

Aquaculture & Fisheries Development Centre  
School of Biological, Earth & Environmental Sciences  
University College Cork



## Annual Report 2010



**UCC**

Coláiste na hOllscoile Corcaigh, Éire  
University College Cork, Ireland



A large, stylized white outline of a fish is positioned in the background, facing right. The outline is composed of thick, rounded strokes, capturing the essential shape of the fish including its head, eye, dorsal fin, and tail.

**OUR VISION:**

**EXCELLENCE**

**in AQUACULTURE and FISHERIES**

**RESEARCH and DEVELOPMENT**



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## EXECUTIVE SUMMARY

2010 was another successful year for the Aquaculture and Fisheries Development Centre in the School of Biological, Earth and Environmental Sciences at University College Cork. The four thematic areas: Fisheries, Aquaculture, Molecular Genetics and Shellfish health have continued to thrive. During the year three PhD theses and six MSc theses were produced by students based within the centre. A total of 18 peer reviewed publications in high ranking journals such as Molecular Ecology and Proceedings of the Royal Society B were produced along with one book chapter and one report. Eight oral presentations were made at international conferences and the best student poster prize was awarded to Maud Cross for her poster presented at the European Marine Biological Symposium.

Through publications, presentations and AFDC representation on national and international committees the group continues to collaborate with colleagues nationally and worldwide. This is also reflected in the continuing success of the AFDC in attracting funding. In 2010 funding continued to grow with €8.43 million in grants ongoing during this year and it is envisaged that this will grow again in 2011. The research strengths available within the centre have allowed the group to respond to a diverse range of research challenges and potential funding areas. The centre also plays a large part in education of undergraduate and postgraduate students with the School of BEES.

Dr Sarah Culloty,  
Director AFDC

## AFDC FACILITIES & SPECIFICATIONS

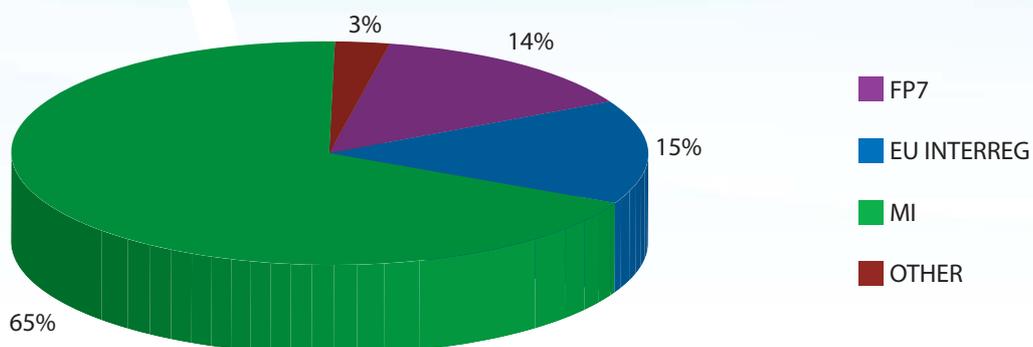
The Aquaculture & Fisheries Development Centre is a 1200 m<sup>2</sup> complex with facilities to carry out fisheries and aquaculture research including two tank rooms with tropical marine system freshwater and marine recirculation units, broodstock conditioning units, shellfish on-growing units, filter-feeder broodstock conditioning units, a larval culture system and live food culture facilities. Continued upgrading during 2010 included the installation of a walk-in refrigerator. A purpose built marine recirculation system was also installed.



Facilities at the AFDC

## AFDC FUNDING - GRANT CAPTURE

Since 2007, on-going funding has increased from €7,743,673 to €8,434,813 in 2010. Twenty three research projects were ongoing at the AFDC during 2010. Marine Institute funding accounted for 68% of the total funding at the AFDC (Figure 1). European Union funding, from FP7 and ERDF programmes, accounted for 29% of the total funding at the AFDC. Total EU funding has increased from 3% of the total grant capture in 2007/2008. The increased proportion of EU funding at the AFDC in recent years reflects increased efforts to secure non-Exchequer funding for research. During 2010, four new research projects, with a combined value of €1,311,298, were initiated supported by EU FP7 and ERDF funding programmes. During 2010, Dr Sarah Culloty secured €580,000 for two new EU FP7 funded projects, BEADS and BIVALIFE, which will begin in 2011.



**Figure 1.** Allocation of research funding ongoing during 2010 from different funding bodies

## MOLECULAR GENETICS RESEARCH

Molecular genetics research at the AFDC is primarily funded by the Beaufort Marine Research Award in Fish Population Genetics, which runs to 2015 and also includes Queens University Belfast, underpinned by several EU and National contracts. A diversity of research projects conducted within the group produces vital information for many different customer groups e.g. commercial fishing communities, fisheries managers, aquaculturalists, environmental protection agencies, angling groups, policy makers, regulators. During 2010, over 12 research projects were ongoing within the group with new projects including the Atlantic Aquatic Resource Conservation Project (AARC) funded by the EU INTERREG programme and a Government of Ireland ministerial request for a genetic analysis of mixed stock fisheries in the Cromane and Waterford Estuary experimental salmon fisheries. During 2010, the Molecular Genetics group consisted of two principal investigators, Prof. Tom Cross and Dr Phil McGinnity, two senior researchers, Dr Jamie Coughlan and Dr Jens Carlsson, one Post-doctoral researcher, Dr Eileen Dillane, one PhD student, Ciar O'Toole, three MSc students, Bill Brazier, Fionn Keating and Nora Curtin and three research assistants, Mary Cross, Alicé Antomiacomi and Serena Keane. Outputs over this period included 4 peer-reviewed publications.

**FOCUS ON: ATLANTIC AQUATIC RESOURCE CONSERVATION (AARC) PROJECT :** An assessment of the fitness of the hatchery Atlantic salmon (*Salmo salar*) population and the genetic composition of the extant naturally spawning population as a support to the development of stock restoration strategies in the river Shannon

The AARC project is funded by the European Regional Development Fund INTERREG IV Atlantic-area Trans-national Programme. Project partners include UCC, QUB/AFBINI, Inland Fisheries Ireland, the Marine Institute and the Electricity Supply Board.

Some of the most productive Atlantic salmon rivers in Europe have been harnessed for hydro-electric power generation e.g. Shannon (Ireland), Conan (Scotland), Linares (Spain). In Ireland alone some 35% of the potential salmon producing habitat is impounded above hydroelectric dams. In compensation, hatchery mitigation programmes were established in most of these rivers, in order to compensate for the loss of productivity, to maintain natural runs and to preserve biodiversity. Despite the best efforts of these hatchery programmes, many of the salmon populations above these facilities are effectively extinct. The large hatchery programmes continue to exist but are increasingly coming under the spotlight from cost benefit analyses and their success in maintaining fisheries and protecting biodiversity. Most of these mitigation schemes were developed many decades ago before much of the contemporary information about sub-specific population genetics was developed. Thus, it would seem timely to reassess and redirect mitigation programmes with respect to the large body of evolutionary, population and quantitative genetic knowledge that now exists, particularly in terms of metapopulation theory, landscape genetics and new knowledge about the biology of the salmon (effective population size etc). It might also be possible to simulate natural re-colonisation processes, by combining ecological and evolutionary biological principles to resolve these most difficult fisheries management problems.

This project addresses the research question, "What is the potential of artificially assisted re-colonisation of Atlantic salmon (*Salmo salar*) based on applying meta-population theory for ecological mitigation?". There are two parts to this project (1) *Common Garden Experiment* and (2) *Establishment of a Genetic Baseline*. The first part is an assessment of the relative fitness

of the progeny of the Shannon hatchery population with respect to the progeny of the contemporary extant naturally-spawning population and the progeny of two non-impacted wild salmon populations obtained from rivers located below the dam. The second part is the provision of a genetic baseline consisting of: samples collected from (1) historical populations derived from archive scale collections (1929–1980); (2) contemporary residual naturally-spawning populations from above the hydroelectric generating facility; (3) the contemporary hatchery population; and (4) contemporary samples from wild populations in rivers located below the dam. In 2010, we collected material from five residual populations in tributary rivers flowing into Lough Derg and the two principal rivers downstream of the hydroelectric facility. In addition, we have been undertaking some trial screening of archive scale samples to assess DNA quality and to determine the most effective method of acquiring high quality DNA.



Spring Atlantic Salmon

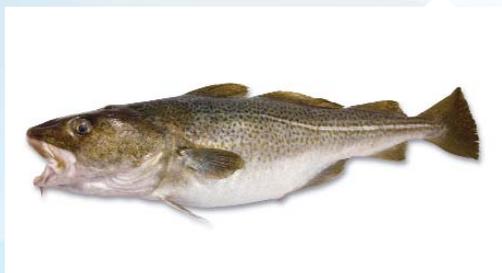
### **FOCUS ON: EIRCOD: The use of novel and published microsatellite DNA marker loci for the study of population structure of cod (*Gadus morhua* L.) in the North Atlantic**

This project is a research collaboration between UCC and the Carna Research Station NUIG, and is part of the EIRCOD cod breeding and broodstock project sponsored by the Marine Institute through the NDP, supported by the Beaufort Marine Genetics Award.

The EIRCOD project addresses the research question “Do additional microsatellite marker derived from next generation sequencing data help to resolve population structure of cod (*Gadus morhua*) in the North Atlantic, and what role has selection in determining this structure?”.

Genetic studies based on different genetic markers have revealed varying degrees of population structure in Atlantic cod across their range. However, little attention was paid to the possibility of selection acting on the loci used in these studies. In this study, samples of cod were sourced from a recent expedition to the Celtic Sea in addition to samples from the cod archive of the molecular genetics research group to represent the species' geographic range. These included samples from the west Atlantic (Scotian Shelf), east Atlantic (Barents Sea), Trondheimsfjord, the North Sea, the Celtic Sea and the mid-Atlantic (east and west Iceland). Samples were analysed at nine microsatellite loci, of which six were novel and three were previously published.

This study provided confirmation of the observation of previous studies that cod is not a single panmictic population in the North Atlantic. This implies that there might be significant biological differences among populations that might be of importance for stock management. More importantly, the results suggest that all loci used in fisheries population genetics should be tested for selection, and the implications of including selected loci in genetic studies that provide management advice should be considered. As a result of this research, a pipeline for identification, validation and deployment of microsatellite markers has been developed that is fast, economical and can be applied to any organisms without the need for prior genetic information.



Atlantic Cod (*Gadus morhua*)

## MARINE MAMMALS & FISHERIES RESEARCH

During 2010, five research projects were ongoing within the marine mammal and fisheries research group. This included a new project funded by an Bord Iascaigh Mhara which was a pilot marine mammal observer programme in Irish pelagic trawl and gillnet fisheries. This project was conducted in fulfilment of Ireland's requirement to implement monitoring schemes for incidental catches of cetaceans, using observers, in pelagic trawl and gillnet fisheries under Articles 4 and 5 of EC Regulation 812/2004 of 26/04/2004 (transposed as S.I. No. 274/2007).

Personnel with the group during this period included three post-doctoral researchers, Dr Sarah Kraak, Dr Alison McCarthy and Dr Susie Brown (Beaufort PDR with Prof. Gavin Burnell, Aquaculture Research), five PhD students, Anneli Englund, Ana Santos, Gema Hernandez-Milian, Deepak George Pazhayamadom, Hocine Benchikh, three MSc students, Eimear Curran, Tara Keana and Martha Gosch and three research assistants, Ailbhe Kavanagh, John Enright and Roisin Pinfield. Research project outputs included four peer-reviewed publications, one report and six oral presentations at conferences. Research degrees were awarded to two other students; Aisling Lannin was awarded a PhD for a project entitled "The biology, dynamics and fisheries for Hake (*Merluccius merluccius*) in the waters around Ireland" and Roseanne Miller was awarded an MSc for "A genetic and behavioural insight into the population and social structure of bottlenose dolphins, *Tursiops truncatus*, along the Irish Coast".



Common dolphin, *Delphinus delphis*

**FOCUS ON: LIFE HISTORY, ECOLOGY & DYNAMICS OF THE BLACK SCABBARDFISH, *APHANOPUS CARBO* (LOWE, 1839), IN THE DEEP WATER ECOSYSTEM IN THE NORTH EAST ATLANTIC**

*(Funded by the Marine Institute under the Sea Change Framework)*

The black Scabbardfish (*Aphanopus carbo* Lowe, 1839) is a benthic-pelagic deep water species with a wide distribution, in the North West and North East Atlantic, from Iceland to Canary Islands, including the islands of Madeira and Azores. This species is commercially exploited in Portugal (Madeira and mainland), where it is caught with longliners. In the north of Europe the species has been mainly captured west of Ireland and Scotland, by the French, U.K. and Icelandic multi-species trawlers since the early 1990's. Over the last 10 years black scabbardfish became one of the main commercial deep-water species landed in Europe which makes it one of the most important among the various deep-water species that are covered by the ICES Working Group on the Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP). Despite the increasing commercial interest in this species, little is known about its life history and stock structure in North East Atlantic.



Black Scabbardfish, *Aphanopus carbo*

Using a multi-disciplinary approach, this project is examining the biology, dynamics and fisheries for black scabbardfish in North East Atlantic. It will incorporate fisheries data to examine changes in fishing effort and distribution, which should give insights into the habitat use, migratory and seasonal behaviour and may indicate spawning areas. Biological information will give a better understanding of age structure, growth, reproduction and diet of the black scabbardfish. The highly innovated technique to use stable isotope analyses in the otoliths will give temporally defined insights into the life history of this species and understand its dynamics and long distances migrations in NE Atlantic.

Results of this project will increase our understanding of black scabbard dynamics in the waters around Ireland and the NE Atlantic and this knowledge will inform the establishment of an ecosystem approach to deep waters fisheries management.



Ana Santos performing a Black Scabbardfish dissection

## FOCUS ON: PILOT MARINE MAMMAL OBSERVER PROGRAMME IN IRISH PELAGIC TRAWL & GILLNET FISHERIES

(Funded by an Bord Iascaigh Mhara)

Under Articles 4 and 5 of EC Regulation 812/2004 of 26/04/2004 (transposed as S.I. No. 274/2007), there is a requirement for Member States to implement monitoring schemes for incidental catches of cetaceans, using observers, in pelagic trawl and gillnet fisheries. Independent observations of fishing activities are essential to provide reliable estimates of the incidental catches of cetaceans, and to extrapolate the by-catch observed to the whole fishery concerned. To meet Ireland's requirements to the Directive, we are providing observer coverage on Irish vessels, primarily in ICES sub areas VI and VII. The initial phase of the project, from August to October 2010, involved observer coverage of the Albacore tuna pair pelagic trawl fishery. From December 2010 to March 2011 we will provide 10% coverage on single and pair pelagic trawl fisheries for Mackerel, Herring, Horse Mackerel, and Blue Whiting. In addition there will be 5% coverage of gillnet and tanglenet fisheries.

In order to maximise the overall value of the programme, observers will carry out a number of tasks aboard fishing vessels. These include biological sampling, where possible, of cetaceans for life-history characteristics and diet studies. The incidental catch of Endangered Threatened and Protected (ETP) species, such as seabirds and turtles will also be monitored. The behaviour of cetaceans and other animals around fishing gear will be monitored and recorded. Observers will also carry out constant effort watches for cetaceans, in order to contribute to the mapping of the distribution and relative abundance of cetaceans in Irish waters.



Common dolphin, *Delphinus delphis*, bow-riding a fishing boat.

## AQUACULTURE RESEARCH

During 2010, Prof. Gavin Burnell was involved in several projects with a central theme of sustainable development of aquaculture and fisheries. This involved two new collaborative research projects; COEXIST is a project which aims to produce a roadmap to sustainable integration of aquaculture and fisheries in the coastal zone and SEAFARE is project which project will strengthen links between research and industry and influence policy development at regional and national level for sustainable and environmentally friendly aquaculture. During this time, research continued on the Valentia Harbour Scallop Restoration Project which aims to build a sustainable fishery of King Scallop, *Pecten maximus*, based on the carrying capacity of the harbour and in sympathy with the local stakeholders. Tara Griffin completed a bursary in Valentia Harbour on this project with the support of the Beaufort Ecosystem Approach to Fisheries Management fund. Prof. Burnell also co-supervised (with Dr Emer Rogan) Beaufort Post-doctoral researcher, Dr Susie Brown and PhD student, Gema Hernandez-Milian. Outputs for the Aquaculture group over this period included one peer-reviewed publication and one conference presentation.

In 1989 Prof Gavin Burnell and Dr Richard Fitzgerald set up AQUATT (Aquaculture Training and Technology) as a University Enterprise Training Partnership funded by the EU COMET Programme. UCC and NUIG are Founder Members of AQUATT and as such have always had a presence on the Board of Directors. Since its foundation to facilitate training of aquaculture undergraduates across the EU, this company has evolved to become specialised in Knowledge Management. It has been very successful in coordinating and partnering many FP7 projects in the aquatic resource management area (food, environment, health and energy) and currently has a turnover of several hundred thousand per year. During 2010 Prof Burnell took part in several meetings between UCC Management and AQUATT in order to consolidate and clarify their inter-relationship and in order to promote a new era of collaboration between the two organisations.



Valentia Harbour Scallop Restoration Project:  
Juvenile Scallop *Pecten maximus*.

## **FOCUS ON: AN EXPERIMENTAL ASSESSMENT ON THE EFFECTS OF PHOTOPERIOD TREATMENTS ON THE SOMATIC AND GONADAL GROWTH OF THE JUVENILE EUROPEAN PURPLE SEA URCHIN *PARACENTROTUS LIVIDUS***

Sea urchins respond differently to light. Research has shown that photoperiod regimes can have varying effects on somatic growth across all species. Under a summer light regime, some species can produce large gonads. In other cases, shortening daylight promotes gonadal growth. Numerous trials have incorporated photoperiod as part of their experimental procedure or alternatively differentiated the effect of photoperiod between somatic and gonadal growth. However, only few papers have focused on the effects of photoperiod on somatic growth.

Determining the optimum light conditions for sea urchins reared in land-based systems is vital for the future use and assessment of possible commercial systems of sea urchin farming. Recent research at the AFDC investigated the effects of two different light regimes, complete darkness and a long day photoperiod of 16 h light:8 h darkness, on the somatic and gonadal growth of the European sea urchin *Paracentrotus lividus* (19.5-23.0mm) using the commercial UrchinPlatter™ System over a 6-month period (5 March to 5 September). Hatchery-produced *P. lividus*, reared on a diet of *Laminaria digitata*, were used in this study. Females were the predominant species of the animal group, displaying a reproductive Stage III (growing stage) where gametogenesis was commencing. Results show that darkness supports higher somatic growth than the photoperiod treatment. Feeding rates were higher for sea urchins reared under darkness with gonadal growth increasing for both experimental treatments. Individuals reared under darkness had a higher per cent change in gonad index from the initial sample taken at the beginning of the experiment.



The sea urchin *Paracentrotus lividus*

This research was published in the journal *Aquaculture Nutrition* in 2010 (McCarron, E., Burnell, G., Kerry, J. & Mouzakitis, G. Volume 71, issue 7, pages 1072-1081).



## FOCUS ON: COEXIST: INTERACTION IN COASTAL WATERS: A ROADMAP TO SUSTAINABLE INTEGRATION OF AQUACULTURE & FISHERIES

Europe's coastal zones are of great socio-economic value. Population densities are high and coastal zones constitute prime space for development of a range of different activities. They provide a vast supply of food, energy resources, and natural products, and they represent a fertile space for recreation and tourism. The dynamic processes that occur within the coastal zones produce diverse and productive ecosystems which have historically been of great importance for human populations. However, many of Europe's coastal zones are under pressure to balance competing activities and face potential conflict for space allocation. Stakeholder groups are diverse and represent distinct sectors, such as fisheries, aquaculture, tourism, wind farm operation, and natural conservation areas. Above all, there is a requirement to meet valuable environmental protection rules and regulations.

Coexist is a broad-based, multidisciplinary project which will evaluate competing activities and interactions in European coastal areas. The Coexist project will aspire to provide a roadmap to better integration, sustainability and synergies across the diverse activities taking place in the European coastal zone.



COEXIST: Aquaculture in the coastal zone; salmon farms in Bantry Bay

## SHELLFISH HEALTH RESEARCH

The Shellfish health group is led by PI Dr Sarah Culloty and has one postdoctoral researcher Dr Sharon Lynch, two research assistants, Jeanette Carlsson and Grainne Darmody and six PhD students, Maud Cross, Emer Morgan, Grace Flannery, Aaron Maloy, Laura Lyons and Eddie O'Grady. Further MSc projects were carried out during the year as part of the MSc Marine Biology by Oliver Hegarty and Aisling Mulvihill. Two further PhD students, Jan Fermer and Katrin Prinz, who had carried out studies on trematode parasites in soft sediment and rocky shore fauna respectively were conferred with their degrees in Spring 2010. They had been supervised jointly by Sarah Culloty, Ruth Ramsay and Tom Kelly. The group published nine papers and one book chapter during the year. Sarah Culloty was invited to give a keynote address at the European Marine Biological Symposium in Edinburgh in September looking at the impact of parasites in marine systems. At the same meeting, PhD students Emer Morgan and Maud Cross presented a paper and poster respectively and Maud Cross was awarded a prize for best student poster at the Conference.

Within the group, two large projects were on-going during 2010. **SUSFISH** which is funded under the Ireland Wales Interreg 4A program is a joint project between UCC and Bangor, Aberystwyth and Swansea Universities in Wales. The project is looking at the impact of climate change on aquaculture in the Irish Sea. Emer Morgan commenced fieldwork in Bannow Bay and Cork looking at cockle biology and mortality events, Maud Cross is looking at the impact of climate change on clam species in Ireland including the razor clam *Ensis* and unexploited species such as the soft shell clam *Mya arenaria* and Dr Sharon Lynch is working on the impact of pathogens and climate change on oyster species in Ireland. During the year, in a joint initiative with Applied Mathematics in UCC, PhD student Eddie O'Grady joined the project to model some of the data being generated on host: pathogen interactions. The EU FP7 funded project **OYSTERECOVER** also commenced during 2010. This project was funded under the Support for SME program and is a collaborative project between seven European research Institutes and SMEs and SME-AGs groups throughout Europe. Grace Flannery commenced a PhD looking at the impact of the parasite *Bonamia ostreae* on the native oyster *Ostrea edulis* in Ireland. She is working with fishermen and the Loughs Agency and Bim in Ireland and her fieldwork is concentrated in Cork harbour, Clew Bay and Lough Foyle. The project within the AFDC is a collaborative project between the Shellfish Health group and Molecular Genetics and Jeanette Carlsson joined the project to work on the genetics of this oyster species. During 2010 the group were carrying out studies on various aspects of the health of the native oyster, the pacific oyster, mussels, razor clams, soft shelled clams and cockles and have a large number of collaborations throughout Europe, North America and Australia. The group works closely with industry to address issues of concern related to health and ultimately productivity.

## FOCUS ON: OBSERVATIONS RAISE THE QUESTION IF THE PACIFIC OYSTER, *CRASSOSTREA GIGAS*, CAN ACT AS A CARRIER OR A RESERVOIR FOR *BONAMIA OSTREAE* OR *BONAMIA EXITIOSA*.

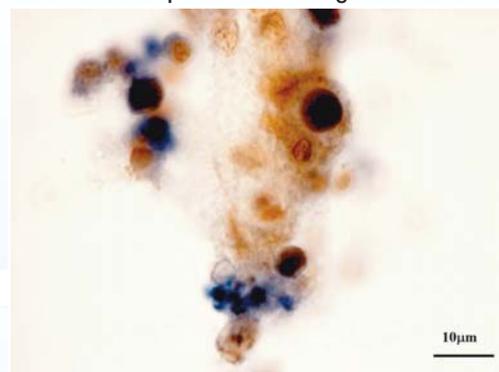
The protistan parasite *Bonamia ostreae*, the causative agent of bonamiosis, has had a detrimental effect on the production of the European flat oyster, *Ostrea edulis* in Europe since the 1970's. The presence of another parasite of the genus *Bonamia*, *B. exitiosa*, has been recorded in *O. edulis* in Spain and more recently in Italy. Prior to its discovery in Europe, *B. exitiosa* was considered a southern hemisphere species whose hosts included *Ostrea angasi* and *Ostrea chilensis*.

*B. ostreae* can be transmitted directly from infected oysters to uninfected oysters and it is suspected that the infective stages of *B. exitiosa* are carried passively on currents between oyster beds. One study has described how resilient *B. ostreae* infections remain once present on oyster beds and that *O. edulis* become infected when relayed to areas that have remained fallow for a number of years.

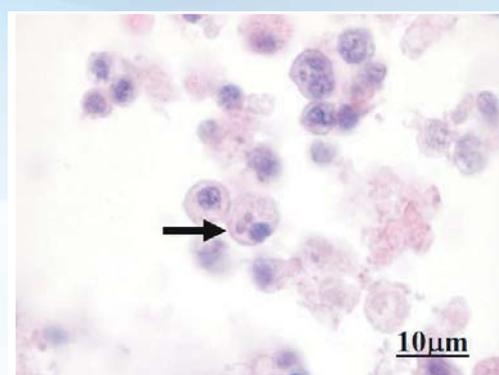
In Ireland, *C. gigas* spat are mainly imported from France and the Channel Islands with very limited supply available from Irish hatcheries. *C. gigas* is an important commercial species and has been transplanted worldwide. The European Food Safety Authority considers *C. gigas* to be a low risk carrier for *B. ostreae* ([www.efsa.europa.eu](http://www.efsa.europa.eu)). There is no evidence available to date to suggest that *C. gigas* is a natural host for this pathogen. Carriers or reservoirs are rarely included in the pathogen screening process and the effects of such transfers are unpredictable. As *O. edulis* and *C. gigas* can both be grown in adjacent beds the transfer of pathogens between these species could potentially occur. The objectives of this study were to determine whether *C. gigas* could act as a carrier or a reservoir for *B. ostreae*. Some experiments were performed in Ireland involving (a) natural exposure of *C. gigas* to the parasite in the field and (b) co-habitation experiments in the laboratory to evaluate if *B. ostreae* could be transferred between *O. edulis* to *C. gigas*. Other experiments were performed in Spain to evaluate whether *C. gigas* can become infected by *B. ostreae* through (a) field exposure and (b) experimental injection of the parasite in the laboratory. The results showed that *B. ostreae* DNA was detected in the tissues and/or shell cavity fluid of a small number of *C. gigas* in the field and in the laboratory. *B. ostreae*-like cells were visualized in the haemocytes of one *C. gigas* and *B. ostreae*-like cells were observed extracellularly in the connective tissues of one other *C. gigas*. When *C. gigas* naturally exposed to *B. ostreae* were held with naïve *O. edulis*, *B. ostreae* DNA was detected in *O. edulis*; however, *B. ostreae* cells were not visualized. In Spain, *B. exitiosa* DNA was also detected in Pacific oyster tissues.

The results of this study have important implications for *C. gigas* transfers from *B. ostreae*-endemic areas to uninfected areas and highlight *B. ostreae* and *B. exitiosa*'s ability to survive extracellularly and in other non-typical hosts.

This research was published in *Parasitology* in 2010 (Authors: Lynch, S.A., Abollo, E. Ramilo, A., Cao, A., Culloty, S.C. & Villalba, A. Volume 137, pg. 1515-1536).



*In situ* hybridisation *Bonamia ostreae* cells (stained dark blue) in Pacific oyster (*Crassostrea gigas*) blood cells.



*Bonamia ostreae* cells (arrow) in Pacific oyster (*Crassostrea gigas*) blood cells.

## oysterecover FOCUS ON: OYSTERECOVER

The EU FP7 SUPPORT for SME's funded project, OYSTERECOVER, is a collaborative project between 7 research centres in Ireland (UCC), Spain, UK, Denmark, France & The Netherlands and a number of SME & SME-AG's throughout Europe. The project was set up to deal with the continuing problem of *Bonamia ostreae* infection in European flat oyster populations and threats to the conservation of this native bivalve.

The European flat oyster, *Ostrea edulis*, has been part of the human diet for many centuries and is farmed in many European countries including Ireland, France, Spain and Holland. In the first half of the 20<sup>th</sup> century stocks were greatly reduced due to overfishing and mismanagement but populations were completely devastated in the 1970's and 80's with the introduction of two invasive parasites, *Marteilia refrigens* and *Bonamia ostreae*. *Bonamia ostreae* was particularly lethal with mortality levels of up to 80% reported in infected populations. Production numbers in Ireland alone declined from 30 000 tons in 1961 to 6 000 tons today despite much research, several breeding programmes and the establishment of new management practices to tackle the parasite. Many aspects of the biology of *Bonamia ostreae* remain unknown; for example, uncertainties exist about its life cycle, and the possibility that species other than oysters could act as vectors. The recovery of European flat oyster production, achieved through the control of *Bonamia ostreae*, would be an important boast to the shellfish industry in Europe. Within the OYSTERECOVER project, researchers at the AFDC will focus on several topics including validation of current diagnostics methods for *B. ostreae* by laboratories involved in the project. assessment of the current status of *B. ostreae* in Irish waters, evaluation of the genetic diversity of susceptible, disease tolerant and naïve *Ostrea edulis* in affected areas, ongoing investigations on certain aspects of the life cycle of *Bonamia ostreae* such as (a) macroinvertebrates role in *B. ostreae* transmission, (b) screening for vertical transmission of *B. ostreae*, (c) study of stages of infection progression and (d) screening for possible external stages of *B. ostreae*.



Oyster fishing boats in Lough Foyle

## OUTREACH & DISSEMINATION



### AFDC Newsletter

Issue 1 of the AFDC Newsletter was distributed in Spring 2010. This document contained highlights of the activities within the research groups at the AFDC and included information on book publications, peer-reviewed publications, research project progress, forthcoming project and new appointments.

### Seminars

The AFDC co-hosted a number of seminars throughout 2010 with the School of Biological, Earth and Environmental Sciences.

Mr Kevin Lay – Wildlife telemetry technology options for avian, marine and terrestrial studies. AFDC/BEES Seminar Series, 15<sup>th</sup> June, 2010.

Dr Gina Newton - "An Aussie Perspective on Climate Change, with reference to coastal and aquatic systems, and biodiversity". AFDC/BEES Seminar Series, 26th October, 2010.

Dr Nigel Milner - "The Celtic Sea Trout Project - the trout's dilemma, should I stay or should I go?". AFDC/BEES Seminar Series, 9th November, 2010.



### EUROPEAN MARINE BIOLOGY SYMPOSIUM 2010: ASPECTS OF THE BIOLOGY OF THE SOFT SHELL CLAM, *MYA ARENARIA*, IN IRELAND. WINNER OF "BEST STUDENT POSTER".



PhD student Maud Cross attended the European Marine Biology Symposium in Edinburgh, Scotland on 23-27 August 2010. Maud presented a poster on "Aspects of the Biology of the softshell clam, *Mya arenaria*, in Ireland", which is part of SUSFISH research at University College, Cork, and was subsequently awarded "Best Student Poster".

## THE AFDC AND GLOBAL AQUACULTURE

Professor John Benzie played a leading role in International developments related to better utilisation of genetic improvement in aquaculture and better understanding the world's aquatic genetic resources. He led the expert panel reporting on "Promoting responsible use and conservation of aquatic biodiversity for sustainable aquaculture development" to the Global Conference on Aquaculture in Phuket, Thailand in September 2010. Recommendations from the Conference will guide policy for the Food and Agriculture Organisation of the United Nations (FAO) over the next decade. He also served on the scientific steering committee of, and facilitated workshops for, a major conference designed to assist biotechnology production for developing countries [FAO international technical conference dedicated to Agricultural Biotechnologies in Developing Countries (ABDC-10)] that took place in Guadalajara, Mexico on 1-4 March 2010, and addressed the Ecuadorian shrimp industry at their invitation on "Past and future of the genetic improvement programs for white shrimp *Litopenaeus vannamei*" at the XII Congreso Ecuatoriano de Acuicultura y AquaExpo in Guayquil, Ecuador, in October 2010.



## DEGREES AWARDED

### **Ph.D. Theses**

Jan Fermer - "Parasitological investigation of soft sediment bivalves, with a particular reference to the digenean trematode *Meiogymnophallus minutes*". Supervisors: Dr Sarah Culloty, Dr Tom Kelly, Dr Ruth Ramsay

Aisling Jimi Lannin - "The biology, dynamics and fisheries for Hake (*Merluccius merluccius*) in the waters around Ireland". Supervisors: Dr Emer Rogan, Dr Paul Connolly

Kathrin Prinz - "Macroparasites in intertidal molluscs of the Irish coast: occurrence and transmission in rocky shore habitats". Supervisors: Dr Sarah Culloty, Dr Tom Kelly, Dr Ruth Ramsay.

### **M.Sc. Theses**

Martha Gosch – "Diet of grey seals on the south-west coast of Ireland". Supervisor: Dr Emer Rogan.

Sarah Healy – "A river specific juvenile Atlantic Salmon growth model for the Srahrevagh River, West of Ireland: potential for life history changes in response to projected increases in water temperature". Supervisor: Dr Sarah Culloty, Prof. Tom Cross.

Oliver Hegarty – "A survey of the health status of the mussel *Mytilus* sp. in Ireland". Supervisors: Dr Sarah Culloty, Dr Ruth Ramsay.

Jessica Leahy – "A behavioural insight into the social structure of bottlenose dolphins, *Tursiops truncatus*, in the Shannon Estuary". Supervisor: Dr Emer Rogan.

Roseanne Miller - "A genetic and behavioural insight into the population and social structure of bottlenose dolphins, *Tursiops truncates*, along the Irish coast". Supervisors: Dr Emer Rogan, Prof. Tom Cross.

Aisling Mulvihill – "A survey of the health status of the shore crab *Carcinus maenas*". Supervisors: Dr Sarah Culloty, Dr Ruth Ramsay.

## AFDC FUNDING – ONGOING AND NEW RESEARCH GRANTS DURING 2010

### *2010 Funding*

**Cross, T.F., McGinnity, P. & Coughlan, J.** Atlantic aquatic research conservation (AARC). European Regional Development Fund (ERDF): INTERREG 4 Atlantic Area Programme. 2010-2012, €255,429.

**Culloty, S.C.** Establishing the scientific bases and technical procedures and standards to recover the European flat oyster production through strategies to tackle the main constraint bonamiosis (OYSTERCOVER). EU FP7 Funding, 2010-2013, €730,894.

**McGinnity, P., Coughlan, J., Dillane, E. & Cross, T.** Ministerial request for mixed stock fisheries analysis for the Cromane & Waterford Estuary experimental salmon fisheries. €46,000

**Rogan, E.** Pilot marine mammal observer programme in Irish pelagic trawl and gillnet fisheries. Bord Iascaigh Mhara, 2010-2011. €49,999

### *2009 Funding*

**Cross, T.F. & McGinnity, P.** Celtic Sea Trout project: Genetic Stock Identification of sea trout stocks. EU INTERREG, 2009-2012, €359,830.

**Cross, T.F. & McGinnity, P.** Deel river project : Genetic Stock Identification of Atlantic salmon in the Deel river (Moy system). Marine Institute (Aquaculture and Catchment Management Services division), 2009-2010, €15,000.

**Cross, T.F. & McGinnity, P.** Limit Attainment Project. Central Fisheries Board, 2009-2010, €120,536.

**Cross, T.F. & McGinnity, P.** Ireland-Newfoundland Partnership Marine research Grant, 2009-2010, €2000.

**Culloty, S.C.** Shellfish productivity in the Irish Sea: working towards a sustainable future (SUSFISH). ERDF INTERREG 4A, 2009-2012, €618,399.

**Sheehan, D., Davenport, J. & Culloty, S.C.** Do nanoparticles induce neurodegenerative diseases? Understanding the origin of reactive oxidative species and protein aggregation and mis-folding phenomena in the presence of nanoparticles. EU 7<sup>th</sup> Framework (Prof. D. Sheehan, Biochemistry PI), 2009-2013, €167,000.

**2008 Funding**

**Cross, T.F. & McGinnity, P.** SALSEA – Merge: Advancing understanding of salmon at sea: Merging genetics and ecology to resolve stock specific migration and distribution patterns. EU RTD FP7, 2008-2011, €254,609.

**Cross, T.F. & McGinnity, P.** Irish cod breeding programme. Marine Institute, 2008-2015, €213,088.

**Cross, T.F. & McGinnity, P.** Norwegian Research Council: Natural Selection in farmed Atlantic salmon. Norwegian Research Council, 2008-2010, €33,810.

**Cross, T.F. & McGinnity, P.** Genetic Stock Identification of Atlantic salmon in the Castlemaine fishery, Co. Kerry. South Western Regional Fisheries Board, 2008-2010, €9,000.

**Rogan E. & E. Codling.** Develop and test through simulation a suite of measures that will contribute to rebuilding depleted fish stocks in waters around Ireland. Marine Institute, 2008-2014, €625,570.

**Rogan E. & E. Codling.** Modelling the ecology, population dynamics, assessment and management of Nephrops (*Nephrops norvegicus*) in the waters around Britain & Ireland. Marine Institute, 2008-2011, €105,000.

**Rogan E. & E. Codling.** The application of signal detection methods to the fisheries management system. Marine Institute, 2008-2012, €115,000.

**Rogan E.** The life history, ecology and dynamics of the Black Scabbard (*Aphanopus carbo*) in the deep water ecosystem of the North East Atlantic. Marine Institute, 2008-2012, €115,000.

**2007 Funding**

**Burnell G. & Cummins V.** Beaufort Marine Research Award: Ecosystem approach to fisheries management. Irish Government NDP administered by Marine Institute, 2007-2014, €1,860,004.

**Cross, T.F. & McGinnity, P.** Beaufort Marine Research Award: Fish population genetics. Irish Government NDP administered by the Marine Institute, 2007-2014, €2,710,236.

**Cross, T.F. & McGinnity, P.** Post Smolt test survey. Genetic Stock Identification of Atlantic salmon post smolts. Marine Institute (Aquaculture and Catchment Management Services division), 2007-2010, €2,400.

## AFDC PUBLICATIONS

### JOURNALS

Anderson, C.M., Aparicio, G.J., Atangana, A.R., Beaulieu, J., Bruford, M.W., Cain, F., Campos, T., Cariani, A., Carvalho, M.A., Chen, N., Chen, P.P., Clamens, A.L., Clark, A.M., Coeur D'Acier, A., Connolly, P., Cordero-Rivera, A., **Coughlan, J.P., Cross, T.S.**, David, B., De Bruyn, C., De Meyer, M., De Ridder, C., Delatte, H., Dettori, M.T., Downer, S.J., Dubreuil, C., Evans, K.J., Fan, B., Ferrara, G., Gagne, A., Gaillard, M., Gigliarelli, L., Giovinazzi, J., Gomez, D.R., Grunwald, N.J., Hansson, B., Huotari, T., Jank, L., Jousselin, E., Jungmann, L., Kaczmarek, M.E., Khasa, D.P., Kneebone, J., Korpelainen, H., Kostamo, K., Lanfaloni, L., Lin, H.R., Liu, X.C., Lucentini, L., Maes, G.E., Mahaffee, W.F., Meng, Z.N., Micali, S., Milano, I., Mok, H.F., Morin, L., Neill, T.M., Newton, C.H., Ostrow, D.G., Palomba, A., Panara, F., Puletti, M.E., Quarta, R., Quilici, S., Ramos, A.K.B., Rigaud, T., Risterucci, A.M., Salomon, M.P., Sanchez-Guillen, R.A., Sarver, S.K. (2010). 'Permanent Genetic Resources added to Molecular Ecology Resources Database 1 December 2009-31 January 2010'. *Molecular Ecology*, 10 :576-579.

**Culloty, S.C.**, Favier, E., Ní Ríada, M., Ramsay, N.F. & **O'Riordan, R.M.** (2010). Reproduction of the biogenic reef-forming honeycomb worm *Sabellaria alveolata* in Ireland. *Journal of the Marine Biological Association of the United Kingdom*, 90 (3):503-507.

**Drummond, L., Mulcahy, M.F., Culloty, S.C.** (2010). A survey of the health status of the Manila clam *Ruditapes philippinarum* in Ireland with specific reference to brown ring disease. *Aquaculture International*, 18 (5):787-800.

**Fermer, J., Culloty, S.C.**, Kelly, T.C., **O'Riordan, R.M.** (2010). Temporal variation of *Meiogymnophallus minutus* infections in the first and second intermediate host. *Journal of Helminthology*, 84 (4):362-368.

Fontaine, M.C., Tolley, K.A., Michaux, J.R., Birkun, A., Ferreira, M., Jauniaux, T., Llavona, A., Öztürk, B., Ayaka A Öztürk, A. A., Ridoux, V., **Rogan, E.**, Sequeira, M., Bouquegneau, J-M, & Baird, S.J.E. (2010). 'Genetic And Historic Evidence For Climate-Driven Population Fragmentation In A Top Cetacean Predator: The Harbour Porpoises In European Water'. *Proceedings of the Royal Society, B*, doi: 10.1098/rspb.2010.0412.

Griffiths, A.M., Machado-Schiaffino, G., **Dillane, E., Coughlan, J.**, Horreo, J.L., Bowkett, A.E, Minting, P., Toms, S., Roche, W., Gargan, P., **McGinnity, P., Cross, T.**, Bright, D., Garcia-Vazquez, E., Stevens, J.R. (2010). 'Genetic stock identification of Atlantic salmon (*Salmo salar*) populations in the southern part of the European range'. *BMC Genetics*, 11:31 doi:10.1186/1471-2156-11-31 .

**Kavanagh, A.**, Cronin, M., Walton, M., **Rogan, E.** (2010). Diet of the harbour seal (*Phoca vitulina vitulina*) on the west and south west of Ireland. *Journal of the Marine Biological Association of the United Kingdom*, 90 (8):1517-1527.

**Kraak, S.B.M.**, Kelly, C.J., Codling, E.A. & **Rogan, E.** (2010). On scientists' discomfort in fisheries advisory science: the example of simulation-based fisheries management-strategy evaluations. *Fish and Fisheries*, 11, 119-132.

**Lynch, S.A.**, Abollo, E., Ramilo, A. Cao, A, **Culloty, S.C.** & Villalba, A. (2010). Observations raise the question if the Pacific oyster *Crassostrea gigas* can act as either a carrier or a reservoir for *Bonamia ostreae* or *Bonamia exitiosa*. *Parasitology*, 137 (10):1515-1526.

**Maloy, A.P.**, **Culloty, S.C.**, Bolton-Warberg, M., Fitzgerald, R. & Slater, J.W. (2010) Molecular identification of laser dissected gut contents from hatchery reared larval cod, *Gadus morhua*: a new approach to diet analysis. *Aquaculture Nutrition*, doi: 10.1111/j.1365-2095.2010.00836.x

**McCarron, E.**, **Burnell, G.**, Kerry, J., **Mouzakitis, G.** (2010). An experimental assessment on the effects of photoperiod treatments on the somatic and gonadal growth of the juvenile European purple sea urchin *Paracentrotus lividus*. *Aquaculture Research*, 41:1072-1081.

Murphy, S. Pierce, G.J. Law, R.J. Bersuder, P. Jepson, P.D. Learmonth, J.A. Addink, M. Dabin, W. Santos, M.B.. Deaville R, Zegers B.N., Mets A., **Rogan E.**, Ridoux V., Reid R.J., Smeenk C., Jauniaux T., López A., Alonso Farré J.M., González A.F., Guerra (2010). Assessing the effect of persistent organic pollutants on reproductive activity in small cetaceans in the eastern North Atlantic. *Journal of Northwest Atlantic Fishery Science*, 42, 153-173.

**Prinz, K.**, Kelly, T.C., **O’Riordan, R.M.**, **Culloty, S.C.** (2010). Factors influencing cercarial emergence and settlement in the digenean termatode *Parorchis acanthus* (Philophthalmidae). *Journal of Marine Biological Association of the United Kingdom*, doi:10.1017/S002531541000071.

**Prinz, K.**, Kelly, T.C., **O’Riordan, R.M.** & **Culloty, S.C.** (2010). Occurrence of macroparasites in four common intertidal molluscs on the south coast of Ireland. *Marine Biodiversity Records*, 3 (e89); doi:10.1017/S1755267210000035.

**Prinz, K.**, Kelly, T.C., **O’Riordan, R.M.** & **Culloty, S.C.** (2010). Infection of *Mytilus edulis* by the trematode *Echinostephilla patellae* (Digenea: Philophthalmidae). *Journal of Helminthology*, 84 (2):193-198.

**Prinz, K.**, Kelly, T.C., **O’Riordan, R.M.** & **Culloty, S.C.** (2010). Temporal variation in prevalence and cercarial development of *Echinostephilla patellae* (Digenea, Philophthalmidae) in the intertidal gastropod *Patella vulgata*. *Acta Parasitologica*, 55 (1): 39-44.

Thaler, A.D., Zelnio, K., Jones, R., **Carlsson, J.**, Van Dover, C.L. & Schultz T.F. (2010). Characterization of 12 polymorphic microsatellite loci in *Ifremeria nautilei*, a chemoautotrophic gastropod from deep-sea hydrothermal vents. *Conservation Genetics Resources*. DOI 10.1007/s12686-010-9174-9.

Zlenio, K.A., Thaler, A.D., Jones, R.E., Saleu, W., Schultz, T.H., Van Dover, C.L. & **Carlsson, J.** (2010). Characterization of nine polymorphic microsatellite loci in *Chorocaris* sp. (Crustacea, Caridea, Alvinocarididae) from deep-sea hydrothermal vents. *Conservation Genetics Resources*. DOI: 10.1007/s12686-010-9243-0.

## BOOKS/CHAPTERS IN BOOKS

**Juhel, G.,** Moroney, G., **O’Riordan, R. & Culloty, S.** (2010). Dynamics of endoparasitic infection in zebra mussels, *Dreissena polymorpha*, in Lough Derg, Ireland. In: *The Zebra Mussel in Europe*. Leiden, The Netherlands: Backhuys Publishers.

## REPORTS

**Rogan, E.** (2010). Ireland. Progress on cetacean research, June 2009 to May 2010, with statistical data for the *calendar year* 2009. Department of Zoology, Ecology and Plant Science, University College Cork, Ireland.



## CONFERENCE PRESENTATIONS

### *Oral Presentations:*

**Culloty, S.C.** (2010). Why parasites? The significance of parasites and disease in the marine environment. KEYNOTE LECTURE. 45th European Marine Biology Symposium, 23-27 August, 2010, Heriot-Watt University, Edinburgh, Scotland.

Morgan, E., Ramsay, R.M. & **Culloty, S.C.** (2010). The influence of disseminated neoplasia and trematode infection on summer mortality events in the cockle, *Cerastoderma edule*. 45th European Marine Biology Symposium, 23-27 August, 2010, Heriot-Watt University, Edinburgh, Scotland.

**Hernandez-Milian, G. & Rogan, E.** (2010). Atlantic white-sided and Bottlenose dolphins: the unknown foraging ecology in the waters around Ireland. 24th Annual Conference of the European Cetacean Society, 22nd -24th March, Stralsund, Germany.

**Hernandez-Milian, G., Rogan, E. & Reid, D.G.** (2010). Modelling the ecosystem role of top predators (Cetaceans and Seals) in Irish waters. The Irish Fisheries Science Research Partnership; The Fisheries Resource - linking Advice, Research and the fishing Industry. A Mini Conference, The Marine Institute, Galway, Ireland, 23-24 June, 2010.

**Mouzakitis, G., Pereira, A., Chamberlain, J. & Burnell, G.** (2010). Pilot-scale assessment of sea urchin on-growing and roe enhancement using the UrchinPlatter<sup>TM</sup> System. Aquaculture 2010, San Diego, California, 2nd March, 2010.

**Santos, A.R., Connolly, P. & Rogan, E.** (2010). Preliminary findings on the biology of the Black Scabbardfish (*Aphanopus carbo* Lowe, 1839) in the North East Atlantic - implications for management. (Identifying areas of mature and immature black scabbard in the North East Atlantic). The Irish Fisheries Science Research Partnership; The Fisheries Resource - linking Advice, Research and the fishing Industry. A Mini Conference, The Marine Institute, Galway, Ireland, 23-24 June, 2010.

**Pazhayamadon, D.G., Rogan, E., Kelly, C. & Codling, E.** (2010). Forgotten signals in fisheries management. (Looking at fish stock status with a new technique). The Irish Fisheries Science Research Partnership; The Fisheries Resource - linking Advice, Research and the fishing Industry. A Mini Conference, The Marine Institute, Galway, Ireland, 23-24 June, 2010.

**Kraak, S.B.M., Davie, S., Kelly, C.J., Codling, E.A. & Rogan, E.** (2010). A possible management tool allowing flexible choices in the Celtic Sea mixed fisheries. (An idea for giving fishermen more flexibility in mixed fisheries). The Irish Fisheries Science Research Partnership; The Fisheries Resource - linking Advice, Research and the fishing Industry. A Mini Conference, The Marine Institute, Galway, Ireland, 23-24 June, 2010.

**Benchikh, H.A., Lordon, C., Codling, E. & Rogan, E.** (2010). Geostatistical analysis of *Nephrops norvegicus* density around Ireland. (Distribution of prawns around Ireland). The Irish Fisheries Science Research Partnership; The Fisheries Resource - linking Advice, Research and the fishing Industry. A Mini Conference, The Marine Institute, Galway, Ireland, 23-24 June, 2010.

**Poster Presentations:**

**Cross, M.E.**, O’Riordan, R., **Lynch, S.A.**, Whitaker, A. & **Culloty, S.** (2010). Aspects of the biology of the soft shell clam, *Mya arenaria*, in Ireland. 45th European Marine Biology Symposium, 23-27 August, 2010, Heriot-Watt University, Edinburgh, Scotland. **Winner of the Best Student Poster.**









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