-

gated. Much of the study will concentrate on assessing the impact of climate change on diseases with different aetiological agents and potential pathogens such as viruses, bacteria, protists and macroparasites in bivalve populations. Another aspect of the study will investigate the population genetics of the bivalves and their pathogens and data will be used to develop models to facilitate the interpretation of different aspects of climate change and their effect on bivalve populations in the future.

Dr Sharon Lynch is a Post-doctoral researcher with the Shellfish Health and Disease Research Group (AFDC). Dr Sarah Culloty is Principal Investigator on this project.



Ecotoxicology of Marine Biotoxins in *Mytilus edulis* and *Tapes semidecussatus*

Moira McCarthy

The main focus of my project is to examine the behavioural; physiological; immunological; cellular and genotoxic effects of marine biotoxins on *Mytilus edulis* and *Tapes semidecussatus*. Both species are farmed by the aquaculture industry and are of great economic importance in Ireland. There are a number of biotoxins produced by marine algae that negatively impact this industry, and cause food poisoning in humans if consumed, included among them are Domoic acid, Saxitoxin, Azaspiracids, and the Okadaic acid group which includes the dinophysis toxins.

A major limiting factor of my PhD project is the lack of commercial availability of the most common biotoxins found in Irish waters, the Dinophysis toxins (DTX1, DTX2, and DTX3) and Azaspiracids. To combat this, a number of methods for algal and toxin harvesting will be employed. Solid phase adsorption and toxin tracking (SPATT) discs are being assembled, these employ adsorptive resin to allow passive collection of toxins in the water column, and this provides information on the toxins present. We can then determine the best locations for deployment of our submersible pumping machine. This machine enables active extraction of toxin from algae and water. Seawater is pumped through a number of filters trapping debris and rupturing the algae releasing toxin. This toxin is then adsorbed on a resin and can be extracted by analytical chemistry techniques in the laboratory. Vertical net trawls for phytoplankton blooms

Forthcoming Projects

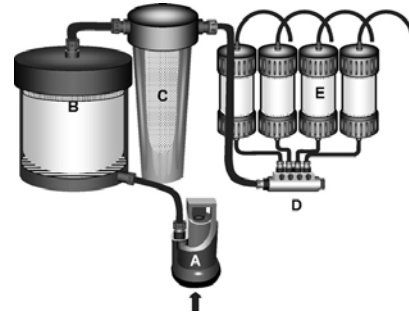
COEXIST: Interaction in coastal waters: A roadmap to sustainable integration of aquaculture and fisheries (EU FP7 Funded, Duration 36 mths) (Prof. Gavin Burnell)

Coastal areas are subject to an increase in competing activities and protection (Natura 2000, Marine Strategy Directive) and are a source of potential conflict for space allocation. COEXIST is a broad, multidisciplinary approach to evaluate these interactions with the ultimate goal to provide a roadmap for better integration, sustainability and synergies among different activities in the coastal zone.

SEAFARE: Sustainability and environmentally friendly aquaculture for the Atlantic region of Europe (INTERREG 4B - Atlantic Area, Duration 35 mths) (Prof. Gavin Burnell)

SEAFARE brings together applied R&D centres, aquaculture industry organisations and environmental agencies across the Atlantic maritime region, to promote sustainable expansion of European aquaculture. SEAFARE will develop solutions to specific constraints on industry development for Europe's fish and shellfish farmers, through species diversification and development of low-intensity aquaculture systems that are compatible with sensitive coastal habitats.

will also be performed and compared to the other two methods. It is envisioned that one, or all, of these methods will provide sufficient toxin for numerous experiments, and algae for subsequent culturing, as well as information on the toxin concentrations and phytoplankton species present at the sampling areas.



Rundberget *et al* (2007) Diagram of submersible pumping device: (A) submersible pump; (B) pre-filter packed with wadding and topped with 100-mm plankton net; (C) filter (50 mm); (D) flow distributor; and (E) columns packed with suitable adsorbent resin.

Moira McCarthy is a PhD student working with Prof. John O'Halloran (ZEPS, UCC), Dr Frank van Pelt (Department of Pharmacology, UCC) and Prof. Kevin James (Cork Institute of Technology & Adjunct Professor, Environmental Research Institute, UCC)

AQUATT is a Success Story

Gavin Burnell

In 1992, Gavin Burnell (Director of AFDC, 2004 - 2009) and Richard FitzGerald (Manager of AFDC, 1992 - 1997) established a University Enterprise Training Partnership using a IRE165,000 grant from the EU Leonardo Programme. It was named Aquaculture Technology and Training (AQUATT). For the first 5 years this *not for profit* company was exclusively involved in student placements across the EU for the aquaculture sector. Over the years its activities have broadened and diversified from aquaculture and fisheries into food, energy and environment. Most recently AquaTT has been extremely successful in securing several significant grants from the European Commission 7th Framework Programme to implement important strategic RTD projects in the marine sector. All this takes place with a permanent staff of 3 and a part-time financial controller in a Dublin based office.

Over the past few months Gavin Burnell (Chairman of AQUATT, 2000 - 2005 and currently on AQUATT Board of Directors) has been actively promoting the company to its co-owners UCC (with NUIG). As a result of recent meetings with Professor Peter Kennedy (VP Research) and Michael Farrell (Corporate Secretary) AQUATT will be included in UCC's strategic plan for exploitation of the FP7 Programme. Already the close links between AFDC and AQUATT have resulted in successful grant applications (see article on CO-EXIST and SEAFARE).

New Appointments

SUSFISH: Shellfish productivity in the Irish Sea: working towards a sustainable future (INTERREG 4A Ireland/Wales). PI: Dr Sarah Culloty

Post-doctoral Researcher: Dr Sharon Lynch

PhD Students: Ms Emer Morgan, Ms Maud Cross