



PRIFYSGOL  
**BANGOR**  
UNIVERSITY

# **Annual Fisheries Science Report**

## **2015**

Fisheries and Conservation Science Group  
School of Ocean Sciences

Annual Report for 2015

# Isle of Man Fisheries Science

Fisheries & Conservation Science Group  
Bangor University



*Reillys Ellan Vannin*

## Review of 2015 by Professor Michel Kaiser

*Michel Kaiser is a Professor of Marine Conservation Ecology within the School of Ocean Sciences at Bangor University and is the academic and scientific lead for the Isle of Man research contract.*



Bangor University has undertaken fisheries and conservation science to support advice to the Department of Environment, Forestry and Agriculture since 2007. During that period we have aimed to respond to the priority science needs of both the Isle of Man Government and the local fishing industry. In an aim to maintain openness and transparency about the work we undertake, we publish all science reports on our website (<http://fisheries-conservation.bangor.ac.uk/>) where they are publicly available. We are pleased to publish this report which is the first in a series of annual reports that provide a summary of the science undertaken by Bangor University over the last twelve months.

Much of our scientific effort in the past has focused on supporting the need for science advice in relation to the king and queen scallop fisheries. This focus was driven in part by the need to fill a wide range of science gaps in relation to the Marine Stewardship Council accreditation process. Although the MSC accreditation of the queen scallop fishery is currently suspended, the framework of the MSC provides the necessary scientific focus to understand the status of a fishery in relation to its sustainability. The investment in the science undertaken to date means that the Isle of Man is well positioned to meet the European Commission's demands for data reporting (e.g. Landings Obligation) that will affect all Manx fisheries in the future. While management to date has focused on single species management (e.g. queen scallops) we have sufficient understanding of the interaction of this fishery with the wider marine ecosystem to move towards an ecosystem-based management system if that was seen (by DEFA and the Manx fishing industry) as a more positive approach to management in the future.

The last twelve months has seen some notable changes in the emphasis of our science with a much greater effort devoted to other important Manx fisheries (lobster, crab and whelk). While our scientific understanding is highly advanced for scallop fisheries, we need to fill a considerable number of knowledge gaps in relation to the key pot fisheries around the Isle of Man. To date, we have had very positive engagement from fishermen in Baie Ny Carrikey (lobster and crab fisheries), from offshore crab potters and whelk fishermen who are actively involved in collecting data on their own catches. This collaboration is providing extremely important insights into the patterns of catches and possible migrations of crabs that occur around the Isle of Man. Whelk tagging has been extremely successful and strongly suggests that whelks do not move very far from small areas of the seabed. This information is critical in helping us understand the potential effects of developments such as windfarms or other fishing activities on the whelk sector. Fishermen collaborating with us on lobster science have been successful in capturing juvenile lobsters which the science community knows little (nothing) about, so this will hopefully lead to a unique understanding of how this important life history stage uses the marine environment. Finally our innovations with camera technology have proved extremely successful at providing very accurate data collected by fishermen. We hope to roll out these systems more extensively so that we can have better coverage around the Isle of Man and thereby improve the quality of the science.

Many fishermen will have realised that we have had some recent staff turnover in our science team. We have been fortunate to date that the science positions on the Isle of Man have continued to attract high quality staff. I was delighted to be able to extend Dr Isobel Bloor's contract for a further 5 years after we won the re-tender for the science contract. Staff continuity is extremely important to maintain good working relationships with fishermen, as mutual trust takes time to develop. Isobel is an extremely competent scientist and her background working on cuttlefish has had an unforeseen benefit in that a squid fishery is beginning to develop in Manx waters. Sam Dignan left us at the end of August 2015 having undertaken superb work on developing methods to display and analyse our scallop data. While we miss Sam, he was replaced by the equally excellent Jack Emmerson who,

like Sam, has a fishing family background and spent six months working with me on prawn fisheries in Cardigan Bay.

Finally, I'd like to focus on a number of recent changes that I consider to have been particularly helpful. The annual fishermen/science symposium that is held in December each year has improved mutual understanding of what we do and why we do it. It also provides us with an opportunity to listen to fishermen's ideas and to try and answer these with the science that we do in the following year. The appointment of Dr David Beard as the CEO of the Manx Fish Producers Organisation (MFPO) has brought a new dimension of collaboration (and challenge) which we welcome and it is clear how hard David is working to ensure that the Manx industry is equipped to meet the challenges presented by European legislation. The instigation of the scientific steering committee that is composed of fishing representatives is a particularly useful sounding board for us to refine and develop better our scientific ideas and it was helpful to have additional sites suggested by Manx industry members for the purpose of the queen scallop stock assessment.

As always, there are many challenges ahead in 2016, but we aim to be responsive to the dynamic priorities of the Isle of Man's commercial sea fisheries.

*M. Kaiser*



*Bangor University's Research Vessel "R.V. Prince Madog" is a state-of-the-art purpose built 35 m research vessel. The vessel travels to the Isle of Man for 2 weeks each year to undertake an annual scallop survey. The vessel is fully equipped for surveying and holds 8 vessel crew and 10 scientists.*

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## Scientific Research Priorities 2015—2020:

Over the past year the relationship between government, scientists and industry has evolved. The Scientific Steering Committee, which includes industry representatives from all of the five main commercial fisheries and local processors together with scientists and government was set up in 2015 to allow greater input into the focus of scientific research priorities from local industry. The Scientific Steering Committee also has several subgroups (e.g. scallop subgroup) which meet to discuss specific issues (e.g. positioning and duration of queen scallop temporary closed areas). In addition to this committee, engagement between science and industry continues throughout the year with regular newsletters, meetings and an annual Fisheries Science Symposium. The symposium is a 1 day event and provides the opportunity for a discussion between resource managers, scientists and the fishing industry on the present and future research options for fisheries management in the Isle of Man.

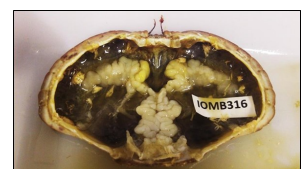
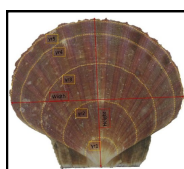
In order to define the scientific and management priorities for fisheries the Department of Environment, Food and Agriculture (DEFA) has worked with industry and scientists to develop 'Future Fisheries' - a 5 year strategy (2016—2021) for the sustainable development of the Isle of Man's sea fisheries and marine environment which was passed by Tynwald in November 2015. Sea fisheries are currently worth £13 million per annum to the Manx economy and the Strategy identifies ways of securing sustainable, thriving and well-managed fisheries providing high quality products whilst continuing to protect and respect the marine environment. A copy of the full Strategy can be accessed from:

<https://gov.im/about-the-government/departments/environment-food-and-agriculture/fisheries-directorate/future-fisheries-strategy>

In December 2015 in line with DEFA's Future Fisheries Strategy, Bangor University developed a 5 year research plan outlining the key scientific research priorities for 2016—2021. These research priorities focus not only on the five main and currently commercially exploited shellfish species (king scallop, queen scallop, crab, lobster and whelk) but also on those species which could provide diversification opportunities for commercial fisheries in the future (e.g. squid and nephrops). The 5 year scientific research plan reflects the aims and objectives of DEFA's Future Fisheries Strategy and will be distributed in early 2016 for industry input prior to finalisation. The plan will then be publically available, together with all published scientific reports, from the Bangor University Fisheries and Conservation Group's website: <http://fisheries-conservation.bangor.ac.uk>

The objective of both Bangor's five year research plan and DEFA's Future Fisheries Strategy is to essentially provide a framework from which to achieve long term sustainable management for all commercial fisheries on the Isle of Man whilst working towards the following objectives set by DEFA:

- To ensure that scientific data is collected for all stocks
- To achieve sustainable stocks with an appropriate level of fishing effort
- To investigate fisheries diversification options within the territorial sea
- To improve stakeholder involvement in science and management
- To secure a high quality and protected marine environment



## Annual Scallop Survey (8th—25th April, 2015)

**Aim:** The aim of the annual scallop survey is to assess the relative densities of king and queen scallops at a fixed set of stations within the Isle of Man's territorial sea (Figure 2). This allows a relative index (showing annual increases or decreases in scallop density) to be produced. In addition, the survey data feeds into a stock assessment model to assess the abundance of the queen scallop stock within this area. The Queen Scallop Management Board propose management measures based on stock status.

As of 2015 the two shorter biannual scallop surveys, which were previously undertaken for a week in both spring and autumn, have been combined to allow a single extended survey to take place over a two week period in spring. This has enabled us to continue to increase both the extent and intensity of sampling stations (Figure 1; Table 1) and to undertake additional sampling outside of the 12 nm limit for the first time (Figure 2), working towards a cooperative, pan-Irish Sea approach to management.

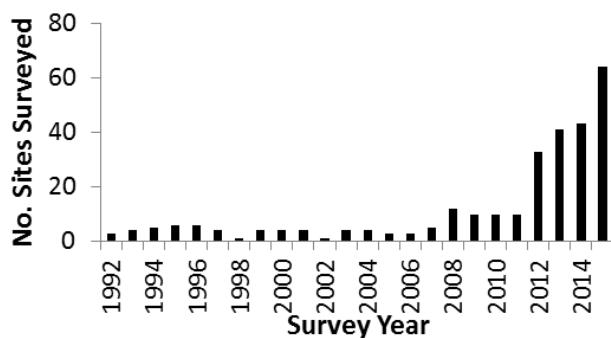


Figure 1: No. of sites surveyed for the spring scallop cruise since 1992.

Table 1: Details of survey stations sampled during the 2015 spring scallop survey.

Survey dates 8 <sup>th</sup> – 19 <sup>th</sup> April 2015		
Station type	Gear used	Number surveyed
Stock assessment	Dredges	48
Industry selected	Dredges	11
Closed Area (QSC)	Dredges	7
Video tows	Camera sledge	15
Juvenile beam trawl	2m beam trawl	16

The survey was undertaken onboard Bangor University's research vessel (R.V. Prince Madog; Figure 3). In addition to the regular set of dredged stock assessment survey stations (n = 48; Figure 2 & 3), the 2015 spring survey also included a set of new industry selected dredge survey stations (n = 11) both inside and outside of the territorial sea and a set of dredge survey stations within the temporary queen scallop closed area (n = 7). A number of video tows were also undertaken inside and outside the temporary queen scallop closed areas (n = 15) and a 2m beam trawl deployed at a subsample of the stock assessment survey stations (n = 16) (Table 1; Figure 2).

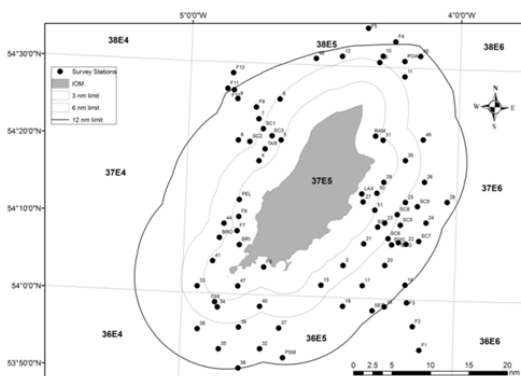


Figure 2: Survey stations sampled during the 2015 scallop survey. Including stations surveyed outside 12nm limit and industry selected.

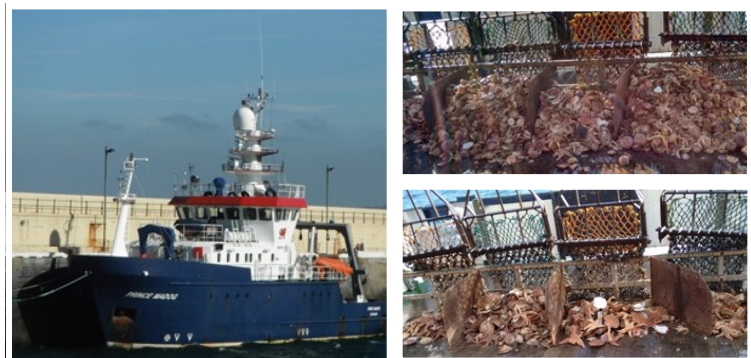


Figure 3: Photographs from the survey: RV Prince Madog and samples from two dredge stations.

**Output:** The Isle of Man *Aequipecten opercularis* fishery stock assessment 2015 Final Report is available for download from <http://fisheries-conservation.bangor.ac.uk/iom/documents/58.pdf>

*In total eight scientists from Bangor University participated in the stock assessment survey together with volunteers from DEFA.*

## Preliminary 2 m beam trawl survey (April 2015)

**Aim:** The dredges used in the scallop surveys have a belly ring internal diameter of 60 mm and thus do not quantitatively sample smaller queen scallops. To address this issue a preliminary survey was undertaken at selected sample stations using a 2 m beam trawl, with cod end mesh size of 4 mm and an outer net with a 10 mm mesh. The aim was to assess the effectiveness of this method for catching smaller queen scallops and to assess the suitability of the technique for future surveys, to improve estimates of small size categories of queen scallops (e.g. recruits 35—55 mm and pre-recruits > 35 mm).

During the 2015 spring scallop survey a 2m beam trawl survey (Figure 4 a) was undertaken across a representative sample of survey stations (e.g. across a range of different habitat types and scallop densities). A total of 16 beam trawl tows were undertaken during the survey at 15 stations (one tow was repeated due to the equipment flipping during deployment). The 2m beam trawl retains a greater number of pre-recruit queen scallops (e.g. > 35 mm) than dredges and can therefore provide a good indicator of future recruitment patterns.



Figure 4: a. 2 m beam trawl sampling equipment being deployed from the RV Prince Madog; b. a sample from a 5 min tow at ST 39.

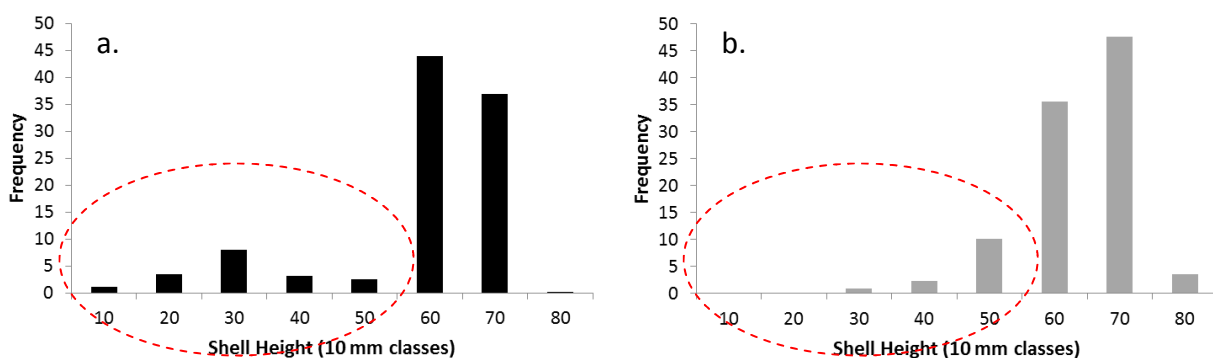


Figure 5: Size frequency distribution data (shell height grouped in 10 mm size classes) from a. all data from sites sampled with the 2 m beam trawl; b. all data from sites sampled with dredges. Red dashed circles indicates recruit and pre-recruit size classes.

**Outcomes:** The beam trawl samples smaller queen scallops more effectively than the queen scallop dredges (Figure 5). Going forward, discussions with industry have highlighted the opportunity for local fishermen to take the lead on future 2m beam trawl surveys for juvenile queen scallops. The 2016 survey will be undertaken by one of the MFPO’s vessels at selected survey stations around the Isle of Man and will likely take place in June. This survey will allow us to build up a relative index of pre-recruit queen scallops to enable earlier forecasting of recruitment patterns, both spatially and temporally, within the territorial sea (e.g. highlighting where high densities of queen scallops are present before they are large enough to be fished thereby providing an early indication of the intensity and location of successful recruitment events at each fishing grounds which will help to inform management).



## Queen Scallop Age and Maturity

**Aim:** The aim of this research is two-fold: to investigate the seasonal and spatial variation in age composition and growth rates of the exploited queen scallop populations around the Isle of Man and to assess the maturity status of queen scallops from different survey sites and depths. This is of importance to assess differences between the age composition of queen scallops at different fishing grounds and to investigate differences in recruitment success and the effects of fishing. The increased knowledge of population dynamics will be used to support sustainable management of the fishery.

**Methods:** During the 2015 spring scallop survey a subsample of 20 queen scallops was kept from every survey station. These queen scallops were returned to the laboratory for storage. The scallop shells were bleached and are now being analysed for age by counting the annual growth rings which are made more visible following the bleaching process (Figure 6 c). The maturity stage, weight, meat yield and size of the queen scallops are also being analysed. The analysis will be completed for the full spatial range of samples from 2015 and will be repeated during the spring 2016 survey.

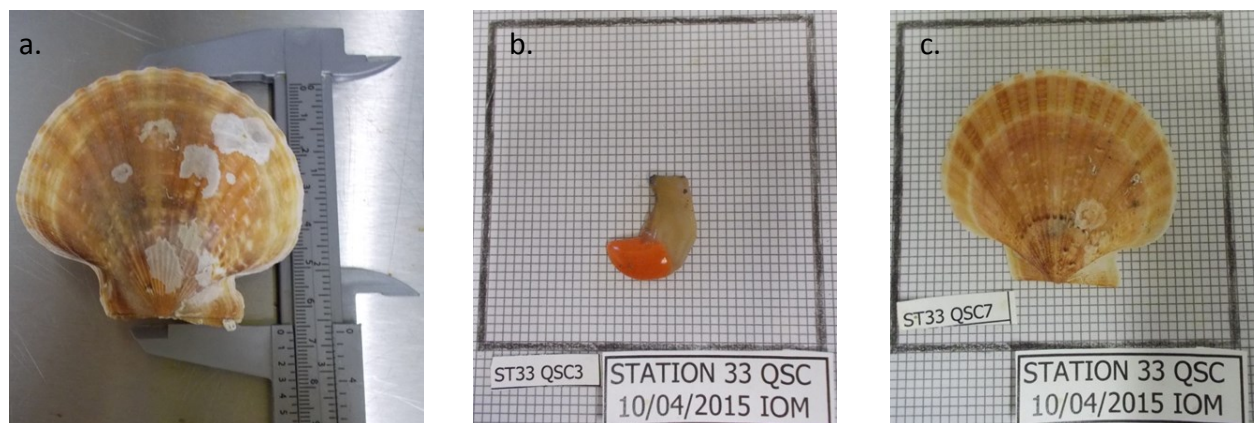


Figure 6: A queen scallop being measured for a) height, b) maturity stage and c) age.

**Output:** The ageing methodology was initially trialed on a small sample of sites. The method will now be used to analyse the remaining samples collected from survey sites around the Isle of Man. Once all the laboratory analysis has been completed the results will be analysed and a report published on the Fisheries and Conservation Science Group's website (<http://fisheries-conservation.bangor.ac.uk/iom>). The intention is to repeat the sampling during each years annual scallop survey to build up a long-term dataset. In addition to this fine resolution spatial sampling that occurs during the survey, additional monthly samples are being collected (Figure 7) and analysed from four sites around the Island (North, South, East and West) on a monthly basis as part of DEFA's monthly scallop and water sampling survey.



Figure 7: Monthly samples of king and queen scallops being collected onboard the F.P.V Barrule as part of a monthly scallop and water sample survey that is undertaken at four stations around the Isle of Man (North, South, East and West). During this survey up to 20 king and queen scallops from each survey site are retained for ageing and maturity analysis to investigate interannual variability in the timing of spawning for scallops around the Island .

# Comparison of catch efficiencies for king and queen scallops between the R.V. Prince Madog and the F.V. Alena

**Aim:** The MFPO requested that a gear comparison trial take place during the 2015 scallop survey. The purpose of undertaking comparable trials between the F.V. Alena and the R.V. Prince Madog was to enable the MFPO to utilise the F.V. Alena for future surveys that it may wish to undertake when the R.V. Prince Madog is not available and/or to sample inshore areas where this vessel’s skipper has good knowledge. The MFPO expressed its interest in becoming more involved in participating in scientific surveys in the future and felt that this was the best way forward in order to achieve this.

**Methods:** In recent years (2008 – 2015) Bangor University’s research vessel (R.V.) the Prince Madog has been used for stock assessment work. To assess whether a significant difference in catch efficiency exists between the Fishing Vessel (F.V.) Alena (13.82 m length overall) and the R.V. Prince Madog (35 m) a catch efficiency trial was undertaken on 10<sup>th</sup>, 11<sup>th</sup> and 16<sup>th</sup> April 2015. In order to ensure comparability the F.V. Alena equipped one of its two dredge bars in an identical manner to the R.V. Prince Madog (Figure 8) and equipped the other dredge bar with four of its own commercial king scallop dredges. Specifications for spring tensions were discussed prior to the commencement of the trial and warp was deployed at a standard rate of three times depth.

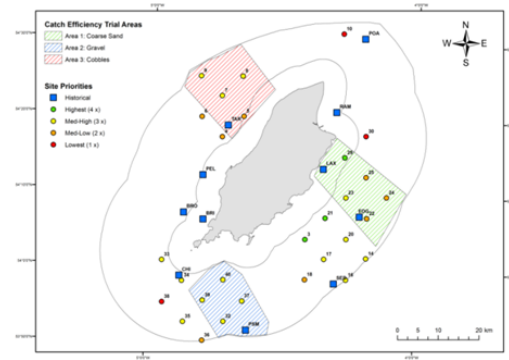
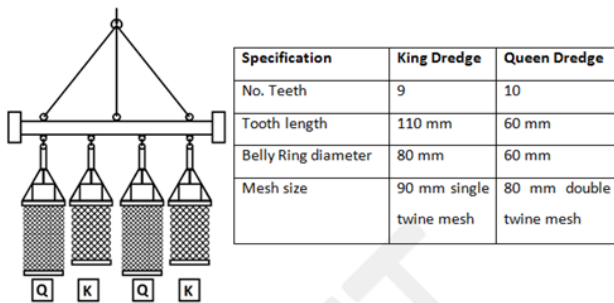


Figure 8: A diagram showing the set up of the comparable research gear, with 2 queen and 2 king scallop dredges. Gear specifications, such as numbers of teeth and tooth length are also provided.

Figure 9: Locations of surveyed sites within three fishing grounds (shaded areas: green, red and blue) which represent different habitats, a range of densities were also represented across the sites.

To determine differences between the catch efficiencies of the two vessels, abundances of queen and king scallops, were compared by a two-way factorial analysis of variance. The fixed factors were vessel (1, 2) and the 3 Areas (1, 2, 3; Figure 9). Five replicate samples (tows) were taken in each area. Data was Log transformed prior to analysis. Catches from the two gear types used, King Dredges (PD) and Queen Dredges (QD) were analysed separately. Catches by both vessels at each individual site were plotted against each other and a regression line plotted. Overall, there was no significant difference in king or queen scallop catches between the two vessels. On average R.V. Prince Madog caught 2.37 S.D. ± 4.61 and F.V. Alena 2.27 S.D. ± 5.13 king scallops per 100 m<sup>2</sup> and R.V Prince Madog caught 15.29 S.D. ± 37.33 and F.V. Alena 18.24 S.D. ± 32.23 queen scallops per 100 m<sup>2</sup>. However, trend lines fitted to the data following regression analyses deviated from a 1:1 ratio suggesting that while F.V. Alena caught slightly more at low density sites R.V. Prince Madog caught slightly more at higher density sites (Figure 10).

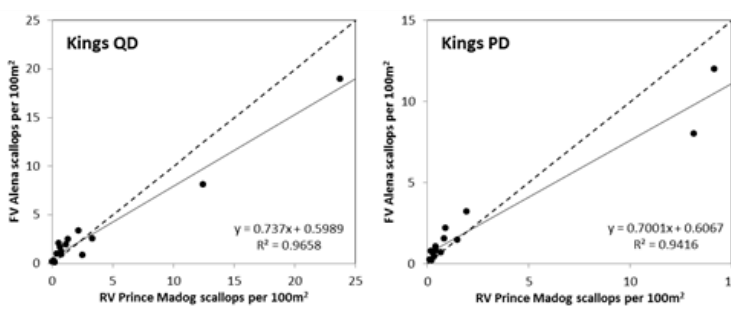


Figure 10: Regression analyses showing the relationship between the numbers of king scallops per 100 m<sup>2</sup> caught by each vessel at each site. A trend line has been fitted to the data as well as a dashed line depicting a 1: 1 ratio.

**Output:** Dignan, S.P., Bloor, I.S.M., Murray, L.G. & Kaiser, M.J. (2015). Comparison of catch efficiencies for king and queen scallops between the RV Prince Madog and the FV Alena. Fisheries and Conservation Report (Draft), Bangor University. pp.11.

## King scallop fishery update (1<sup>st</sup> Nov 2014– 31<sup>st</sup> May 2015)

As quota systems have limited opportunity in other sectors of the UK fishing industry there has been an increase in vessels targeting both king and queen scallops which are non quota species.

The king scallop fishing season in Area VIIa runs from 1<sup>st</sup> November to 31<sup>st</sup> May each year. Over the past four fishing seasons there has been a steady increase in the total quantity of king scallops (live weight tonnes) landed from ICES Rectangle 37E5 (Figure 11 a), which covers a large proportion of the Isle of Man’s territorial sea. There has also been a steady increase in the number of unique vessels prosecuting the fishery during a fishing season (Figure 11 b).

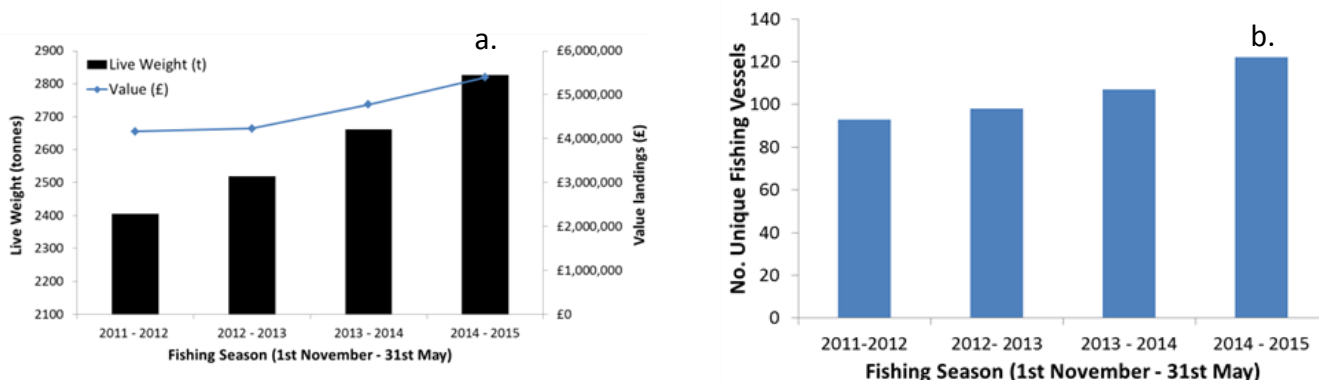


Figure 11: **a.** bar chart showing the quantity (live weight tonnes) and value (£) of king scallop landed from 37E5. **b.** bar chart showing the number of unique fishing vessels landing king scallops from 37E5 both graphs are for the fishing seasons 2011/12–2014/15.

A large proportion of the territorial sea is not fished for scallops with fishing effort tending to be concentrated in particular areas, the precise location of which may vary between years (Figure 12). While the spatial distribution of fishing effort for king scallops varies on an annual basis, the mean area of the territorial sea dredged during a fishing season has remained relatively stable at 28.4 % ± 3.9 %. During the 2014/2015 fishing season the majority of the west coast of the Island were closed to fishing at the start of the season (November & December 2014) as a result of increased toxin levels (ASP/Domoic acid) and thus effort was displaced to the east coast.

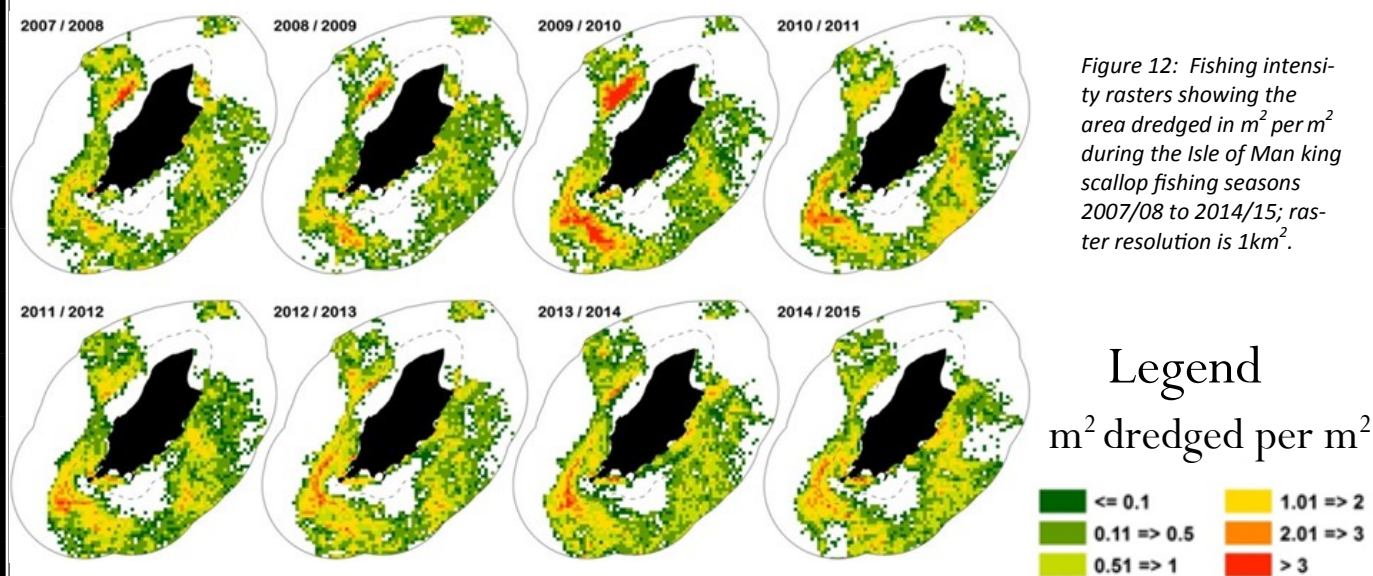


Figure 12: Fishing intensity rasters showing the area dredged in m<sup>2</sup> per m<sup>2</sup> during the Isle of Man king scallop fishing seasons 2007/08 to 2014/15; raster resolution is 1km<sup>2</sup>.

## Title: Study of the dynamics of king scallop populations

**Student:** Antoine Pourchet

**Universities:** Bangor University and Ecole D'Ingénieurs en agriculture

**Dates:** September 2014 – April 2015

**Supervisors:** Lee Murray, Isobel Bloor, Sam Dignan & Mike Kaiser

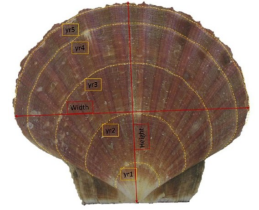


Figure 13: King Scallop Measurements

In addition to the scientific research funded by DEFA, Bangor University has access to a wide range of students both from Bangor and further afield like Antoine who complete work using data from the Isle of Man and who are self-funded or funded by external sources. April 2014 samples of scallops were collected from 40 sites around the Isle of Man during the annual scallop survey. A student from Ecole D'Ingénieurs en agriculture in France processed these samples (up to 20 king scallop samples from each site) in the laboratory at the School of Oceans Sciences at Bangor University, Wales, from September 2014 – April 2015. Data was collected on annual growth increments, reproductive condition, meat yields and shell damage. Data was then analysed to calculate scallop growth rates around the Isle of Man and to map yields and reproductive condition. Consideration was given to how these variables affect the profitability of the fishery. The results of the project will be useful in informing management of the fishery in the future and will form the basis of similar studies going forward. A report, written in French, has been produced and the work is currently being written up by Dr Lee Murray for publication as part of a wider research study on king scallop growth rates in the Isle of Man.

## Title: A spatially dynamic model to engage fishers in evaluating management strategies in the Isle of Man scallop fishery

**Student:** Jenny Shepperson (PhD student)

**Universities:** Bangor University & Centre for Environment, Fisheries and Aquaculture

**Dates:** October 2013 – October 2016

**Supervisors:** Michel Kaiser, Lee Murray, Steven Mackinson & Ewan Bell

Another non-DEFA funded project focused on the Isle of Man scallop fishery is funded by a joint Bangor University – CEFAS initiative and under completion by Jenny Shepperson. Her PhD research is investigating how management influences fishing activity with the aim of demonstrating the potential impacts of various management strategies. The ultimate aim of this research is to produce a computer simulation 'game' where fishers can explore management options in a scientific context. For this project Jenny has talked to a large proportion of the Isle of Man scallop fleet undertaking questionnaires in 2014 - 2015 to understand how environmental and economic conditions affect fishing activity, and therefore how management could affect fishers. In addition, the information from the questionnaires has also helped determine what fishermen would be interested in predicting and exploring in a simulation of management scenarios. The current stage of the project is to turn a more hypothetical model of the fishery into something that is really applicable to the Isle of Man scallop fishery, in terms of reproducing patterns in effort, catches, and costs. Once the model can satisfactorily recreate patterns observed in the real-life fishery, novel management scenarios could be simulated. Jenny's PhD will be completed towards the end of 2016.

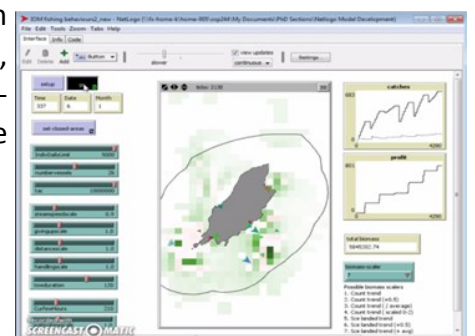


Figure 14: A screenshot of the Individual Based Model of the Isle of Man scallop fishery, created in Netlogo software. Arrows depict fishing vessels, who move about the territorial sea fishing for scallops as they would in real life. Green cells indicate the scallop abundance, but these change to red as vessels fish in them. The catches and costs of each vessel are recorded.

## Queen scallop fishery update (2015)

Following a public consultation by DEFA during 2014/2015 the number of queen scallop licences was reduced from 146 to 48 (41 trawl vessels & 7 dredge vessels) with eligibility based on a given track record period. As for the 2014 fishing season all vessels prosecuting the queen scallop fishery during the 2015 fishing season were required to carry and operate a GPS logger with position recordings at 30 second intervals and complete and submit (by the end of each days fishing) a daily catch return form that details the start and end time and locations for each tow and the quantity of catch associated with it. A curfew was in place with fishing allowed from 06:00 to 18:00 Monday to Friday only. Within the Isle of Man’s territorial sea a quota of 1040 tonnes was set for the queen scallop trawl fishery and an additional 200 tonnes for the queen scallop dredge fishery. The trawl fishery opened on 1<sup>st</sup> July 2015 and closed on 18<sup>th</sup> September 2015. The dredge fishery opened on 1<sup>st</sup> October 2015 and closed on 14<sup>th</sup> October 2015. A total 30 (plus dredge boats) eligible vessels prosecuted the fishery during the Isle of Man 2015 queen scallop season.

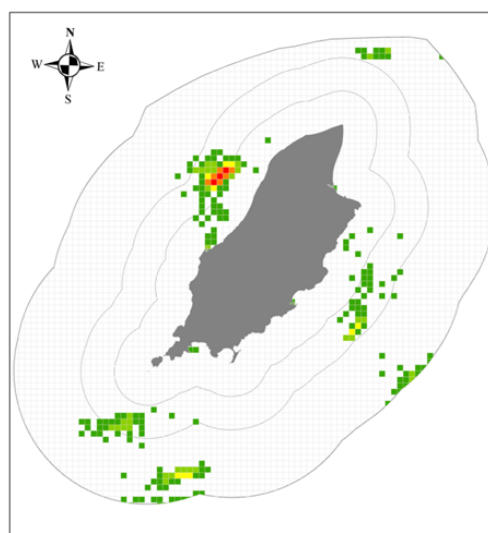
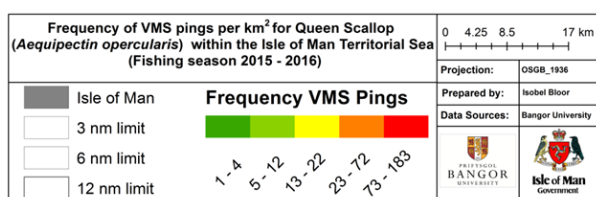
### Fishing intensity queen scallop trawl fishery

During the 2015/16 queen scallop trawl fishing season the 2014/15 closed area on the west coast was moved to allow fishing to occur in a high density bed containing large (70 -80 mm) queen scallops of a single class within an area that had been effectively closed (both as a result of natural events and legislation) for a period of up to four years. By closing areas of good recruitment and allowing the queen scallops to grow on to a larger size the fleet was able to target an efficient fishery, increasing the yield and value of the catch and reducing time at sea and the area impacted by the fishing fleet on the seabed and habitat within the territorial sea.

The majority of fishing effort during the season was therefore focused on a small high density patch of scallops (around 8 km<sup>2</sup>) within the fishing ground known as Targets (TAR) (Figure 15). Approximately 790 tonnes of the 1040 tonne quota was removed from that area. There was a large amount of fishing effort focused into this area with a large number of vessels and LPUE was found to deplete significantly across the season.

Data from the fishery in the TAR grounds is currently being analysed to further investigate depletion rates within the area and provide estimates of trawl efficiency and abundance.

Figure 15: A map showing the fishing intensity (frequency of VMS pings per km<sup>2</sup>) for queen scallop trawlers during the 2015 fishing season. The map highlights a high density of effort within a small fishing area to the west of the Island within the Targets fishing ground.



## Comparison of 2014 & 2015 queen scallop trawl fisheries

There was a large spatial difference in the fishing activity between the 2014 and 2015 fishing seasons. In 2014 fishing effort was concentrated in the lower density fishing ground of East of Douglas (EDG) whilst in 2015 fishing effort was focused at the higher density fishing ground of Targets (TAR) (Figure 16 & Table 2).

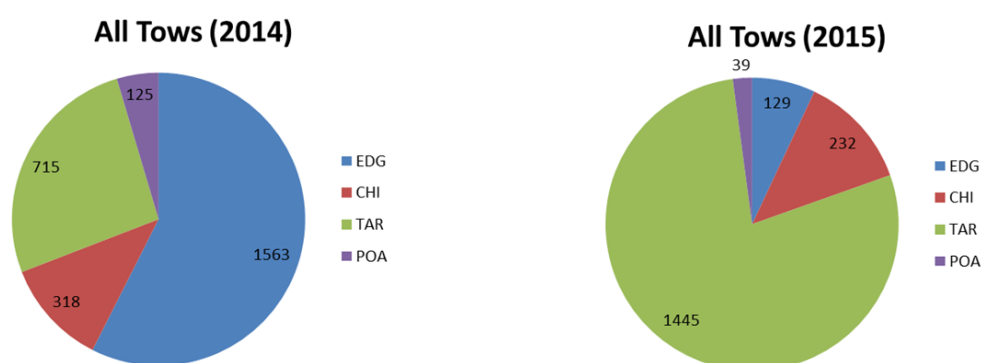


Figure 16: Pie charts showing the total number of tows undertaken at each of the four main fishing grounds during the 2014 and 2015 fishing seasons.

By targeting a higher density area of large scallops at TAR the fishery in 2015 was more efficient than in 2014 as represented by the relative reduction in total hours spent fishing (time gear on seabed) despite a higher total quantity of catch (Table 2).

In 2015 only a few vessels targeted the fishery at EDG due to low catch per unit effort. In total only 27 t was landed from this fishing area for a total of 225 hours of fishing (Table 2). For most vessels the low catch per unit effort at EDG made the fishing ground uneconomically viable to fish. There was also very limited fishing activity at Point of Ayre (18 t) during the 2015 fishing season (Table 2).

Table 2: A table comparing the quantity of queen scallops (live weight tonnes) landed and the corresponding effort (hours fished) from each of the four main fishing grounds for both the 2014 and 2015 queen scallop trawl fisheries.

Ground	2014	2015
EDG	460 t (2700 h)	27 t (225 h)
CHI	183 t (453 h)	180 t (297 h)
TAR	242 t (949 h)	790 t (1365 h)
POA	84 t (147 h)	18 t (53 h)
<b>Total</b>	<b>969 t (4249 h)</b>	<b>1015 t (1940 h)</b>

A 2015 stock assessment summary sheet (below) was produced and distributed along side the full report (Bloor, I.S.M., Dignan, S.P. Murray, L.G. & Kaiser, M.J. (2015) The Isle of Man *Aequipecten opercularis* fishery stock assessment 2015. Fisheries and Conservation Report No. 58, Bangor University.

## 2015 Stock Summary

## Queen scallop (*Aequipecten opercularis*) in ICES Statistical Rectangles 36 and 37 E5 (including Isle of Man territorial sea)

### 2015 Survey

In April 2015 an annual survey of queen scallop stocks was undertaken in the Isle of Man territorial sea aboard R.V. Prince Madog. A record number of sites were sampled both inside and outside the territorial sea (Fig. 1.), some of which were recommended by fishermen prior to the survey. Beam trawl and camera tows were also conducted as well as a gear comparison trial with a local fishing vessel, F.V. Alena.

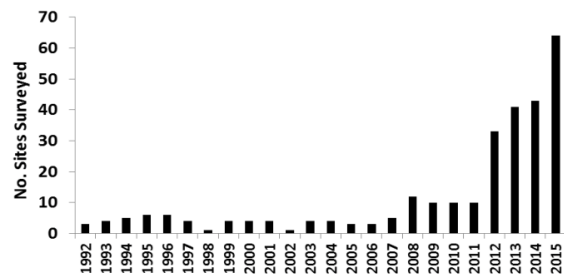


Fig. 1. Sites surveyed during IOM queen scallop survey

### 2014/15 Fishery

In total 33 vessels took part in the queen scallop fishery in the territorial sea from July to October 2014 landing a total of 1,000t; however landings from outside the territorial sea added a further 4,626t to the total landings for the stock assessment unit (ICES Statistical Rectangles 36 and 37 E5). The fishery inside the territorial sea was tightly controlled with curfews, daily bag limits, limits on days per week and uptake monitored with daily catch returns and GPS loggers. In addition 4 areas that had exhibited sufficiently high abundances in the April 2014 survey were strategically closed around the island. This was done to ensure that some scallops existed in high enough densities to spawn successfully and to try and promote improved recruitment to the fishery in the future years. Densities of queen scallops have remained relatively stable, or increased, in 3 out of the 4 closed areas and these individuals will have had additional opportunities to contribute to the future stock.

### 2015 Stock Assessment

The 2015 stock assessment was conducted using the same model (CSA V.3.1.1) and the same survey sites as the 2014 stock assessment. It showed that for the stock assessment unit (ICES Statistical Rectangles 36 and 37 E5):

- Landings had fallen from 11,940t in 2013/14 to 5,626t in 2014/15 (Fig. 2.).
- Median estimated biomass had fallen from 6,429t for the 2014/15 fishing season to 3,656t for the 2015/16 fishing season (Fig. 3.) with 80% confidence intervals of 2,164t and 5,777t.

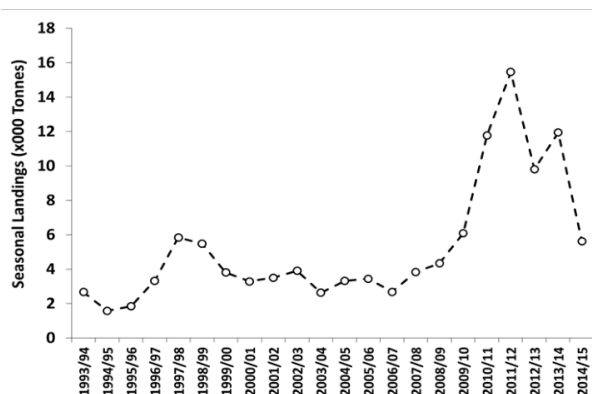


Fig. 2. Summary of total landings (weights in tonnes).

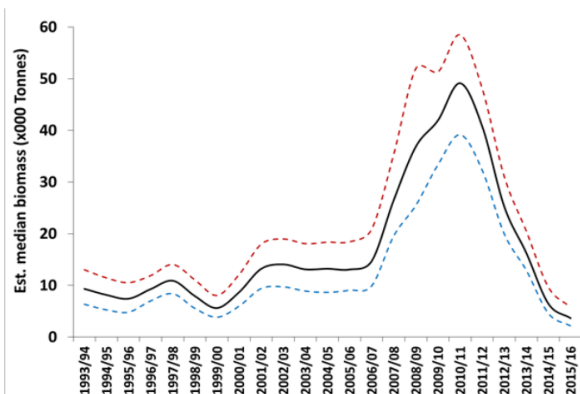


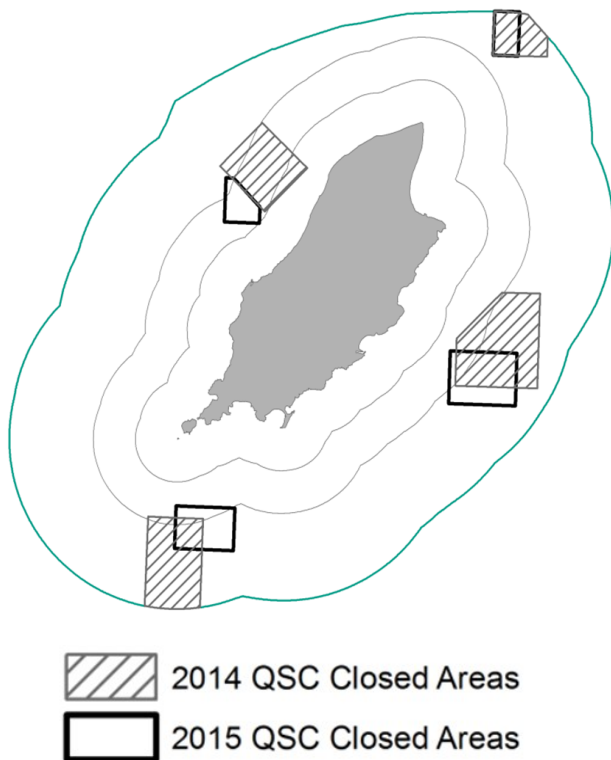
Fig. 3. Total median estimated biomass.

### Advice for 2015

As spawning stock biomass is below the level at which recruitment is expected to be impaired, it is not possible to recommend a scientifically advised TAC for queen scallops in ICES Statistical Rectangles 36 and 37 E5 in the 2015/16 fishing season. As any fishing activity will delay the recovery of the stock to a sustainable level, it is recommended that no fishing for queen scallops occurs within the stock assessment unit (ICES Statistical Rectangles 36 and 37 E5) during the 2015/16 season.

It is further advised that a Pan-Irish Sea management plan is urgently needed to develop and implement measures to substantially reduce fishing mortality throughout the entire range of the stock both inside and outside the Isle of Man territorial sea.

## Queen scallop temporary closed areas



Four small areas that exhibited sufficiently high densities of post-recruits in the April 2015 survey were strategically closed around the Island.

The purpose of these closures is to ensure that some scallops existed at high enough densities around the Island to spawn successfully and to try and promote improved recruitment to the fishery in the following years.

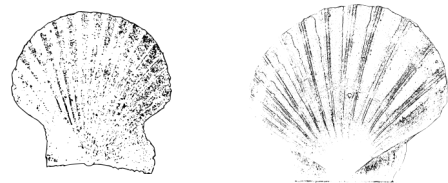
As the main purpose is to promote successful spawning and spat delivery to areas around the entire Island, the effects of these closures will need to be monitored over several years to assess whether any positive impact on recruitment impact on recruitment has occurred.

Management promoting successful spawning, fertilisation and recruitment around the Island may help improve the recovery time for this fishery. The siting, size and access status of these closed areas should therefore be considered annually to ensure optimal performance. As such the siting of these closures has changed from 2014 to 2015 (Figure 17).

Figure 17: A map showing the locations of the four temporary closed areas for queen scallops for both 2014 (hashed boxes) and 2015 (solid lined boxes). The siting of these closed areas will be dis-

## Scallop research priorities for 2016

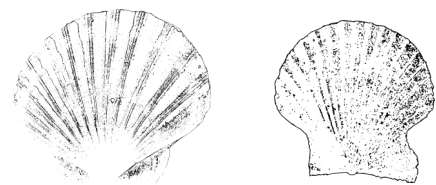
- **2016 Spring Scallop Survey:**
  - ⇒ 25th April—8th May 2016 survey
  - ⇒ New Camera/Dredge set up
  - ⇒ Industry Beam Trawl Survey



- **King Scallop Stock Assessment:**
  - ⇒ March / April 2016

- **Spawning & Settlement timings:**
  - ⇒ Continuous Spatial Sampling (Spring Survey: R.V. Prince Madog)
  - ⇒ Temporal sampling (monthly surveys: F.P.V. Barrule)

- **Summer research projects:**
  - ⇒ QSC gear modification trials (MFPO)
  - ⇒ Discards survival (MFPO)





## Potting sector fisheries: Crab, Lobster & Whelk

The potting sector of the fishing industry is defined by vessels that use baited traps (pots) to capture target species. This traditional, environmentally benign method of fishing supplies a number of shellfish species, including lobster, crab and whelk.

New “Monthly Shellfish Activity” Logbooks have been distributed to active license holders. The fishing effort (i.e. number of pots hauled) and quantity of commercially exploited species retained data are now geo-referenced to ICES rectangle 37E5 scientific squares and scientific sub-squares. This provides a higher-resolution image of the distribution and trends in fishing activities and will also create an evidence-base from which to inform marine-spatial planning. 10-years of records have now been digitised and are available for LPUE and fishing effort analysis for all pot fisheries.

The potting sector has been asked to record the number of whelk pots and lobster creels separately as it is vital to assess trends in LPUE separately for crustacea and whelk fisheries. Additional space for ‘comments’ is also being used by some fishermen to record the number of *berried* (i.e egg-bearing) lobster being caught in pots. This data should give scientists a good indication of what environmental factors may shape the spawning period of female lobster.

Onboard cameras, which are currently deployed on two vessels in the south of the island, are collecting data on a monthly basis. The technology (both hardware and software) is being developed by the electronics workshop at Bangor University with the aim of improving: 1) ease-of-use from a fishers perspective (i.e. less manual handling in setup & complete on/off control); 2) data storage capacity; 3) the ability to capture length-based data and 4) the processing of video data (ease-of-use from scientist perspective). Once a 2<sup>nd</sup> generation prototype has been developed, Bangor University scientists will be looking to conduct sea-trials. It is vital that, going forward, these fisheries are monitored so that trends in productivity can be understood and management plans can properly address the evidence presented.



Landings data shows a strong inter-annual cycle of landings (solid line) and LPUE (dashed line). This time-series of data is being continually revised and will be monitored for trends that may indicate a weakening fishery.

### Update on whelk fishery

There has been very good engagement from the whelk sector, with both Manx and UK registered vessels attending the scientific subgroup along with UK-based processor AM Seafoods. The uptake of fisheries-dependent sampling with ‘scientific pots’ has been very positive; Bangor University are now receiving two samples per month from each vessel and will use the data collected to investigate how whelk populations vary around the island, specifically looking at population parameters.

- SIZE- AT-AGE
- SIZE-AT-MATURITY
- LENGTH DISTRIBUTION
- SEX RATIO
- CPUE

Recent evidence suggests that populations of whelk can show significant variation in the parameters being investigated (left), even on a local scale. Understanding how these basic biological parameters vary over time and space is essential for sustainable management of the fishery, i.e. the management measures controlling the fishery are biologically appropriate to Manx whelk populations.

The methods of analysis for the above have been developed and refined by colleagues in Menai Bridge, who have had their work peer reviewed and published (see Haig et al., 2015).

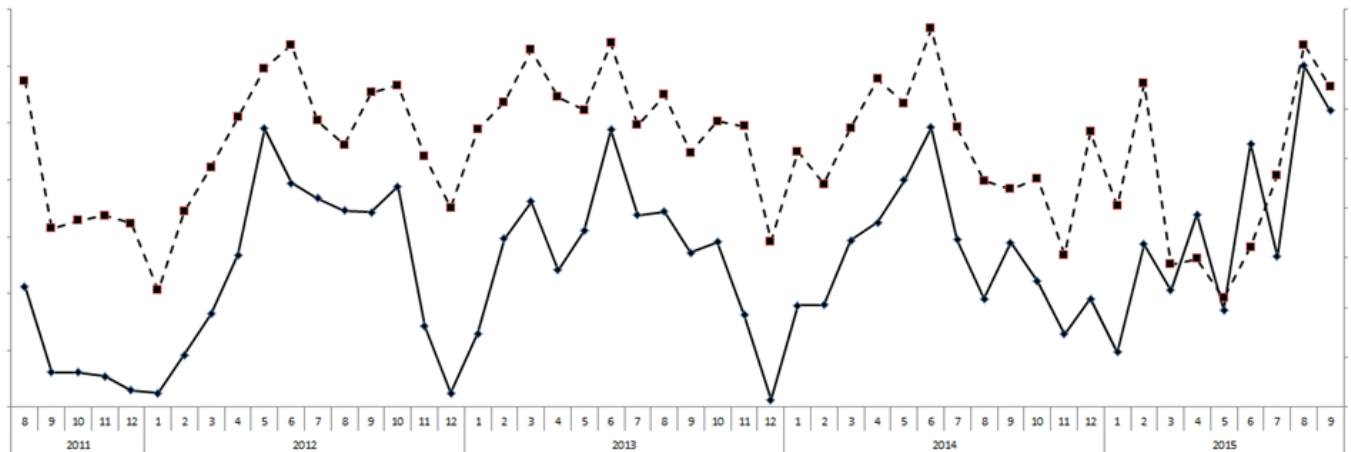


Figure 18: Landings (solid) and LPUE (dashed) of a single vessel targeting whelk (*Buccinum undatum*). Data source: Monthly Shellfish Activity Log, DEFA

## Age and growth rates of whelks

Initial results from an ageing technique being developed by Phil Hollyman at Bangor University using the statolith are very promising and are able to be replicated within the Fisheries laboratory at DEFA.

As part of an ongoing sampling project we receive monthly samples of whelks from fishermen around the Isle of Man. These samples will be analysed for age and growth using these new techniques.

Establishing these parameters will create a sound evidence-base from which to manage the fishery in a sustainable way.

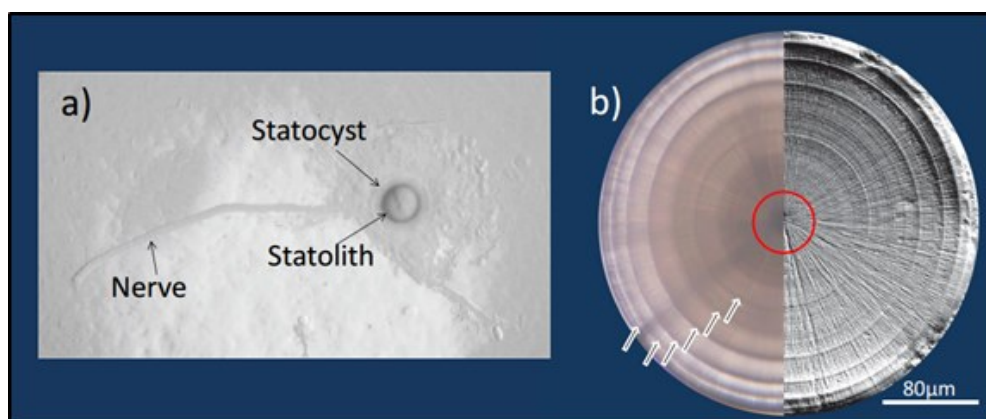


Figure 19: Whelk (*Buccinum undatum*) statolith. A) statolith located in situ inside of the statocyst, b) statolith extracted from statocyst with arrows indicating annual growth rings. Source: Phill Hollyman

Each year we have the opportunity to add value to the current contract by submitting MSc project proposals for Bangor University students to select. In 2015 we had three students on-island undertaking MSc project research for 6 weeks during the summer. This additional research was self-funded by the Bangor University project students who provide a valuable additional resource to the Isle of Man .

## Title: The abundance, movement and site fidelity of adult whelk, *Buccinum undatum*, in the territorial waters of the Isle of Man

**Student:** Matthew Robinson (MSc student)

**Universities:** Bangor University

**Dates:** June 2015 – October 2015

**Supervisors:** Michel Kaiser, Sam Dignan & Isobel Bloor

A tag-recapture experiment was conducted during the summer as part of a Masters-degree project. Matt Robinsons' project involved tagging 5000 whelks (772; 15.5% recapture rate) and presents results on site fidelity, movement and abundance within the study-area. The tagging method has been shown to be effective (high re-capture rate) and Bangor University scientists are collaborating with mark-recapture experts in Menai Bridge to refine the experimental methodology in preparation for further research within the area of seabed designated for development as an offshore windfarm.

On the 30th November 2015, DONG Energy signed an Agreement for Lease (AfL) to carry out preliminary investigations for a potential offshore wind farm. In response to this development, the fishing industry has requested that further scientific work on whelk resources in the area be conducted. Bangor scientists are aiming to carry out a multi-annual study that will provide evidence on the abundance and movement of whelk and help inform the Environmental Impact Assessment (EIA) process.

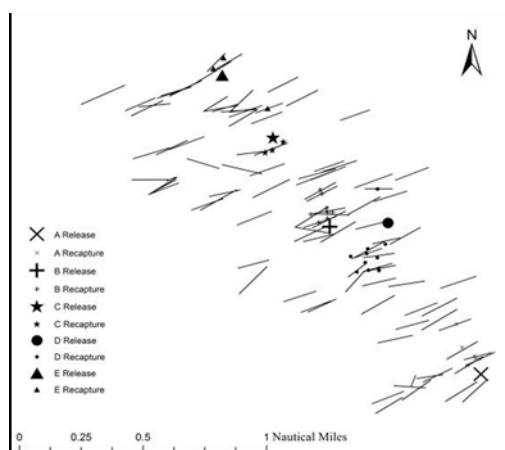


Figure 20: Full extent of the study site on the north-west coast of the Isle of Man, with release and recapture points for tagged whelk from series A-E of the mark-recapture study to estimate abundance and movement. Lines indicate the position of all pot strings fished during the study.



Figure 21: The tag design used in the mark-recapture study of whelk in Isle of Man from 17th June—19th July. The tag is composed of an embossed plastic label with a unique code attached with a plastic snap lock tag fastener to a thick rubber lobster claw band.

*Thank you to Jon-Joe Skillen and the crew of Boy Shayne for their assistance without which this whelk tagging research would not have been possible*

# Title: A population assessment of the adult common whelk (*Buccinum undatum*) around the Isle of Man and implications for fisheries management

**Student:** Jennifer Langdon (MSc student)

**Universities:** Bangor University

**Dates:** June 2015 (ongoing)

Fisheries-dependent data was analysed by Jennifer Langdon, who collected data on-board commercial whelk fishing vessels (e.g. CPUE and length-distribution). In addition, samples collected by commercial fishermen on a monthly basis from a standardised scientific were analysed within the laboratory (e.g. length-distribution, weight, damage, maturity and other morphometrics).

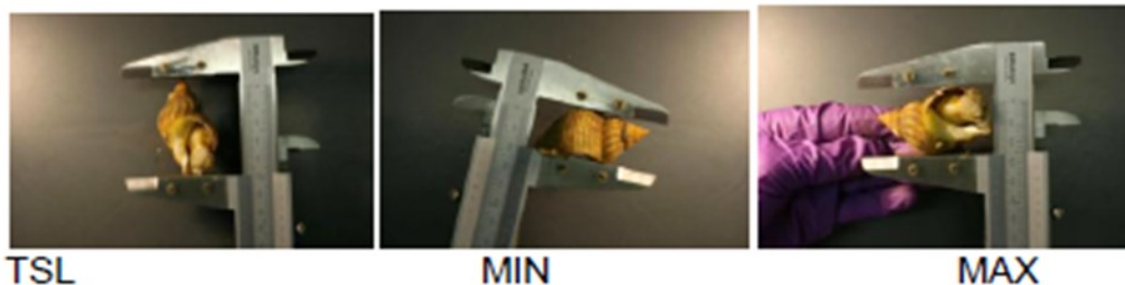


Figure 22: Method of taking shell morphometrics (Haig et al, 2015a).

Importantly, all the samples have been retained for ageing analysis (see Pg. 11 for details). The data collected will help begin to assess relationships and patterns in allometric growth rates such as inflections in penis size, which can indicate maturation. Her work will contribute to the continuing research of the biological parameters of whelk populations around the island.

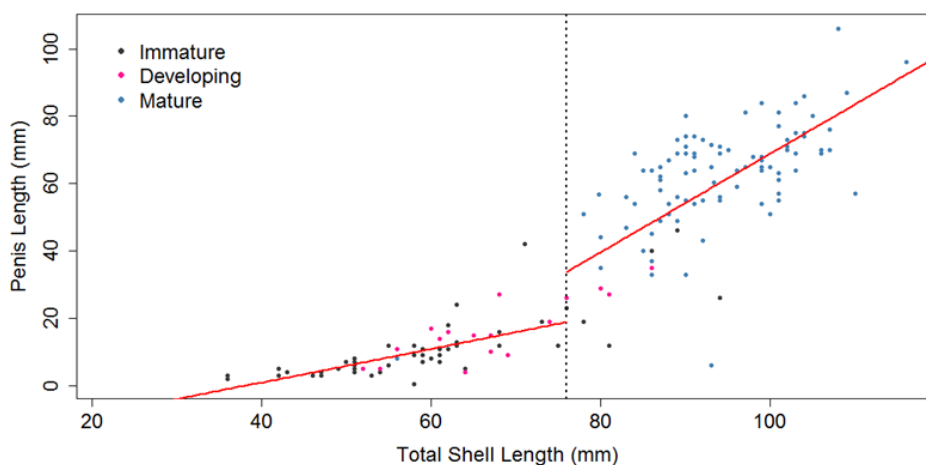
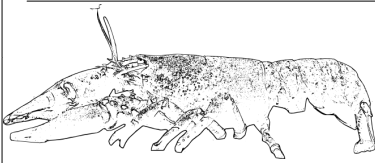


Figure 23: Allometric growth of the penis amongst the sampled population, indicating pubertal growth and size at onset of maturity

Thank you to all the fishermen who participated in this research by collecting samples or by allowing a scientific observer onboard their vessels.



## Update on lobster fishery

Landings data (2007–2015) have been compiled into a database and is being modelled by scientists investigating trends in the catchability of the species (i.e. LPUE). Initial results show a highly variable fishery that shows natural inter-annual fluctuations in landings (dashed line) and LPUE (solid line). The relationship between environmental data (sea-bottom temperature) and landings will be investigated.

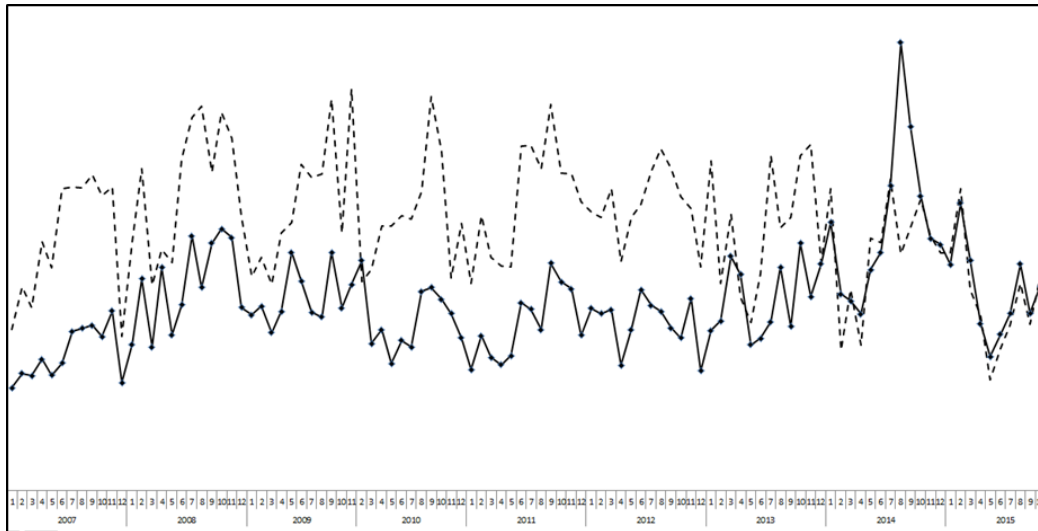


Figure 24: Landings (solid) and LPUE (dashed) of a single vessel targeting lobster (*Homarus gammarus*). Data source: Monthly Shellfish Activity Log, DEFA

## Juvenile lobster research

Data was collected onboard commercial fishing boats during the Autumn and included CPUE, length-distribution and location. In addition, several fishermen are targeting juvenile lobster using Roscoff style prawn pots to build a database of morphometric measurements that indicate the size at onset of maturity (i.e. a puberty moult).

Looking forward, Bangor University research will focus on several aspects of lobster biology. Principally, the reproductive biology (size-at-maturity, functional maturity and behavioural maturity estimates) as well as beginning a long-term mark-recapture study to look at movements within the Baie ny Carrickey. Acoustic technology has also been used to investigate fine-scale movements and habitat use by this species elsewhere in the UK; providing the equipment can be acquired, researchers hope to utilise this methodology.

This information will facilitate an understanding of lobster movements and general life-cycle that will inform the relevant spatial-scale on which to manage the species and the biological appropriateness of current management measures (such as the minimum landing size).



Figure 25: A juvenile lobster undergoing measurement for fine-scale morphometric data.

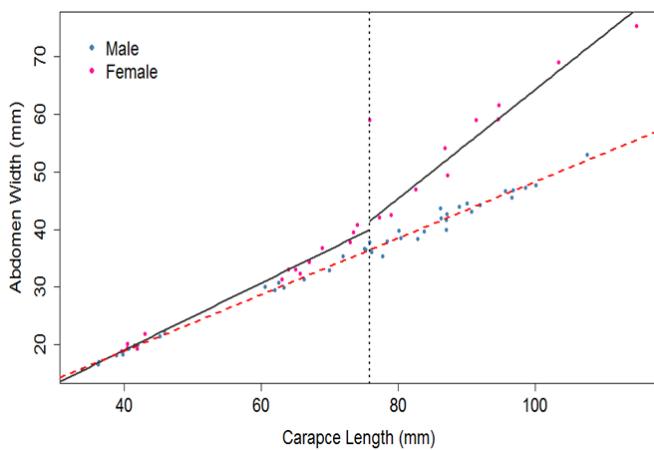


Figure 26: Allometric growth of the abdomen in male and female lobster, indicating a puberty moult and size an onset of maturity in the female population.

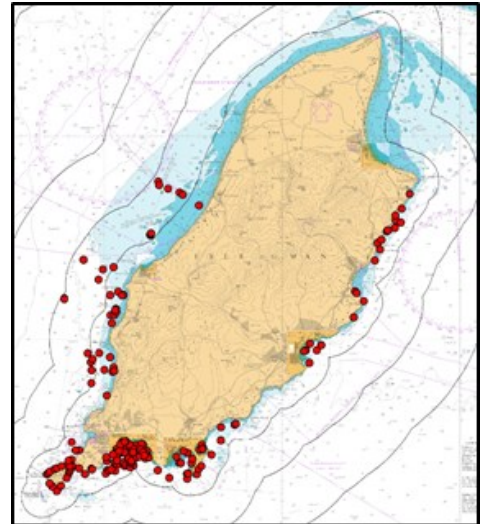


Figure 27: The locations sampled by Bangor University scientists between 2013-2015.

## Update on crab fishery



Landings data is highly variable between vessels as many inshore potters principally target lobster (through the use of different bait and/or deploying gear on specific habitats). Below is a figure showing the LPUE trends of three vessels, which exemplifies this variability. However, vessels that predominantly target brown crab show an inter-annual cycle of rise and fall of LPUE, which Ondes (2015) has linked to environmental variables such as sea temperature. It may also indicate migratory behaviour of the female population. Researchers are planning a mark-recapture study to better understand the movement of females, especially during spawning migrations. The knowledge of where and when egg-bearing females migrate is essential for protecting the population via a multi-species, ecosystem based approach to management.

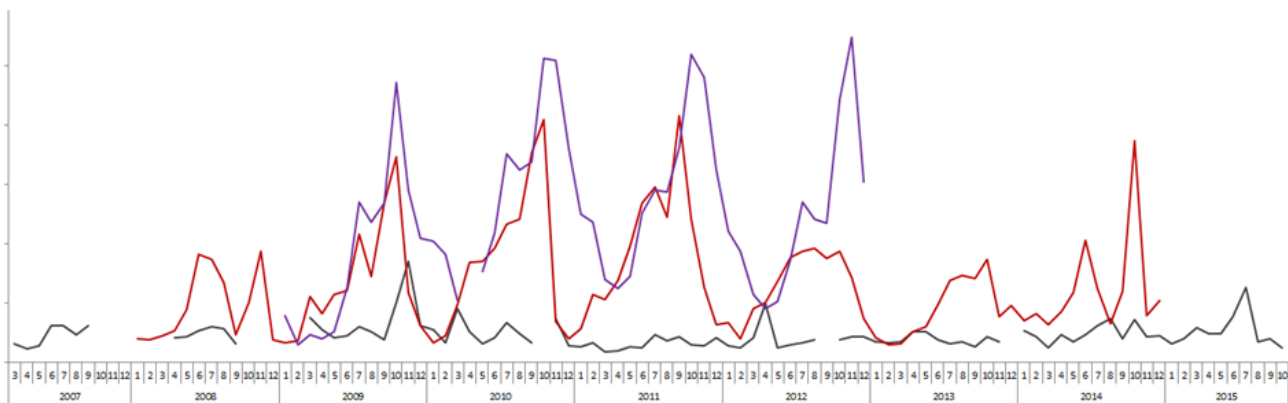


Figure 28: LPUE of three vessels targeting crab (*Cancer pagurus*). Data source: Monthly Shellfish Activity Log, DEFA

## Title: Fisheries ecology of the brown crab (*Cancer pagurus* L.) in the Isle of Man.

**Student:** Fikret Ondes (PhD student)

**Dates:** June 2012—October 2015 (completed)

One of the advantages of being a University science provider is that we can draw down additional externally funded resources to support existing science contracts. Since 2007, Bangor University has been able to contribute an additional 9 years of PhD student research focused on the Isle of Man at no additional cost to the Manx tax payer. Two of these students (Gwladys Lambert and Jenny Shepperson) were funded by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) while Fikret Ondes was supported by the Turkish Government. Fikret worked with the crab fishing sector on the Isle of Man and spent a considerable part of his PhD based in the Isle of Man. He gathered important data relating to the seasonal changes in catch, bycatches in pots, recreational fishery data, and interactions with the scallop fishery. The PhD has proved important in forming a baseline of scientific data on which we can build in the future.

The work reported in the PhD revealed some important findings. The size at maturity of crabs in the Isle of Man appears to be well below the minimum landing size which means that the MLS is an effective technical measure to help conserve the population. The size distribution of catch retained in the Isle of Man appears to have a healthy distribution, in other words, the catches are dominated by large individuals and the fishery is not fishing right down to the MLS. This indicates that at present levels of fishing effort the crab fishery is being prosecuted in a sustainable manner. Larger female crabs carry a greater number of eggs than smaller females. This isn't surprising, but it does reinforce the importance of maintaining a healthy number of large females in the population. Perhaps a more intriguing finding was that female crabs that had lost either one or two claws had smaller eggs on average than those crabs that showed no signs of damage. Larger eggs normally produce better quality larvae than smaller eggs, so the ban on landing claws in the Isle of Man seems to be a sensible conservation strategy. Fikret mapped catches throughout the year and this seemed to indicate a pattern of movement towards the seabed to the south and southwest of the Isle of Man where mating occurs before the ovigerous females head out to deep water in the west. Understanding these patterns of movement is important if the crabs become vulnerable to other activities at a time when they are carrying eggs. We hope to explore this further through the use of an extensive tagging study in the next few years.

One of the issues on all fishermen's minds will be the landings obligation which will come into force for pot fisheries towards 2019. Fikret made extensive observations of bycatches which led to the conclusion that bycatch is very low in this fishery. While this might be obvious to many pot fishermen, having this evidence will be extremely important in the future and we will be trying to come up with innovative ways to collect the information (possibly using cameras) that cause as little inconvenience to fishermen as possible. Showing that bycatch is alive and healthy when returned to the sea is an important factor in convincing the European Commission to grant exemptions to the landings obligation and this is where we think camera evidence will really come into its own.

Fikret passed his PhD after a successful viva in mid September 2015. His external examiner was Dr Richard Hartnoll (formerly of Port Erin Marine Laboratory). He has returned to Turkey where he has started a job as a researcher in a University. If anyone wishes to see the PhD thesis please email ([i.bloor@bangor.ac.uk](mailto:i.bloor@bangor.ac.uk)) for a copy. Many thanks to all those fishermen who worked with Fikret and made him welcome, he specifically acknowledged the contribution of the industry in this PhD thesis.

## Size-at-onset of maturity study (brown crabs)

A collaborative study was undertaken in conjunction with colleagues from England, Wales, Scotland, Ireland during winter 2014/2015. The aim was to collect and compare crabs from each geographical area to determine whether regional variation in size-at-maturity exists. Bangor University scientists based on the Isle of Man contributed to the study, the results of which are currently being analysed and will be published in a scientific journal (Haig et al. *in prep*). Understanding the size-at-maturity is important in assessing the biological appropriateness of the current minimum-landing-size (MLS).

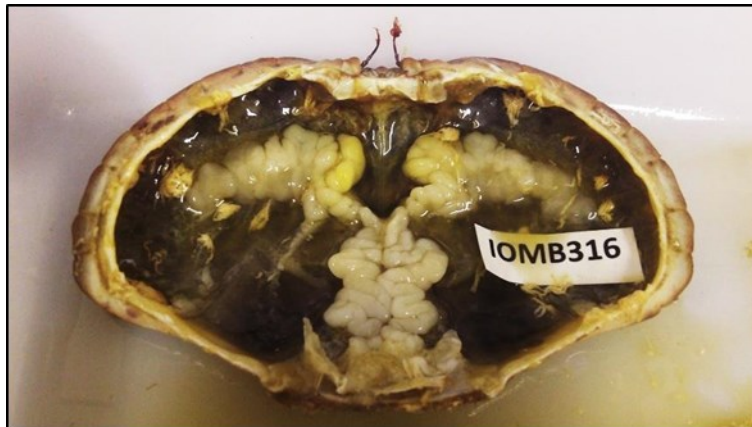
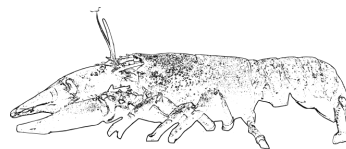


Figure 29: Dissection of crab (*Cancer pagurus*) for the purpose of gonadic assessment. Right: Sam Dignan and Isobel Bloor working on crab size at onset of maturity data collection at the Fisheries Lab, DEFA.

## Pot fishery research priorities for 2016

- **Sea trials of 2nd generation onboard camera systems:**

- ⇒ Develop hardware setup
- ⇒ Sea trials on test boats
- ⇒ Expand to sentinel fleet



- **Whelk monthly scientific pot samples:**

- ⇒ Expand collection of samples to entire fleet
- ⇒ Analyse samples (e.g. maturity, damage, sex etc.) including new ageing methods

- **Lobster size-at-onset of maturity data collection:**

- ⇒ Collect morphometric data from a size-range of lobsters

- **Crab tag-retention study assessing retention of tagging methods**

- **Summer research projects:**

- ⇒ Whelk tag-release experiment within DONG area for lease (AFL)
- ⇒ Biological parameters of whelk populations (maturity, size-at-age, sex ratio, etc.)
- ⇒ Habitat mapping of Ramsey Bay Marine Nature Reserve & Port Erin Closed Area





## Closed Areas:

### Ramsey Bay Fisheries Management Zone

In September 2015 DEFA and Bangor University undertook the annual scallop survey in Ramsey Bay onboard the FPV Barrule. In conjunction with this survey the MFPO also conducted comparison tows with the FV Alena with the purpose of the MFPO leading on future surveys within the Ramsey Bay Fisheries Management Zone.

The survey method was altered to enable multiple tows to be undertaken over a smaller survey area (main fished areas). This has the benefit of leaving areas with low or no scallop density undisturbed whilst also providing more information on the variability in density of the scallops within a box.

Both queen and king scallops are now sampled within the survey. The MFPO has adopted a similar harvest strategy to the previous year with all boats receiving an individual (transferable) quota allocation to target king scallops within the FMZ during December and January.

FPV Barrule & FV Alena Sept 2015 comparison tows bags/dredge/hour (230 scallops per bag)

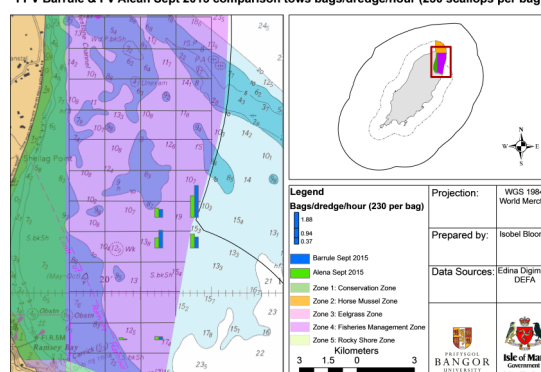


Figure 30: Map showing the density of king scallops caught during comparison tows between the FV Alena and the FPV Barrule in September 2015.

## TITLE: IDENTIFYING HABITAT ASSOCIATIONS OF EUROPEAN LOBSTER *HOMMARUS GAMMARUS* (L.) AND BROWN CRAB, *CANCER PAGURUS* (L.) IN AN ISLE OF MAN MARINE PROTECTED AREA.

**Student:** Lucy May (MSc student)

**Dates:** June 2015—October 2015

**Supervisors:** Michel Kaiser, Sam Dignan & Isobel Bloor

The habitat within the Baie ny Carrickey (BnC) closed area was surveyed extensively during the summer by MSc student, Lucy May. The project involved collaborating with members of the Baie Ny Carrickey Crustacea Fisheries Management Association (BNCCFMA) in order to deploy drop-down and BRUV cameras, whilst the *flying array* was deployed from the DEFA RIB. The project also looked to identify relationships between habitat complexity and the abundance of pre-recruits and recruits of both crab and lobster populations in the area.

The results show a diversity of habitats and biotopes within the closed area, with seagrass (*Z. marina*) and maerl both being observed. The project also identified a positive relationship between structural complexity of the habitat and the abundance of juvenile lobster and crab although the patterns were not observed in adults. Kelp dominated rocky reefs were highlighted as being a particularly important for juveniles. The thesis recommends continued monitoring of habitat elsewhere in the Isle of Man in order to inform ecosystem-based fisheries management within the closed area. Furthermore, the use of habitat by lobster and crab at various stages of the life-cycle can be understood in greater detail by conducting long-term mark-recapture and acoustic tagging experiments.

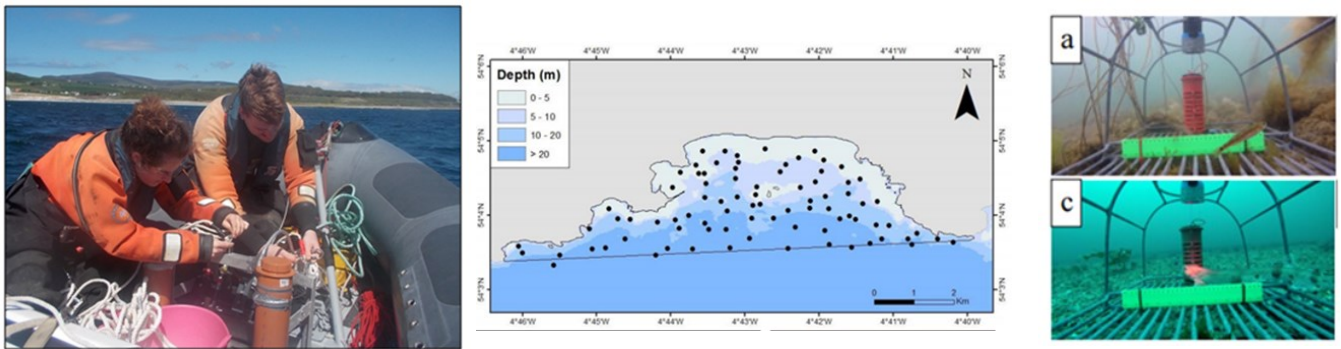


Figure 31: Habitat-mapping project designed and carried out by MSc student Lucy May. Left: The flying array being deployed in Baie ny Carrickey (BnC) to obtain video footage of the seabed; Middle: A map showing the distribution of sites surveyed in BnC using a drop down camera system to assess habitat type and Right: The baited underwater video camera (BRUV) deployed in BnC to obtain video footage of mobile and sessile fauna.

### Baie ny Carrickey (BnC) Closed Area

Scientific monitoring of commercial activity is undertaken by members of the Baie Ny Carrickey Crustacea Fisheries Management Association (BNCCFMA) who provide additional data (length-distribution, sex-ratio, bycatch) from commercial and *scientific* pots on a monthly basis. This data is collected and reviewed by Bangor University and will feed into the final BnC closed area trial report in 2016.

In addition to the works completed by Bangor University MSc students, research staff based on the island have been working with the BNCCFMA to better understand the population dynamics of the lobster and crab populations. Fishers were given 5 scientific pots (no escape gaps) and asked to report the abundance, size, sex and gravid-status of animals captured in these pots once per month. To date 2,093 animals have been recorded, of which 1,547 were lobsters (*Homarus gammarus*).

The data collected by fishermen will be analysed in 2016 as the experimental effort control measures come under evaluation. In addition to the mandatory data collection, several fishermen have opted to trial the use of electronic monitoring systems (onboard cameras). The video footage captured by these vessels is currently undergoing analysis by an undergraduate student at Bangor University and will inform the ongoing development of 2<sup>nd</sup> generation electronic monitoring platforms.

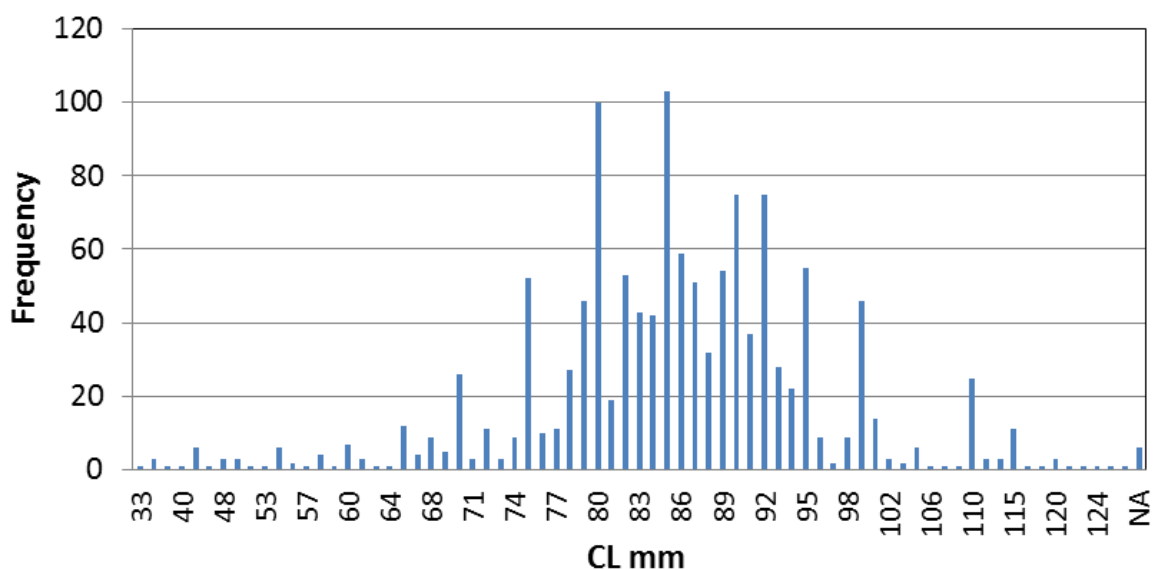


Figure 32: Size-distribution of lobster being captured by scientific and commercial pots in the BnC. Data source: BnC Data Collection programme.

## Publications:

- Szostek C.L., Murray L.G., Bell E., Rayner G. & **Kaiser M.J.** 2015. Natural versus fishing disturbance: drivers of community composition on traditional king scallop, *Pecten maximus*, fishing grounds. *ICES Journal of Marine Science* doi:10.1093/icesjms/fsv152
- **Kaiser M.J.**, Hilborn R., Jennings S., and 46 others (2016) Prioritisation of knowledge needs to achieve best practices for bottom-trawling in relation to seabed habitats. *Fish and Fisheries* doi:10.1111/faf.12134
- Mangano M.C., **Kaiser M.J.**, Porporato E.M.D., Lambert G.I. & Spano N. 2015. Trawling disturbance effects on the trophic ecology of two co-generic Astropectinid species. *Mediterranean Marine Science* **16**: 538-549.
- Haig J., Pantin J., Salomonsen H., Murray L.G. & **Kaiser M.J.** 2015. Temporal and spatial variation in size at maturity of the common whelk, *Buccinum undatum*. *ICES Journal of Marine Science* doi:10.1093/icesjms/fsv12
- Hold N., Murray L.G., Pantin J.R., Haig J.A., Hinz H. & **Kaiser M.J.** 2015. Video capture of crustacean fisheries data as an alternative to on-board observers. *ICES Journal of Marine Science*, doi: 10.1093/icesjms/fsv030
- Ruiz-Frau A., Possingham H.P., Edwards-Jones G., Klein C.J., Segan D. & **Kaiser M.J.** 2015. Multi-disciplinary approach in the design of Marine Protected Areas: integration of science and stakeholder based methods. *Ocean and Coastal Management* 103: 86-93.
- Revill, A., **Bloor, I.S.M.** and Jackson, E.L. (2015). The survival of discarded *Sepia officinalis* in the English Channel. *Fisheries Management and Ecology*, Vol. 22: 164—171.
- **Bloor, I.S.M.** (in press). The role of physico-chemical factors and cues in the early life stage development of the common cuttlefish (*Sepia officinalis*). *Vie et Milieu*, Vol, 65 (4).
- Haig, J.A., Bakke, S., Bell, M.C., **Bloor, I.S.M.**, Cohen, M., Coleman, M., **Dignan, S.P.**, **Kaiser, M.J.**, Pantin, J.R., Roach, M., Salomonsen, H. and Tully, O. (in press). Reproductive traits and factors affecting the size at maturity of *Cancer pagurus* across northern Europe. *ICES Journal of Marine Science*.
- **Bloor, I.S.M.**, **Murray, L.G.**, **Dignan, S.P.** and **Kaiser, M.J.** (2015). The Isle of Man *Aequipecten opercularis* fishery stock assessment 2015. Fisheries and Conservation Report No. 58, Bangor University. pp.55.
- **Dignan, S.P.**, **Bloor, I.S.M.**, **Murray, L.G.** & **Kaiser, M.J.** (2015). Comparison of catch efficiencies for king and queen scallops between the RV Prince Madog and the FV Alena. Fisheries and Conservation Report (Draft), Bangor University. pp.11.
- ICES 2015. Report of the Scallop Assessment Working Group (WGScallop), 5-9 October 2015, St Helens, Jersey. ICES CM 2015/ACOM:XX. 36pp.

## Theses (PhD and MSc):

- Ondes, F. 2015. Fisheries ecology of the brown crab (*Cancer pagurus* L.) in the Isle of Man. PhD thesis, Bangor University. 232pp.
- Robinson, M. 2015. The abundance, movement and site fidelity of the adult whelk, *Buccinum undatum*, in the territorial waters of the Isle of Man. MSc thesis, Bangor University. 44pp.
- May, L. 2015. Identifying habitat associations of European lobster, *Homarus gammarus* (L.) and brown crab, *Cancer pagurus* (L.) in an Isle of Man marine protected area. MSc thesis, Bangor University. 87pp.
- Langdon, J. (in Prep). A population assessment of the adult common whelk (*Buccinum undatum*) population around the Isle of Man and the implications for fisheries management. MSc thesis, Bangor University.

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## Presentations:

- **Bloor, I.S.M.,** Dignan, S.P., Murray, L.G. & Kaiser, M.J. 2015. Fishing for data: Stock status and predator (fishing vessel) response in the Isle of Man queen scallop fishery. The 20<sup>th</sup> International Pectinid Workshop, 22<sup>nd</sup> – 28<sup>th</sup> April 2015, Galway, Ireland.
- **Dignan, S.P.,** Bloor, I.S.M., Duncan, P., Kaiser, M.J., Murray, L.G., Kennington, K. & Gell, F. 2015. Managing fishers to manage themselves: Ramsey Fisheries Management Zone a learning experience. The 20<sup>th</sup> International Pectinid Workshop, 22<sup>nd</sup> – 28<sup>th</sup> April 2015, Galway, Ireland.
- **Bloor, I.S.M.,** Dignan, S.P., Murray, L.G. & Kaiser, M.J. 2015. The role of marine science in developing sustainable fisheries for the Isle of Man. Edward Forbes Bicentenary Marine Science and Conservation Conference, 12 – 14 February 2015, Manx Museum, Douglas, Isle of Man.
- **Dignan, S.P.,** Bloor, I.S.M., Murray, L.G., Duncan, P., Gell, F. & Kaiser, M.J. 2015. The Fisheries Management Zone in Ramsey Marine Nature Reserve. Edward Forbes Bicentenary Marine Science and Conservation Conference, 12 – 14 February 2015, Manx Museum, Douglas, Isle of Man.
- **Ondes, F. & Kaiser, M.J.** 2015. The catch characteristics and population structure of the brown crab (*Cancer pagurus*) fishery in the Isle of Man. Edward Forbes Bicentenary Marine Science and Conservation Conference, 12 – 14 February 2015, Manx Museum, Douglas, Isle of Man.
- **Sutton, G.,** Dignan, S., Duncan, P., Bloor, I.S.M., & Kaiser, M. 2015. Baie ny Carrickey Closed Area – A fishermen's perspective. Edward Forbes Bicentenary Marine Science and Conservation Conference, 12 – 14 February 2015, Manx Museum, Douglas, Isle of Man.
- **Bloor, I.S.M.,** Dignan, S.P., Murray, L.G. & Kaiser, M.J. 2015. Isle of Man Queen Scallop: Stock status, assessment and trawl fishery for 2015. ICES Working Group Scallops, 5-9 October 2015, St Helens, Jersey.

## Presentations continued:

- **Bloor, I.S.M.** 2015. Isle of Man Scallop Fishery Update: Fishery, stock status, assessment and research projects from 2015. 3<sup>rd</sup> Annual Fisheries Science Symposium, 15 December 2015, Peel Golf Club, Isle of Man.
- **Kaiser, M.J.** 2015. Be Kind to Whelks. 3<sup>rd</sup> Annual Fisheries Science Symposium, 15 December 2015, Peel Golf Club, Isle of Man.
- **Emmerson, J.** 2015. Pot fishery update. 3<sup>rd</sup> Annual Fisheries Science Symposium, 15 December 2015, Peel Golf Club, Isle of Man.
- **Shepperson, J.** 2015. Creating a tool to evaluate management strategies in the Isle of Man scallop fishery. 3<sup>rd</sup> Annual Fisheries Science Symposium, 15 December 2015, Peel Golf Club, Isle of Man.
- **Monkman, G.** 2015. Using cameras for onboard sampling of trap fisheries. 3<sup>rd</sup> Annual Fisheries Science Symposium, 15 December 2015, Peel Golf Club, Isle of Man.

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## Conferences:

- Edward Forbes Bicentenary Marine Science and Conservation Conference, Douglas, Isle of Man, 12 – 14<sup>th</sup> February 2015 (Attended by: Dr. Isobel Bloor & Sam Dignan).
- 20<sup>th</sup> International Pectinid Workshop, Galway, Ireland, 22 – 28<sup>th</sup> April 2015 (Attended by: Dr. Isobel Bloor & Sam Dignan).
- 3<sup>rd</sup> Annual Fisheries Science Symposium, Peel, Isle of Man, 15<sup>th</sup> December 2015 (Attended by: Professor Mike Kaiser, Professor Stuart Jenkins, Dr. Isobel Bloor, Jack Emmerson, Jennifer Shepperson & Graham Monkman).

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## Public outreach events:

- Presentation at Henry Bloom Noble Primary School, Douglas, Isle of Man to three Year 6 classes on the topic of 'Under the Sea', Monday 13<sup>th</sup> July 2015.
- IOM Fish News: Newsletter of Bangor University Isle of Man Fisheries, Issue 03, October 2015. PP4.

## Training events:

- ICES Training Course: Analysing and visualization of VMS and EU logbook data using the VMS tools R package, Copenhagen, Denmark, 9 – 13<sup>th</sup> November 2015 (Attended by: Dr. Isobel Bloor).

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## Key Committees, Working Groups etc.:

- International Council for Exploration of the Seas (ICES) Working Group on Scallop Stock Assessment, Jersey, 5 – 9<sup>th</sup> October 2015 (Member of and attended by: Dr. Isobel Bloor).
- International Council for Exploration of the Seas (ICES) Working Group on Crab (Member: Jack Emmerson).
- Queen Scallop Management Board (QMB) - Scientific Advisors; Meetings attended:
  - ⇒ Friday 6th March 2015 (15:00—17:00)
  - ⇒ Friday 15th May 2015
  - ⇒ Tuesday 4th August 2015 (10:00—13:00)
  - ⇒ Friday 21st August 2015 (09:00—12:00)
  - ⇒ Monday 7th September 2015 (10:00—14:00)
  - ⇒ 29th October 2015 (Belfast)
- Scientific Steering Committee— Scientific Advisors; Meetings attended:
  - ⇒ Tuesday 19th May 2015 (10:00—12:00)
  - ⇒ Wednesday 28th October 2015 (10:00—12:00)
- Baie ny Carrickey Management Advisory Committee— Scientific Advisors; Meetings attended:
  - ⇒ Thursday 22nd January 2015 (18:30—20:00)
  - ⇒ Thursday 28th May 2015 (19:00—21:00)
  - ⇒ Thursday 22nd October 2015 (19:00—21:00)
- Ramsey Bay Marine Nature Reserve Fisheries Advisory Committee— Scientific Advisors; Meetings attended:
  - ⇒ Friday 21st August 2015 (15:00—17:00)
- Scientific Steering Committee: Whelk Subgroup— Scientific Advisors; Meetings attended:
  - ⇒ Thursday 9th July 2015 (19:00—21:00)
  - ⇒ Thursday 1st October 2015 (18:30—20:00)
- Scientific Steering Committee: Crab and Lobster Subgroup— Scientific Advisors; Meetings attended:
  - ⇒ Tuesday 22nd September 2015 (19:00—20:30)
- Marine Stewardship Council Annual Audit (queen scallop trawl fishery):
  - ⇒ Tuesday 7th—Wednesday 8th July 2015



**Bangor University**



Fisheries and Conservation  
Science Group

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**Facebook:** <https://www.facebook.com/fisheriesconservation>

**Twitter:** @Fisheriesbangor



Bangor University's Fisheries and Conservation Science Group has undertaken research for the Isle of Man's Department of Environment, Food and Agriculture since 2007. The research focuses on achieving sustainable and economically viable fisheries within an ecosystem context. We are assessing scallop, crustacean and mollusc stocks and quantifying bycatch, as well as focusing on the ecosystem through habitat surveys and studies examining the impacts of different fishing gears. We also use state of the art techniques utilising fishery-dependent data to understand how the Island's scallop fisheries are exploited and how their management can be improved.

The work is funded by the **Isle of Man's Department of Environment, Food and Agriculture**

### Isle of Man Staff: Bangor University

#### Professor Michel Kaiser:

After completing a PhD at Bangor University I worked for CEFAS for eight years and since then have continued to develop my research interests in understanding how fishing affects marine ecosystems and how we can better manage our use of natural resources. To achieve this I have examined the efficacy of using Marine Protected Areas as management tools, the socio-economic impact of different approaches to fisheries management, and the development of an evidence-based approach to conservation. More recently I have been engaged in fishermen-scientist workshops to encourage dialogue and learning. Public duties include an appointment to the board of Seafish and also to the board of the Joint Nature Conservation Committee. I have published over 135 peer reviewed papers and have authored or edited 5 books and write articles for the popular press.



#### Dr Isobel Bloor:

After graduating from Queen Mary's University of London with an MSc in Marine Ecology and Environmental management, I worked as a marine ecologist at a small independent marine consultancy managing the impacts of marine related projects. I then worked on a 3 year cross-Channel EU project on cephalopod ecology and completed my PhD in conjunction with the Marine Biological Association and the Marine Institute, University of Plymouth on Cephalopod ecology, movement and behaviour, undertaking the first electronic tagging field study of the common cuttlefish (*Sepia officinalis*) in the field. My research has been predominately fisheries and field-work based working directly with inshore potting fishermen, undertaking acoustic and data storage tagging studies and completing *in situ* scuba surveys of spawning grounds. I also have experience in developing presence-only and presence-absence species distribution models. My current role as a postdoctoral fisheries scientist on the Isle of Man involves developing and undertaking stock assessments and providing the science necessary to assist the government in managing the scallop, lobster and crab fisheries within the territorial sea.



#### Jack Emmerson:

I am a fisheries scientist focussing principally on the interaction between commercial static-gear fisheries in the Irish Sea and the biology of the shellfish resources they depend upon. I gained my BSc and MSc degrees at York University and have worked as a shellfish research scientist for the Holderness Fishing Industry Group, Orkney Sustainable Fisheries and the Cardigan Bay Fisherman's Society. I am part of the Fisheries and Conservation Science group at Bangor University and am based on the Isle of Man within the Department for Environment, Food & Agriculture. I am leading on research related to the biology and life-history of lobster (*H. gammarus*), edible crab (*C. pagurus*) and whelk (*B. undatum*) and am contracted to supply evidence to inform sustainable management of static-gear fisheries within the Isle of Man territorial waters, whilst working towards a part-time PhD "*Sustainable static-gear fisheries in the Irish Sea*".



