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Annual Fisheries Science Report

2018

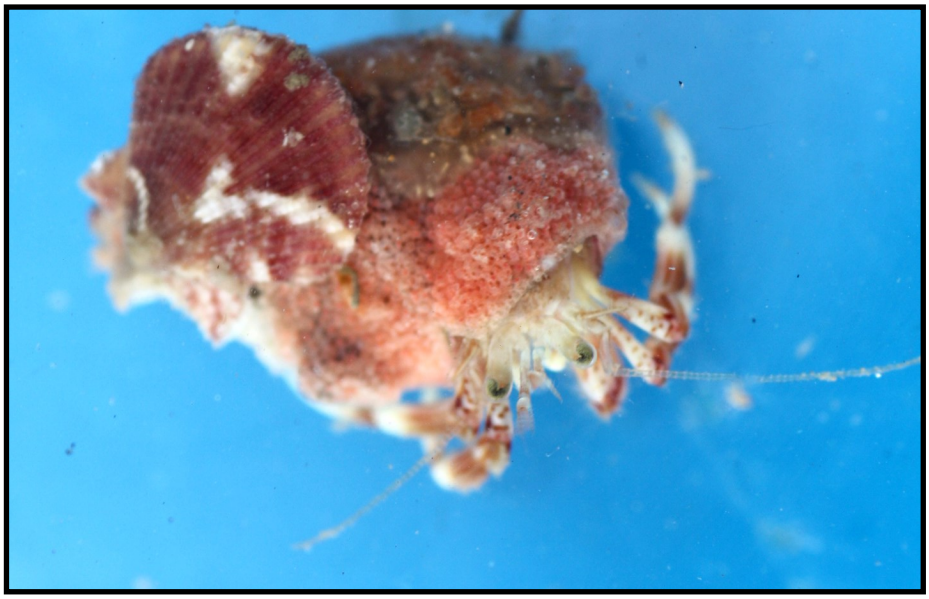
Sustainable Fisheries and Aquaculture Group

School of Ocean Sciences

Annual Report for 2018
(Report No. 4)

Isle of Man Fisheries Science

Sustainable Fisheries and Aquaculture Group
Bangor University



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Isle of Man Government
Reiltys Ellan Vannin

Review of 2018 by Professor Stuart Jenkins

Stuart Jenkins is a Professor of Marine Ecology at the School of Ocean Sciences, Bangor University and is the academic and scientific lead for the Isle of Man.

It was with great pleasure when, in 2018, I took over the Bangor University contract providing fisheries science advice to the Isle of Man Government following the move of Professor Mike Kaiser out of academia to work at the Marine Stewardship Council. Mike has provided exemplary leadership of the project over the past 11 years. He, and Bangor scientists based on the island, have worked closely with the fishing industry and DEFA to maximise the ability of the Isle of Man to maintain sustainable fisheries. Moving forward I see my role as providing support to Dr Isobel Bloor and Jack Emmerson as they continue to implement the program of research and science advice in scallop and static gear fisheries. In addition, I aim to increase access to a wide range of fisheries scientists at the School of Ocean Sciences. In this regard, it is positive to see the recent EMFF funded project at Bangor providing fisheries science input on Welsh fisheries. There is much to be gained from the synergy between fisheries research in the Isle of Man and along the Welsh coastline, providing a much greater Irish Sea perspective.

Looking back at 2018, we continue to conduct our annual spring scallop survey which provides critical data to inform our stock assessments. The efficiency and selectivity of dredge gear used in surveys is always a critical issue and we continue to explore ways in which we can have increased confidence of stock size, whilst recognising the value in maintaining a consistent approach over time. This year, for the first time, we complemented the scallop survey with a laser scanning trial to assess the potential for non-destructive scallop stock assessment using a laser scanning array. Our stock assessments and our engagement with the Scallop Management Board are critical at a time when stocks of both target species are vulnerable. The work we have done over previous years, in developing enhanced methods for both data input from the fishery and rapid weekly delivery of current fishery status, allows informed decisions to be made. Isobel continues to provide significant input at an Irish Sea scale, and beyond, through her engagement with the ICES Working Group on Scallop Stock Assessment which in 2019 will be hosted in the Isle of Man.

Over recent years we have increased our activity in the potting sector. In 2018 this work has provided important insight into variable whelk growth at an Irish Sea scale and the first delivery to participants of fisher collected data from pot logging devices. This exciting development using a sentinel fleet around the island has shown that we can collect geo-referenced industry catch per unit effort data combined with environmental information in Manx static gear fisheries. This has the potential to inform on efficient gear use, assist in sustainable management of these increasingly important marine resources as well as give fundamental insight in to whelk, crab and lobster biology.

Finally, looking ahead, we will continue working closely with industry during 2019 and we thank all those who have shared their time and provided input to our work. It would be great to see many of you at the Manx Fishing Conference on June 24th 2019.

Stuart Jenkins

Table of Contents

Annual Spring Scallop Survey (4th—17th April 2018)

The 2018 stock assessment survey was undertaken using the RV Prince Madog over 14 days from 4th—17th April 2018. Despite adverse weather conditions, sufficient survey time was available to sample 47 survey stations around the Isle of Man, using scientific dredges (four survey dredges positioned King, Queen, King, Queen with dredge cameras attached to the tow bar). In addition, trial work to test laser scanning technology for use in scallop surveys was undertaken with Sonardyne International and 2G Robotics (pg. 2).

The footage from the dredge cameras was the highest quality obtained to date following the addition of an LED bar light to the set up. This footage continues to be useful to check the validity of tows (i.e. dredges are fishing and are in contact with the seabed) and to obtain additional information on the seabed habitat and scallop densities. These videos will be analysed in further detail to assess dredge contact time with the seabed within different habitat types.

Scallop densities on the west coast of the Island were substantially reduced relative to previous years' catches for both king and queen scallops. The highest density was obtained at Station 6 which is located within a closed area (Figure 1).

A total of 6 scientists from Bangor University took part in the survey (Figure 2). We would like to thank all the scientific staff and research vessel crew for their time and assistance during the survey.

Figure 1. The Spat were collected at Station 6, which is inside a temporary closed area on the west coast of the Island established to protect high densities of juvenile queen scallops. The spat was attached to hydroids and bryozoans. The tow inside the closed area had the highest density and showed the only signs of new recruitment to the Targets fishing ground, which has been subject to intense fishing pressure in recent years.

Figure 2. Volunteer scientists separating the catch from a 20 minute tow on the south coast. The catch from each dredge was placed into labelled fish baskets and then sorted by king scallops, queen scallops and bycatch.

Laser Scanning Trial

A laser scanning trial was undertaken during the 2018 survey (pg. 1) with 2G Robotics and Sonardyne International. The aim of the trial was to determine whether this type of technology could be used in the future to undertake non-destructive scallop stock assessment surveys of abundance and biomass. The trial was undertaken on 14th April 2018 in the Ramsey Bay Fisheries Management Zone. The laser scanning array was towed at > 2 knots and positioned 5 m above the seabed using data from an altimeter fitted on the array and fine-tuned using the winch and retrieval cables (Figure 3). The laser scanning array pinged every 30 seconds to create an accuracy of 3 mm. The trials were successful, and a processed image of a king scallop identified during the tow is shown in Figure 4. Future trials comparing laser scanning and dredges as survey methods would be useful to assess the practical validity of using this non-destructive method for scientific scallop surveying.

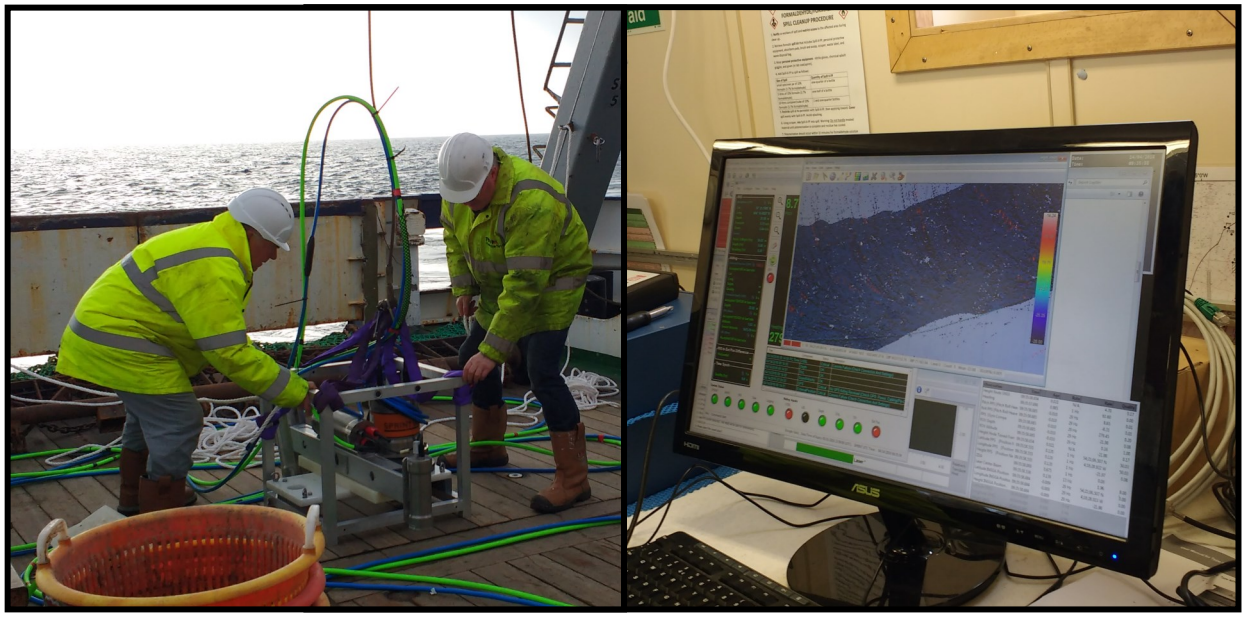

Figure 3. Left: Laser scanner set up on frame for deployment; Right: Laser scanning tracks recording in real time.

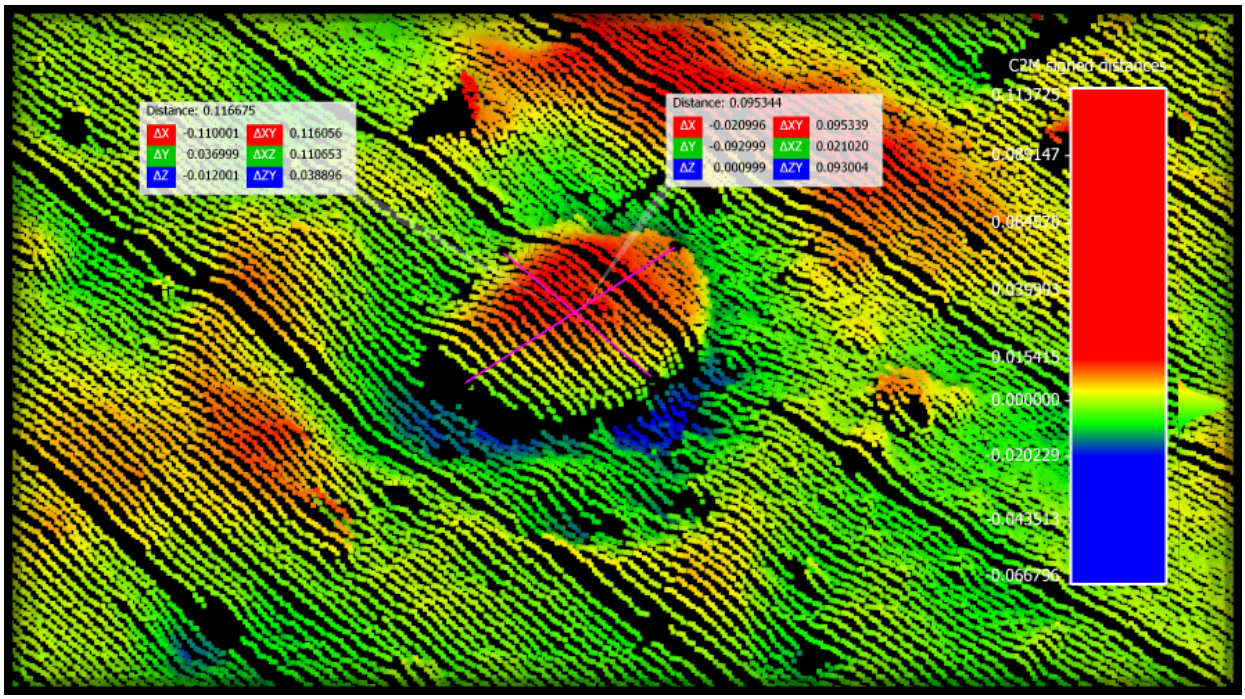

Figure 4. Processed data from the laser scanning trial showing a king scallop identified on the seabed with size measurements displayed (image courtesy of Alon Sella).

King Scallop Fishery Update (2017/2018)

The total allowable catch (TAC) for the 2017/2018 Isle of Man king scallop fishery was 3203 tonnes (t). This represented a 20% reduction in the quota following a decline in the survey abundance index in 2017. Total reported landings for the Isle of Man king scallop fishery during the 2017/2018 season were ~ 3009 t with 85 unique vessels reporting landings. Figure 5 shows the cumulative landings for the king scallop fishery by fished month (with totals for individual fished months marked by the points).

'Soft' monthly targets were introduced as guides to aid management of the fishery and to monitor the uptake rate of the TAC over the season (Table 1). Thus if a soft target was either exceeded or not achieved in a given month this provided a cue to the Scallop Management Board (SMB) to discuss whether current daily catch limits remained appropriate. The soft targets were calculated by allocating the TAC proportionally among months based on historical landings patterns (averaged from 2012/2013 season to the 2015/2016 season; the 2016/2017 fishing season was excluded from the analysis on request of the SMB due to exceptional landings in November 2016). Initial landings in November and December were above the proportional average landings for those month in previous years and the daily catch limit was reduced from 1050 kg to 700 kg on 24th Nov 2017. Subsequent months however saw below proportional average landings (i.e. Jan, Feb, Mar, Apr) and total landings for the season were around 5 % less than the TAC.

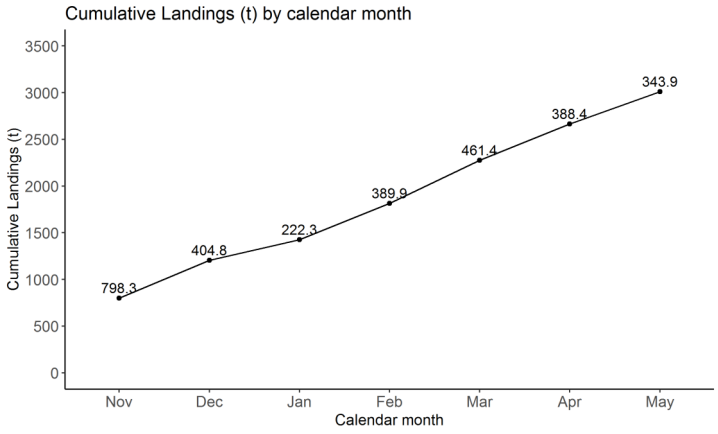

Figure 5. Cumulative landings (t) over the 2017/2018 king scallop fishing season in the Isle of Man. Points indicate monthly totals.

Table 1. Soft monthly targets (t) based on average landings from previous seasons compared to actual landings per month (t). Proportion indicates the percentage of the soft target achieved within each month.

Month	Soft Target	Landings	Proportion
Nov-17	749.2	798.3	107
Dec-17	309.1	404.8	131
Jan-18	328.9	222.3	68
Feb-18	524.6	389.9	74
Mar-18	544.2	461.4	85
Apr-18	443.6	388.4	88
May-18	303	343.9	113
Total	3202.6	3009	94

Landings per unit effort (LPUE) has been standardized to kg per hour fished per dredge. Figure 6 illustrates the mean LPUE by week at each of the main fishing grounds (note the different scales on the Y-axes). LPUE was highest at the limited permit only fishery that occurs in December within the Fisheries Management Zone of Ramsey Bay (*N.B.* a commercial survey also took place in Ramsey Bay in Week 25). Depletion across the season was evident at most of the main fished grounds.

In Figure 7, landings are reported by main fished ground and separated by colour for each month to show the spatial location of landings. There was a relatively even split of landings across the season from the four main fishing grounds (IS9: Targets, IS21: Chickens, IS15: East Douglas and IS14:Bradda/Port St Mary). This is in contrast to the previous couple of seasons where landings at a single main fishing ground have dominated (i.e. IS9 Targets—2016/2017).

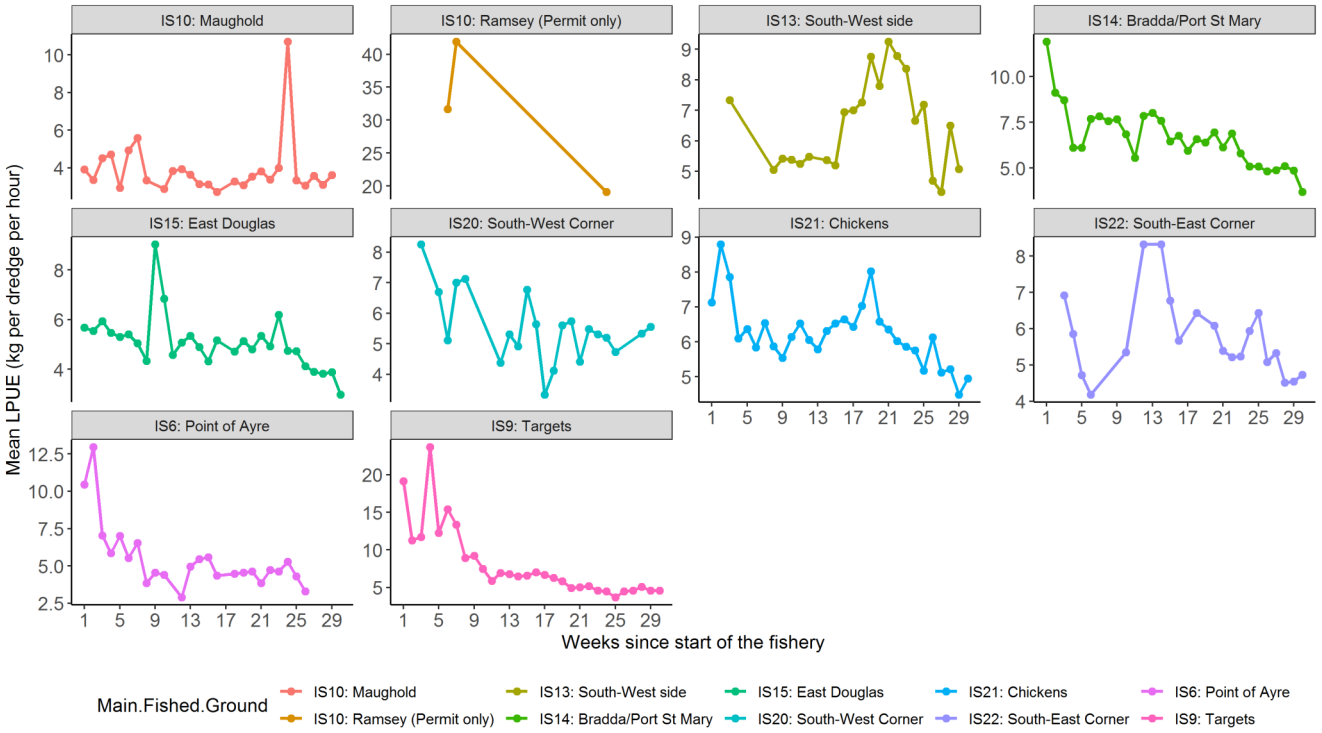

Figure 6. LPUE (kg per dredge per hour fished) for the 2017/2018 king scallop fishing season averaged by week and displayed by main fished ground. ***Note the different scales on the Y-axis.***

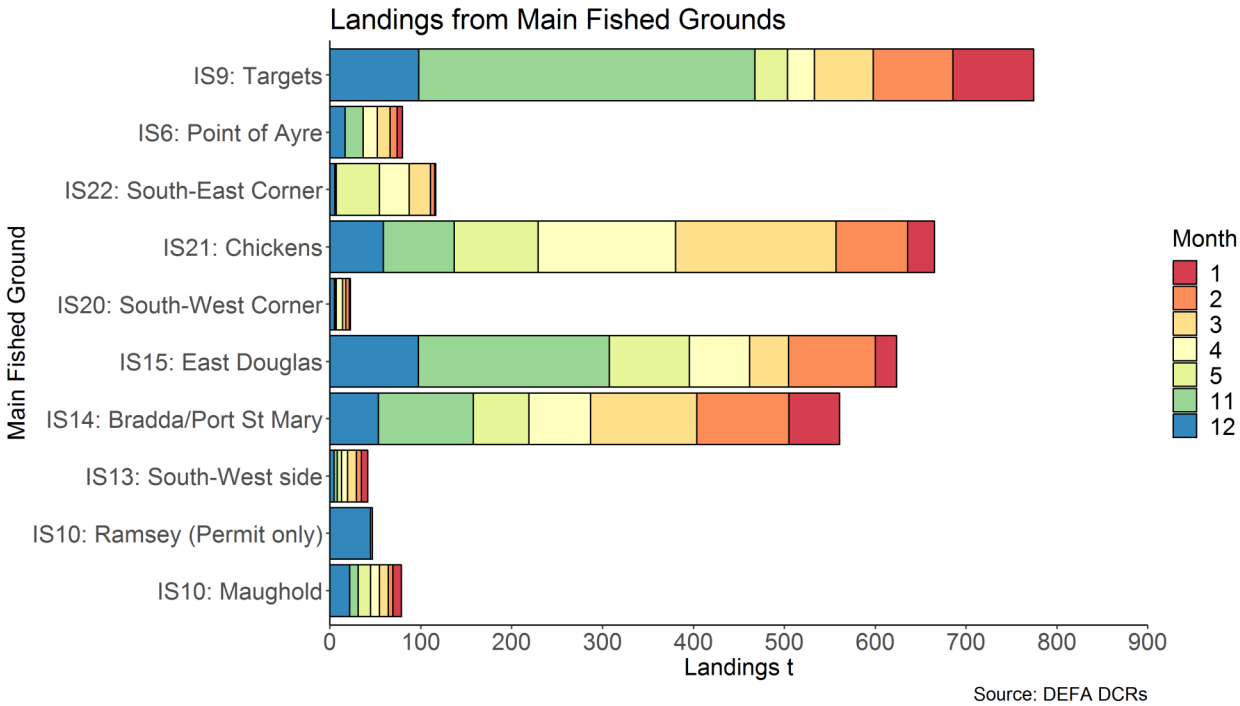

Figure 7. Total landings (t) of king scallops by month from the 10 main fished grounds.

Electronic monitoring via Nestforms Apps was introduced for the king scallop fishery for the first time during the 2017/2018 fishing season. This reporting mechanism has significantly improved the rate and resolution at which monitoring and analysis of commercial data for this fishery can be produced. As a result, DEFA and the SMB can receive data and analysis from the fishery in near real-time enabling flexible management responses (i.e. changes in bag limits, quotas etc.).

King Scallop Stock Assessment Update

There continues to be a general decline in the scientific survey abundance index since 2015 for recruits (scallops <110 m) and since 2016 for post-recruits (scallops > 110 mm), although there was a small increase in the recruit index in 2018 (Figure 8). The commercial catch (ICES Rectangles 36E5, 37E5 and 38E5) also decreased from 5714 t in 2016 to 3515 t in 2017,. This decrease follows the introduction of a total allowable catch (TAC) within the Isle of Man's territorial sea (Figure 9). The stock assessment, which was calculated using the a4a/FLR age-based stock assessment approach, also estimated a significant decline in biomass between 2016 and 2017 (Bloor et al., 2018).

The Scallop Management Board (SMB) has adopted the ICES framework for category 3 data limited stocks (ICES, 2012) to calculate annual changes to the TAC. This approach uses the scientific survey abundance index as an index of stock development to tune the TAC for each year. This method compares a ratio of the latest two index values (index A; i.e. 2017 and 2018) to the three preceding index values (index B; i.e. 2014, 2015 and 2016). This ratio is then multiplied by the TAC from the previous year to provide an adjusted TAC for the current year. Survey indices are assumed to contain noise and so changes of the TAC using the ratio are capped by +/- 20 % in a single year. Thus, although the scientific abundance index is estimated to have decreased by ~ 46%, the reduction in the TAC was capped at 20% relative to the year prior (i.e. 3203 t reduced to 2562 t).

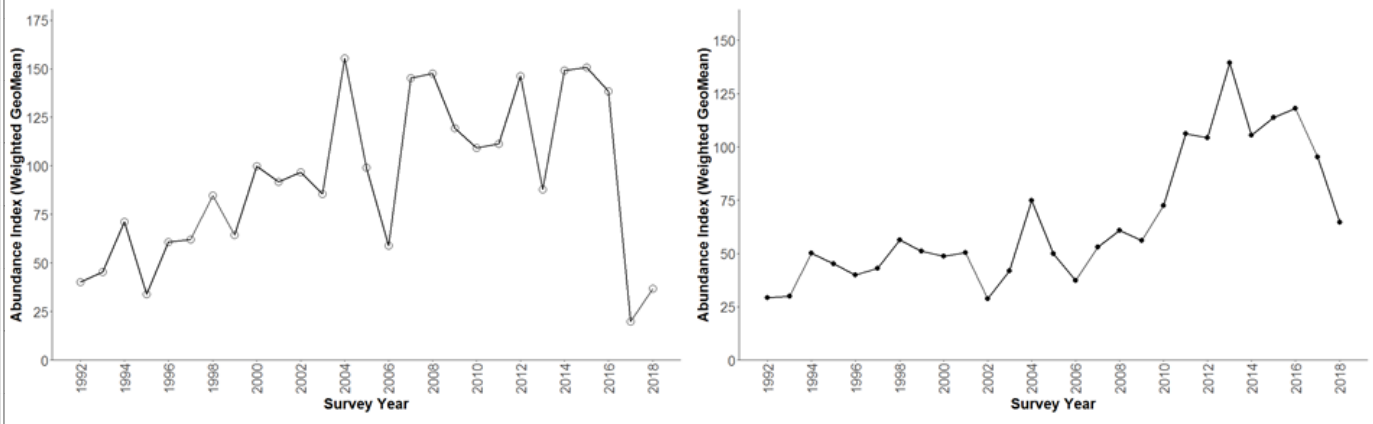

Figure 8. King scallops in ICES Rectangles 36E5, 37E5 and 38E5. Left: Recruit abundance index from survey; ; Right: Post-recruit abundance index from survey.

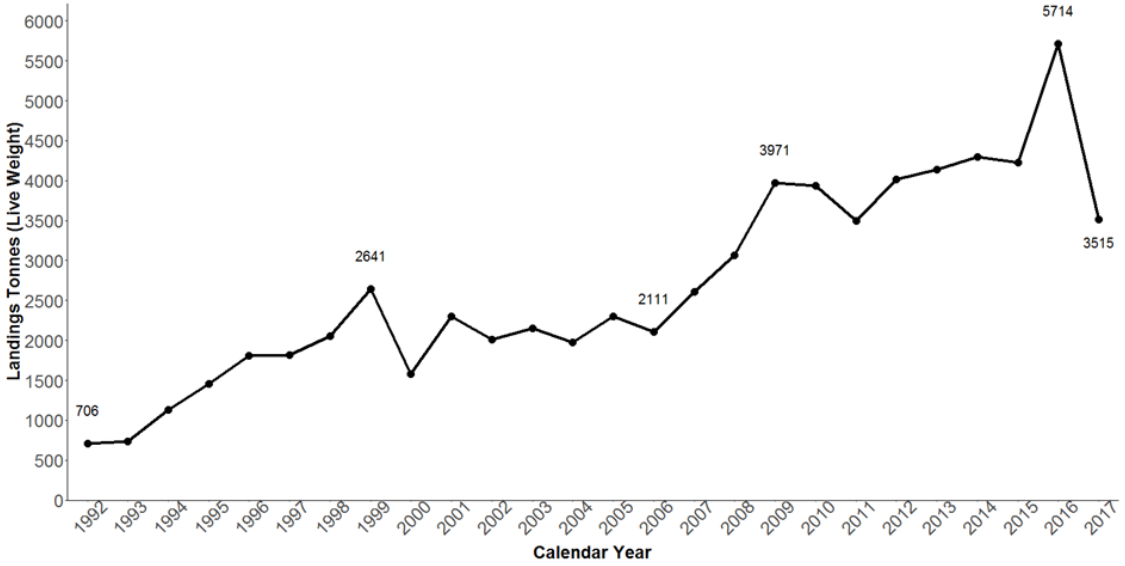

Figure 9. Landings of king scallops from ICES Rectangles 36E5, 37E5 and 38E5 by calendar year (i.e. 1st January to 31st December).

The stock status relative to candidate reference points is unknown. Since there is evidence of recruitment impairment and high fishing mortality (F), it was advised that an additional precautionary buffer (i.e. an additional 20% reduction in the TAC) was applied to safeguard against significant biomass declines (i.e. 3203 t reduced to 2050 t) (Table 2).

Table 2. TAC calculation: The Index Ratio is a ratio of Index A divided by Index B and the previous year's TAC is then adjusted up or down in line with the Index Ratio. As survey indices can contain a level of noise within the data an Uncertainty Cap (which caps inter-annual changes to the TAC at +/- 20%) (ICES, 2012). Where there is uncertainty due to a deficiency of information a 'Precautionary Buffer' of a further 20% reduction in the TAC is advised. ***For Scenario I: TAC for 2017/2018 x Uncertainty Cap; **For Scenario II: (TAC for 2017/2018 x Uncertainty Cap) x Precautionary Buffer.***

	I	II
Index A (2017 - 2018)	135	135
Index B (2014 - 2016)	304	304
Index Ratio (A/B)	0.44	0.44
Uncertainty Cap	20%	20%
TAC from 2017/2018 season	3203	3203
Discard rate	-	-
Precautionary buffer	NA	20%
Catch advice for 2018/2019**	2562	2050

Summary of scientific advice

- A TAC for the 2018/2019 Isle of Man's king scallop fishery was defined on the basis of ICES protocol for Category 3 stocks (Method 3.2) .
- Method 3.2 outlined by ICES compares the values from the two most recent years of the abundance index with the values from the three preceding years. The TAC is then adjusted by the percentage difference of these two values (46% reduction calculated from survey abundance index) taking into account the 20% uncertainty cap. As there is evidence of recruitment impairment and high fishing mortality (F) an additional 20% precautionary buffer should also be applied.
- Based on Method 3.2, the provisional catch advice for 2018/2019 king scallop fishery within the territorial sea is 2050 t (precautionary buffer applied).
- Should the TAC be adopted without the application of the precautionary buffer it is recommended that a review of the fishery is undertaken following the first month of the season with the option to revisit the application of the precautionary buffer.
- The ICES protocol for Category 3 stocks is a data poor method and as such it is advised that in future a biomass linked TAC based on the outputs of the quantitative age-based stock assessment, rather that a survey abundance index, would be more robust.
- The Irish Sea king scallop fishery should be managed at the appropriate spatial scale. Unpublished genetic and oceanographic research indicates that the northern Irish Sea may be the most appropriate management unit for the fishery surrounding the Isle of Man. It is therefore vital that work continues towards achieving a collaborative management approach for king scallop stocks within the different regions of the Irish Sea.

Report: Bloor, I.S.M. (2018). Isle of Man king scallop (*Pecten maximus*) stock advice. Bangor University Report No, 73.

Queen Scallop Trawl Fishery Update (2018)

The quota for the 2018 Isle of Man queen scallop fishery was 794 t. This represented a 20% reduction in the quota following a decline in the survey abundance index. The quota was subdivided into 697 t for the trawl fishery and 97 t for the dredge fishery (based on the number of vessels in each métier). An allocation of 25 t from the trawl fishery quota was ring fenced for the Ramsey Bay permit only fishery. Total reported landings for the trawl fishery during the 2018 season were ~ 659.39 t with 30 unique vessels reporting landings. Figure 10 shows the cumulative landings (t) for the queen scallop trawl fishery by fished month (with totals for individual fished months marked by the points). Figure 11 shows the spatial distribution of landings within the fishery. There was a relatively even split of landings within the four main fished grounds (IS9: Targets, IS6 Point of Ayre, IS21: Chickens, IS15: East Douglas) than in previous years when landings have predominated from a single ground (i.e. IS9 Targets in 2017).

Landings per unit effort (LPUE) was standardised to 35 kg bags per hour fished per 10 fathom net. Figure 12 shows the mean LPUE by week at each of the main fishing grounds. The fishery on the west coast in IS9 occurred in a small ground at the very western edge of the 12 nm limit. LPUE varied between a maximum of 13.3 bags per hour and a minimum of 0.9 bags per hour in the open fished areas. LPUE was highest in the limited permit only fishery in the Ramsey Bay Fisheries Management Zone (~ 14.3 bags.p.h).

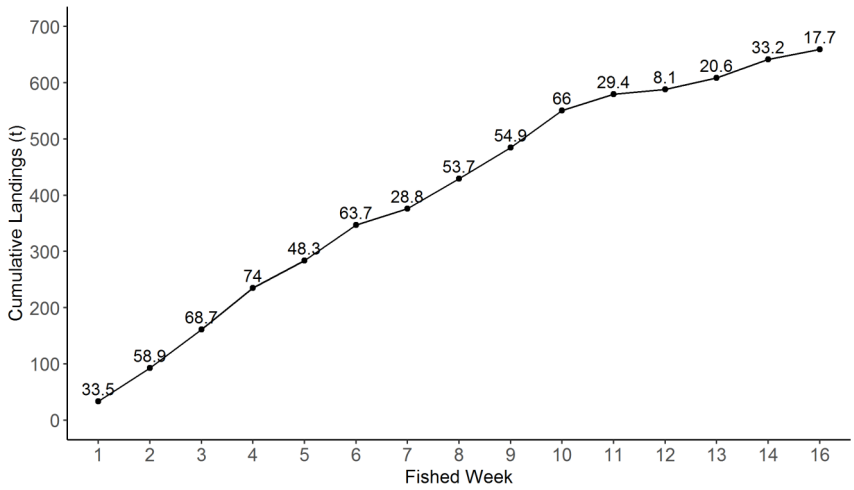

Figure 10. Queen scallop trawl fishery cumulative landings (t) and landings by week (t).

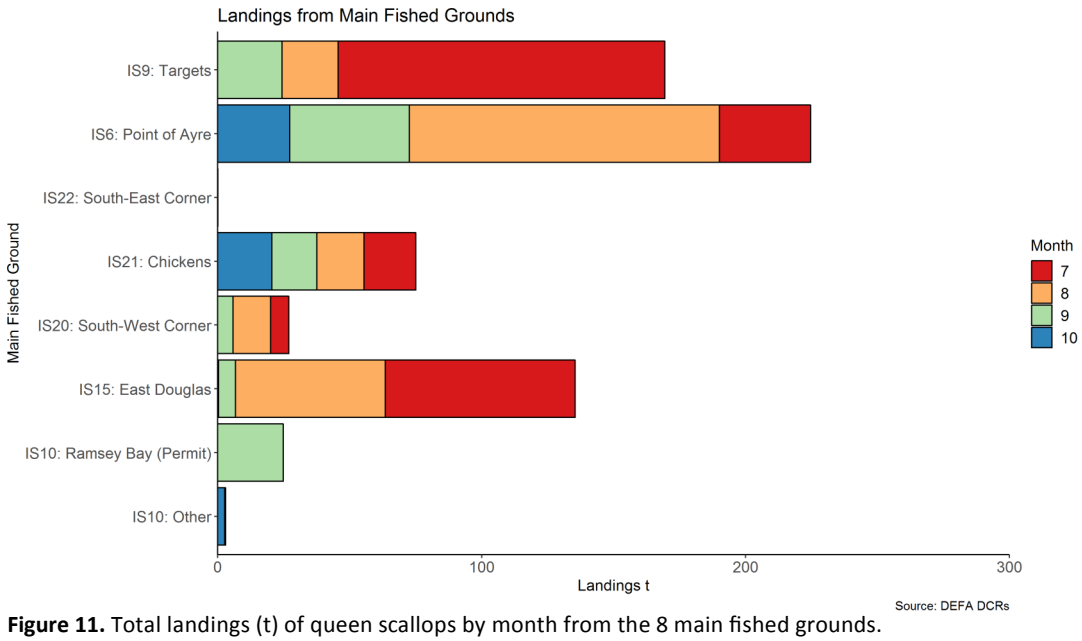

Figure 11. Total landings (t) of queen scallops by month from the 8 main fished grounds.

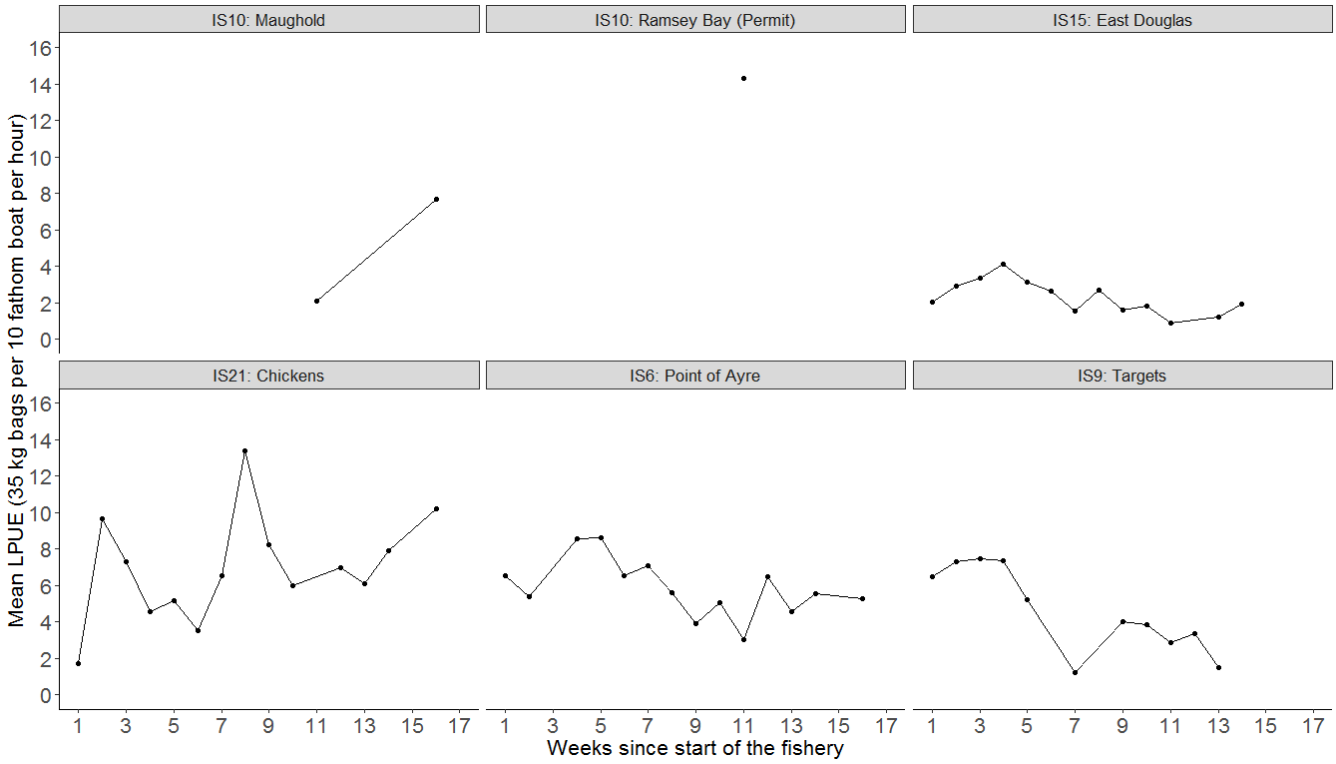

Figure 12. Mean LPUE (35 kg bags per hour fished per 10 fathom net) by week for each of the main IS Boxes.

Queen Scallop Dredge Fishery Update (2018)

The quota for the 2018 Isle of Man queen scallop dredge fishery was 97 t. This represented a 20% reduction in the quota following a decline in the survey abundance index. Total reported landings for the 2018 dredge fishery season are ~ 62.63 t with 5 unique vessels reporting landings (data correct as of 15th March 2019; however this fishery remains open until 31st March 2019). Figure 13 shows the cumulative landings (t) for the queen scallop dredge fishery by fished day (with totals for individual fished days marked by the points).

Landings per unit effort (LPUE) was standardised to kg per dredge per hour fished and averaged 34 and 27 kg per dredge per fished hour in Week 1 and 2 respectively.

Management of the dredge fishery differed during the 2018 fishing season, with each vessel being allocated an individual quota that could be fished as and when suited by the vessel.

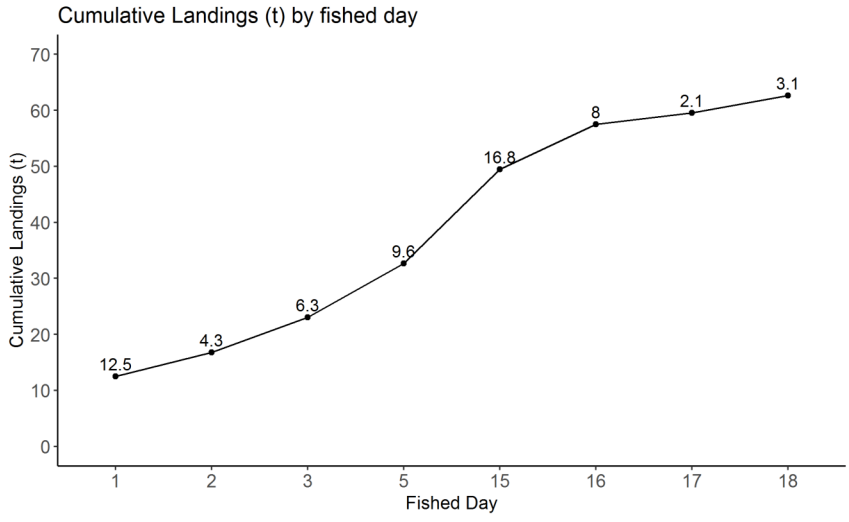

Figure 13. Queen scallop dredge fishery cumulative landings (t) and landings by fished day (t).

Queen Scallop Stock Assessment Update

2017 Fishery

In total, 42 of the 46 licenced vessels took part in the queen scallop fishery in the territorial sea from July to October 2017, landing a total of 992 t (Trawl: 35 vessels; Dredge: 7 vessels). Landings from outside the territorial sea added a further 2095 t to the total landings of the wider stock unit (ICES Statistical Rectangles 36, 37 & 38 E5) for the 2017 fishery (1st January—31st December 2017). The fishery inside the territorial sea was regulated with restricted licences, curfews and weekly bag limits and uptake was monitored with paper daily catch returns and VMS polling at 15 minute intervals.

For the 2017 fishing season two closed areas were created: the East of Douglas Experimental Research Area which was established to investigate habitat recovery over a minimum 3 year period and which remains closed, and Chickens Closed Area (CHI) which was located on the advice of industry and was then opened ahead of the 2017/2018 king scallop fishing season (Figure 14; closures in red).

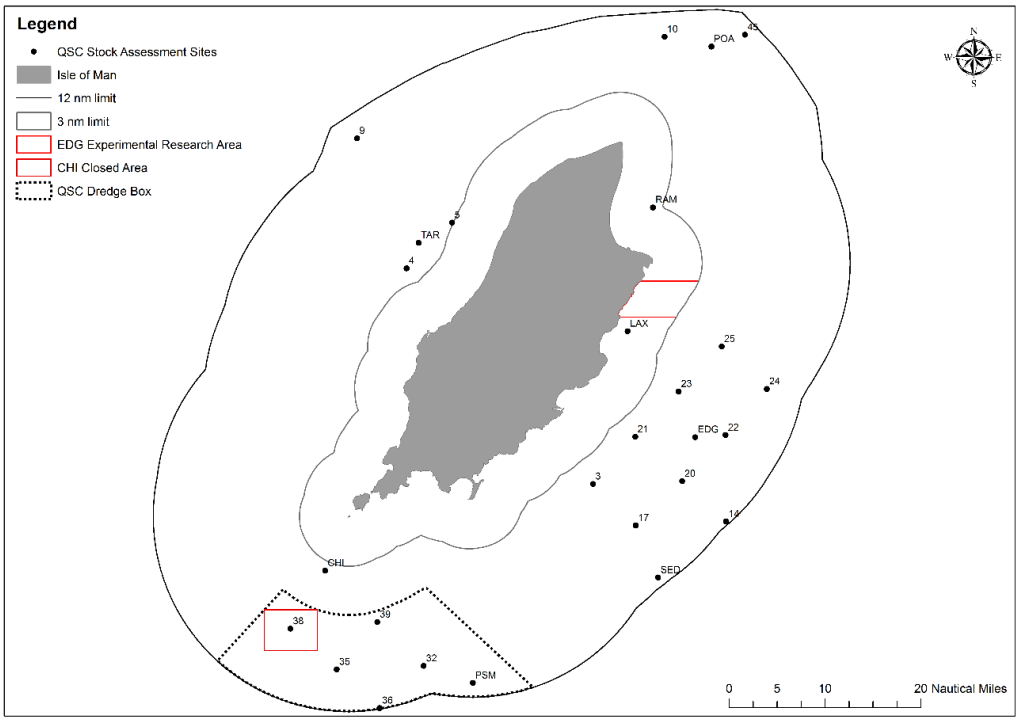

Figure 14. Surveyed stations included in the 2018 queen scallop stock assessment.

2018 Stock Assessment

The 2018 stock assessment was conducted using CSA V.3.1.1 and CSA V.4.3 models and included Stations 3, 4, 5, 9, 10, 14, 17, 20, 21, 22, 23, 24, 25, 32, 35, 36, 38, 39 and 45 and historical stations (CHI, EDG, LAX, POA, PSM, RAM, SED and TAR) (Figure 14). For the stock assessment unit (Isle of Man territorial sea):

- Landings had decreased from **1,240 t** in 2016 to **992 t** in 2017 (this decrease was also evident within 36E5 & 37E5) (Figure 15a).
- Median estimated biomass had fallen from **2759 t** for the 2017 fishing season (80% confidence intervals of 1970 t and 3971 t) to **1701 t** for the 2018 fishing season (80% confidence intervals of 1032 t and 2677 t) (Figure 15b).

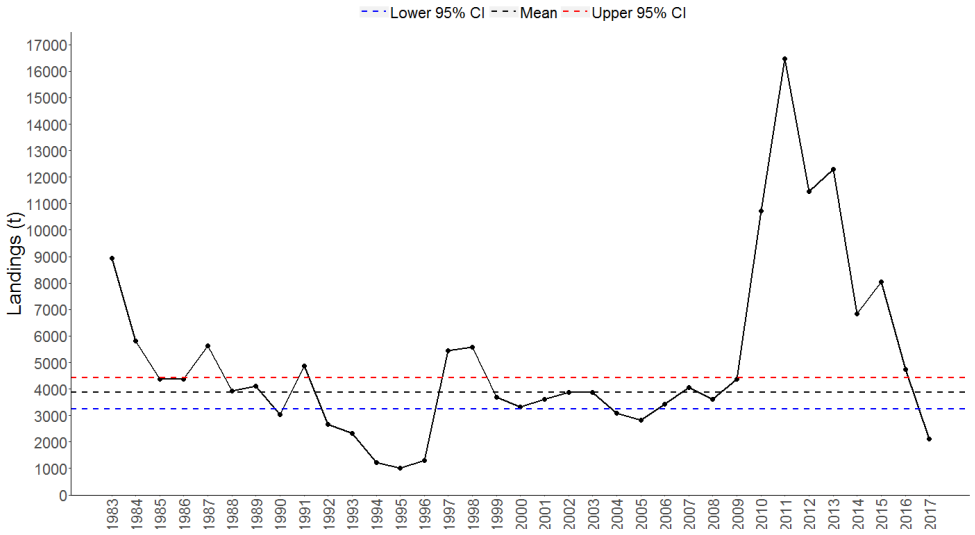

Figure 15a. Summary of estimated total landings (t) from ICES Rectangles 36E5 and 37E5 to the UK and Isle of Man

Figure 15b. Estimated biomass for territorial sea as estimated from the length based stock assessment using CSA. Dotted lines show 10% and 90% confidence intervals. *N.B. in order to focus on the general data trends rather than exact biomass values the scale has been removed from the y-axis.*

Advice for 2018

Estimated biomass for the territorial sea remains low. Recent data from the fishery indicates that with estimated biomass removals of ~ 20% and over, biomass declined in each subsequent year, with insufficient recruitment to replace the losses from natural and fishing mortality combined. As such, while recruitment levels remain low, a precautionary approach should be adopted with biomass removals from fishing mortality limited to less than 20% of the total estimated biomass.

Estimated biomass for 2018 is down from 2017 (Figure 15). As such, there is no scientific evidence that the stock can support the TAC from 2017 (992 t). Furthermore, although the Scallop Management Board agreed in 2017 to the use of the ICES Category 3 data-limited approach for calculating TACs, a 20% reduction of the current TAC using this method still equates to a removal of ~ 47% of estimated stock biomass, which is over double the maximum scientific recommendation.

A Pan-Irish Sea management plan is still urgently needed to develop and implement measures to substantially reduce fishing mortality within the wider stock. Following concerns raised by industry, a three month statutory closure of the queen scallop fishery (Areas VIa and VIIa) was enacted for the 2018 fishery to protect the stock during the spawning period.

East of Douglas Experimental Research Area

An experimental research area (ERA) (Figure 16) was established off the east coast of the Isle of Man in July 2017 and has been closed to scallop fishing since that date. The position of the ERA, recommended by the Scallop Management Board (SMB), encompasses an area where the queen scallop stock had collapsed in 2013 and showed no signs of recovery prior to closure in 2017 (Figure 16). The purpose of the ERA is to test the effectiveness of artificial spat receptors, in the absence of fishing pressure, as a means of encouraging recruitment to depleted areas and increasing scallop densities.

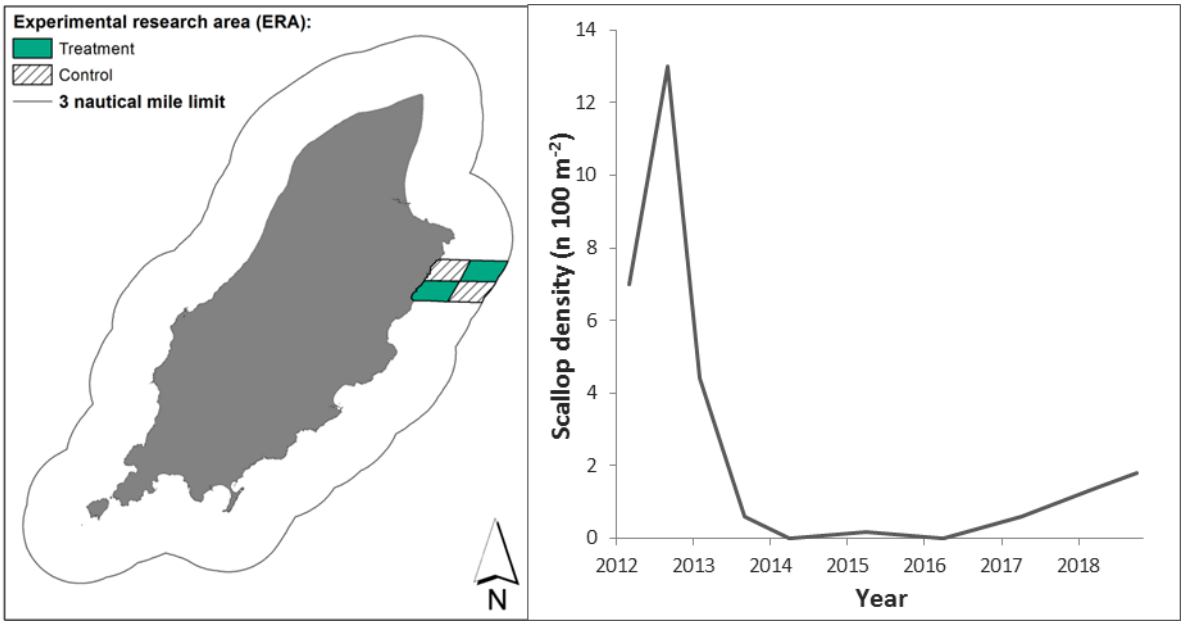

Figure 16. *Left: Map showing the location and survey design of the ERA; Right: Historical dredged queen scallop densities recorded at an annual stock assessment station (Station 29) within the ERA.*

Since the creation of the ERA, a series of initial surveys have been completed and a report published assessing the baseline status of the area before spat settlement structures are deployed, including data on scallop densities, scallop size and age distributions, bycatch community structure, and seabed sediment types (Garratt et al., 2018). This information is key in formulating a suitable strategy for deploying spat receptors in the area, expected to take place in spring 2019, and in quantifying any changes/improvements following deployment. A further aim of the baseline surveys was to determine whether there were any unforeseen differences between the proposed treatment and control areas (Figure 16) for testing artificial spat receptors, with the checkerboard design reducing the potential for confounding differences.

Beam trawl surveys:

Firstly, two comparable beam trawl baseline surveys were completed in October 2017 and October 2018, with the aim of sampling queen scallops and other epifaunal species (bycatch) and determining whether there had been any initial changes in the area over one year of closure. The average density of queen scallops in the ERA displayed a slight increase from 1.4 per 100 m^2 in 2017 to 1.7 per 100 m^2 in 2018, although this change was not significant, and no significant differences were found in the densities between “treatment” and “control” areas. However, the size structure of the queen scallop stock in the area significantly changed from 2017 to 2018, with a much higher proportion of larger individuals being found after one year of growth without fishing pressure (Figure 17).

The larger size cohort made up 44% of the total catch in 2017 compared to 88% in 2018.

The structure of the epibenthic community, with regard to the total density, species richness and diversity of bycatch, was not significantly different between the 2017 and 2018 surveys, nor between the "treatment" and "control" areas.

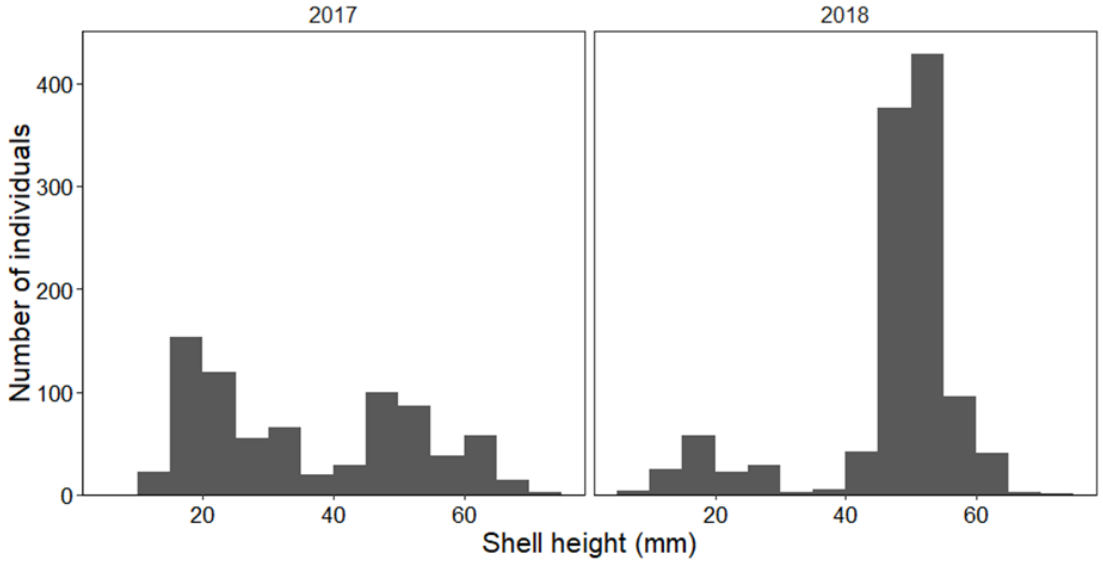

Figure 17. *Size frequency distributions of all queen scallops found in beam trawl catches during the 2017 and 2018 baseline*

Dredge survey:

Although beam trawling has a much higher sampling efficiency for queen scallops, dredging is required to catch king scallops, and therefore a dredge survey was completed in the ERA in October 2018 to account for king scallop density, size and age. The average density of king scallops in the ERA was 0.3 per 100 m^2 , with the population displaying two cohorts with median shell widths of 90 mm and 125 mm and ages of 2^+ and 5^+. The average queen scallop density, although low in comparison to trawling, was higher than has been found in dredge stock assessments since 2013 (Figure 16). The densities of king and queen scallops were not significantly different between "treatment" and "control" areas.

Drop-down camera survey:

A drop-down camera survey, also completed in October 2018, was undertaken in order to account for seabed sediment, a key determinant of scallop recruitment. Footage of the seabed (photos and videos) were taken at 10 randomly selected locations in the ERA which had been sampled during the 2018 beam trawl survey, so that the recent queen scallop data could be compared against seabed sediment type. Scallop density was on average twice as high in gravelly areas as sandy areas. This difference was not statistically significant due to the large variability in catches. Further footage is required to gain a more complete understanding of the distribution of sediment types in the ERA and its effect on scallop densities.

Future work:

The next phase of this research will involve the deployment of three different types of benthic settlement structures within the ERA. The aim of these structures is to try and artificially increase the quantity of suitable structures available for spat settlement thereby potentially improving recruitment of king and queen scallops within the ERA. Traditional spat collectors will also be deployed to monitor natural spat availability.

Ramsey Bay Fisheries Management Zone (FMZ) Survey

The 2018 Ramsey Bay survey was undertaken by F.V. Our Sarah Jane and F.V. Benolas in April 2018. A total of 16 grid squares were surveyed with 2 tows by each vessel in each grid square (64 tows). Tows were 10 minutes in duration and undertaken at 2.5 knots. The gear configuration was 4 survey dredges towed on the Port side in the arrangement King, Queen, Queen, King (dredge configuration was the same as in the 2017 survey). In addition, 4 commercial king scallop dredges were towed on the Starboard side. To keep the analysis constant between 2017 and 2018 only the 4 survey dredges have been included in this analysis. Future discussions on how to use the commercial dredges as an additional index should be made before the next fishery.

The Garden Area (A3, A4, A5, B3, B4, B5) was fished during both the December 2016 and 2017 fisheries. In the April 2018 survey all six of these grid squares were surveyed with two tows by each vessel in each square. The Fished Box (B7, B8, B9, B10, C7, C8, C9 C10, C7 & D8) was fished during the first three years of the Ramsey Bay December king scallop fishery (2013, 2014 & 2015) but only the top three squares (B7, C7 and D7) were fished during 2016. In the December 2017 fishery all ten grid squares were again open to fishing. All ten grid squares were surveyed during April 2018 with two tows by each vessel in each square.

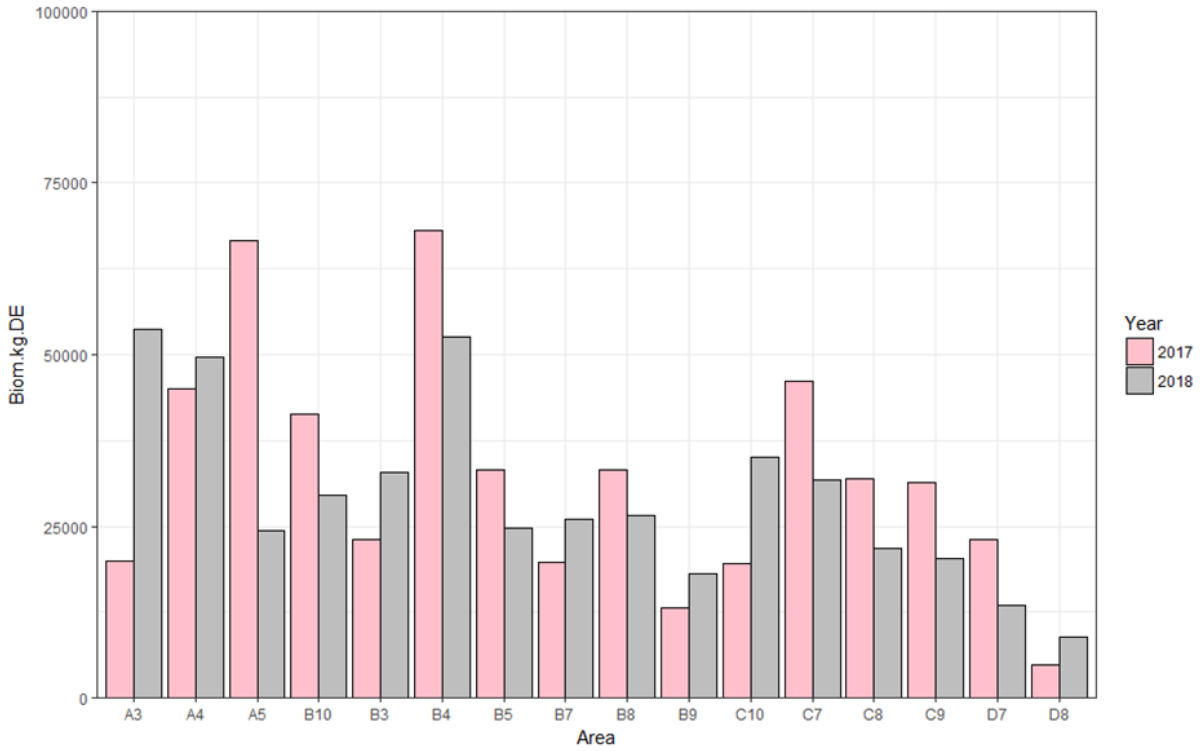

Figure 18. Estimated total biomass (corrected for 31% dredge efficiency) per grid square for 2017 (pink) and 2018 (grey). The biomass estimate for each grid square was averaged across vessels and tows. All grid squares were fished between the 2017 and 2018 fisheries.

Overall there has been approximately a 10 % decrease in the biomass calculated across both fished areas (Garden and Fished area) between the 2017 and 2018 surveys.

Garden Area (North) estimated biomass (Biom.kg.DE) for 2017 was 256.04 tonnes and for 2018 was 238.28 tonnes (decrease 17.76 t).

Fished Area (South) estimated biomass (Biom.kg.DE) for 2017 was 264.03 tonnes and for 2018 was 231.61 tonnes (decrease 32.42 t).

ICES Working Group Scallop Stock Assessment

The 2018 meeting of the ICES (International Council for the Exploration of the Sea) Working Group on Scallop Stock Assessment took place from 9th—12th October 2018 at the University of York, hosted by Dr Bryce Stewart. The overall objective of the group continues to be to provide scientific advice on scallops and defining a common approach to the assessment of scallop stocks. In 2018, for the first time fisheries independent surveys were used to assess all scallop stocks within the ICES area. The growing need for global assessment of stocks and advice on management of scallops is becoming increasingly apparent. The group plans to use the Baie Des Seines/English Channel and the Irish Sea/Isle of Man fisheries as case studies to explore possible management frameworks and to continue with the progress of assessments for all scallop stocks.

The 2018 Working Group was attended by 18 scallop scientists from 10 different countries, and was the last to be chaired by Professor Kevin Stokesbury (USA) following a six year period as chair. The incoming Chair Dr Lynda Blackadder (Scotland) will take over from 2019 onwards. The 2019 meeting will be held in the Isle of Man and hosted by Dr Isobel Bloor at DEFA.

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Scallop Research Priorities of Bangor University for 2019

- **2019 Spring Scallop Survey:**

⇒ 3rd —16th April 2019 survey

- **Queen Scallop fishery:**

⇒ Stock assessment (May 2019)
⇒ Plaice survivability trials (summer 2019 MSc Project)

- **King scallop stock assessment:**

⇒ September 2019

- **Commercial Market Sampling Schemes:**

⇒ Red & Blue bags

- **Economic/conservation assessment of the Ramsey Bay king scallop fishery:**

⇒ Manuscript submission for peer review publication

- **East of Douglas Experimental Research Area:**

⇒ Habitat mapping surveys continued (Spring 2019)
⇒ Field trials: Deploy artificial spat collectors and receptors (March 2019—December 2019)
⇒ Year 3 of baseline monitoring surveys (October 2019)

Potting Sector Fisheries: Crab, Lobster & Whelk

The potting sector of the fishing industry on the Isle of Man remains defined by three target species; crab (*Cancer pagurus*), lobster (*Homarus gammarus*) and whelk (*Buccinum undatum*). These three fisheries face separate challenges and gaps in scientific knowledge, but with some common themes. By collaborating closely with industry and DEFA, Bangor University is working to understand and address these challenges. Our work comes at a potentially pivotal period in static-gear fisheries research on the Isle of Man, as the economic significance of all three fisheries continues to grow. As markets in the far-east continue to expand, so does the economic opportunity for exporting live and processed crab and whelk. However, in order to maximize the long-term value of these fisheries, effective and evidence-based management needs to underpin them.

Whelk (*Buccinum undatum*) Fishery Update

The whelk fishery in the Isle of Man territorial sea is now the only such fishery in the British Isles that is:

- Accessed only by vessels with a species-specific licence;
- Restricted in terms of total number of pots per licences;
- Targets whelk with a biologically referenced minimum-landing-size (MLS);
- Is monitored closely in terms of landings per unit effort (LPUE).

In the years leading up to the public consultation in 2017, which effectively changed the Isle of Man territorial sea whelk resources from open-access to restrictive licensing, landings of whelk were increasing rapidly, peaking at over 700 tonnes in 2016. Since then, the fishery has stabilized (Figure 19).

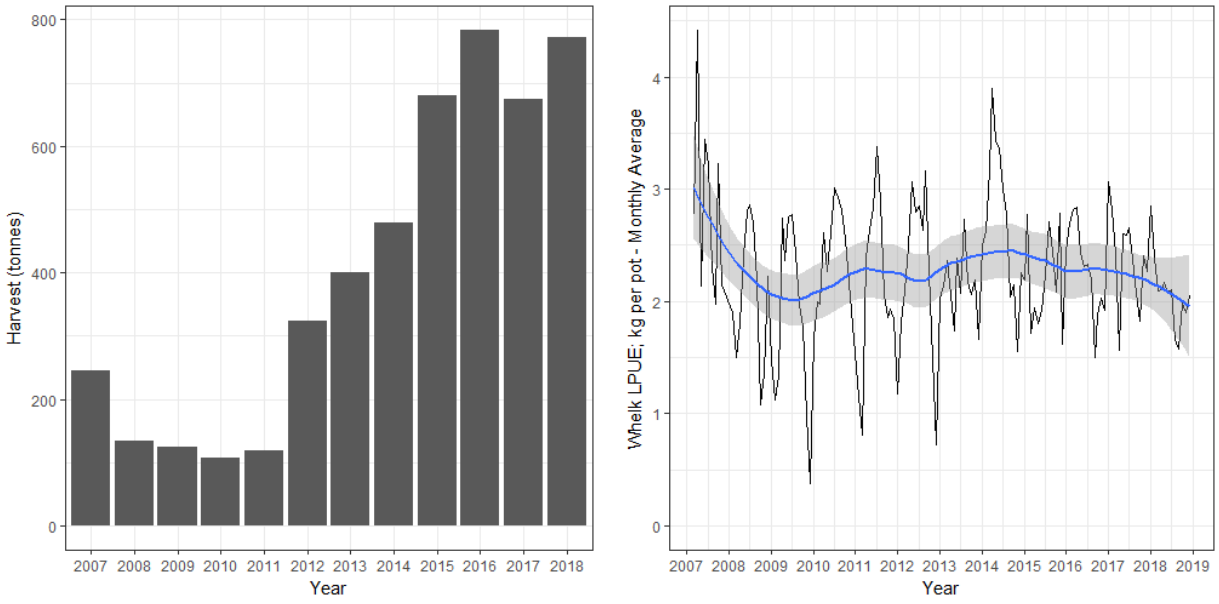

Figure 19. The harvest (left) and estimated landings-per-unit-effort (LPUE) (right) of the common whelk (*Buccinum undatum*) fishery in the Isle of Man territorial sea. Data extracted from the Monthly Shellfish Activity Logbook Database.

Whelk continued…

As the trends in Figure 19 suggest, the LPUE is stable but with significant variability within and between years, with an average typically in the region of 2 to 2.5 kg pot^{-1}. The data also shows that since the whelk fishery was reviewed, fishing effort (pot lifts) has continued to increase (Figure 20). Seasons are characterized by low winter LPUE, which recovers and increases by 50-60% during the spring and into summer (Figure 20). These catch rates reflect the biological patterns in reproduction and feeding in whelk populations.

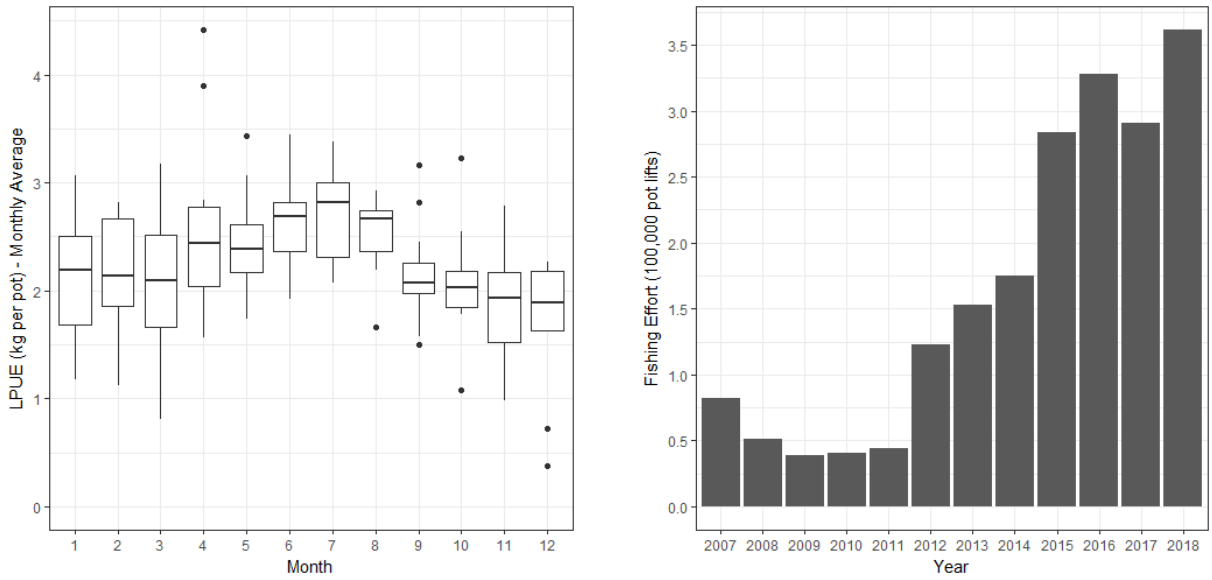

Figure 20. The landings-per-unit-effort (LPUE) variation by month 2007-2018 (left) and the total fishing effort (pot lifts) by year (right)

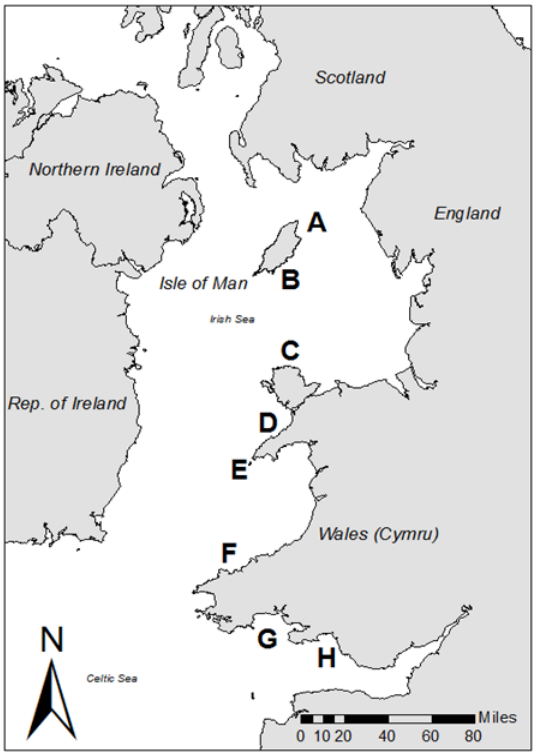

Figure 21. The sampling locations for whelk (*Buccinum undatum)* in the Irish Sea.

Size-at-Age (Statoliths)

In collaboration with colleagues in Wales, samples of whelk were collected and their statoliths (a calcareous structure inside the central nervous system) were extracted. Samples were collected along the full latitudinal range of Wales and the Isle of Man, from Swansea Bay to the Point of Ayre (Figure 21).

By analysing the growth rings in the statolith, the age at which whelk were sampled can be recorded. Furthermore, the size of the whelk shell can be estimated at each growth ring, meaning the growth rate of each individual whelk population can be modelled (Figure 22). The data are set to be published after peer review in the near future, showing a significant relationship between sea-bottom-temperature and maximum size of whelk growth (L_∞).

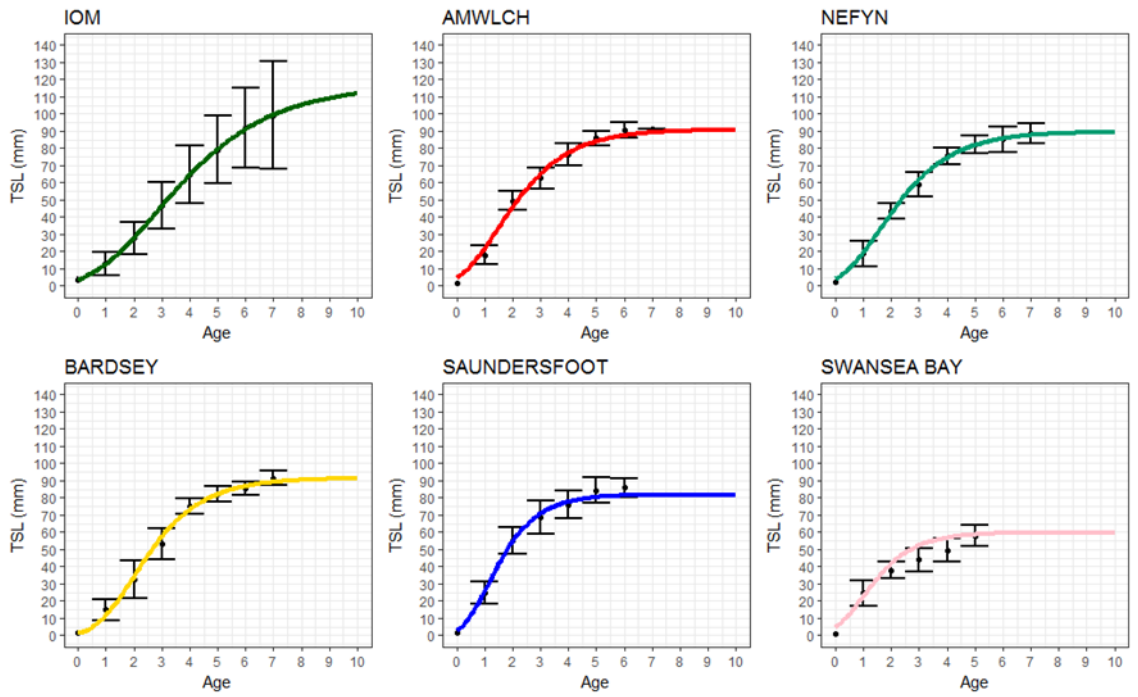

Figure 22. The modelled size-at-age relationship for whelk (*Buccinum undatum*) in various locations in the Irish Sea.

Edible Crab (*Cancer pagurus*) Fishery Update

The edible crab fishery in the Isle of Man territorial sea produces between 400 and 500 tonnes of crab annually (Figure 23). The fishery is characterized by clear intra-annual trends that are primarily temperature driven, with crab movement and feeding slowing significantly when sea-bottom temperature is outside the optimum range of 11°C to 15°C. The summer fishery can reach an average LPUE of up to 2.0 - 2.5 kg pot^{-1} and the catch data from summer 2018 show these high catch rates, despite record low temperature data being observed in the first half of the year.

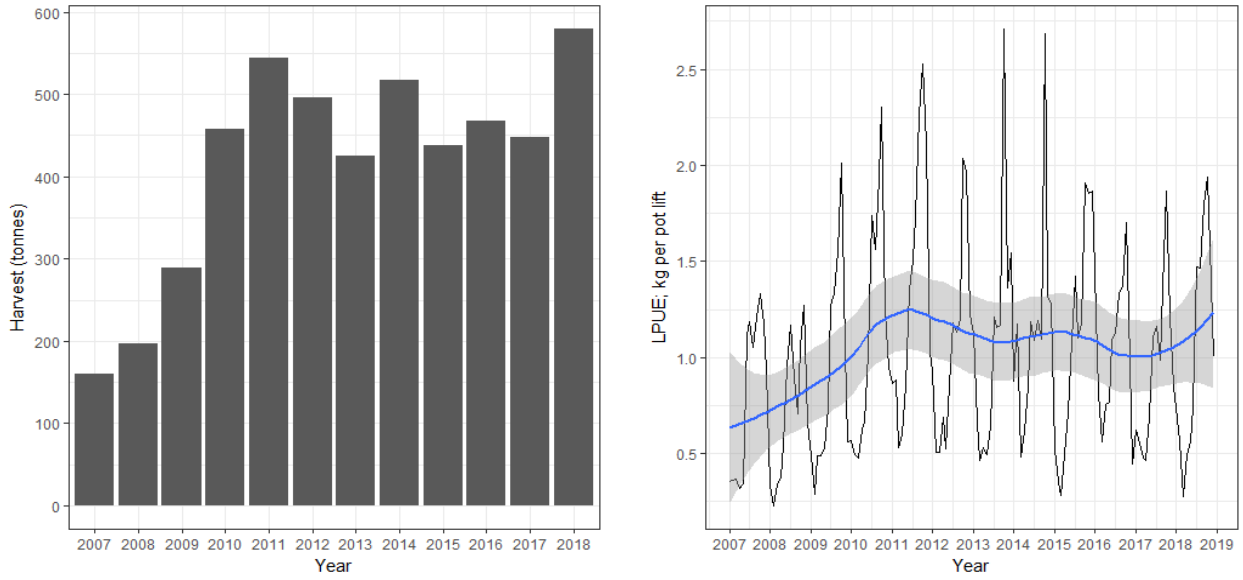

Figure 23. The harvest (tonnes) of edible crab (*C. pagurus*) landed by Manx vessels into the Isle of Man by year (left). The modelled landings-per-unit-effort (LPUE) through time, from 2007—2018.

Edible Crab continued...

As the trends in figure 23 suggest, the LPUE is stable but with intra-annual and inter-annual variability at between 1 and 1.5 kg pot^{-1}. Effort (pot lifts) is stable at approximately 300,000 pot lifts per year. The LPUE data correlates strongly with temperature, with decreasing LPUE through winter into a Spring minimum, increasingly through Summer into Autumn (figure 24). Sea-bottom temperature data collected using novel technology (see p.24) shows clearly that *C. pagurus* move and feed around fishing pots at a temperature range 11—15 °C, with the highest LPUE at 13-14 °C (figure 24).

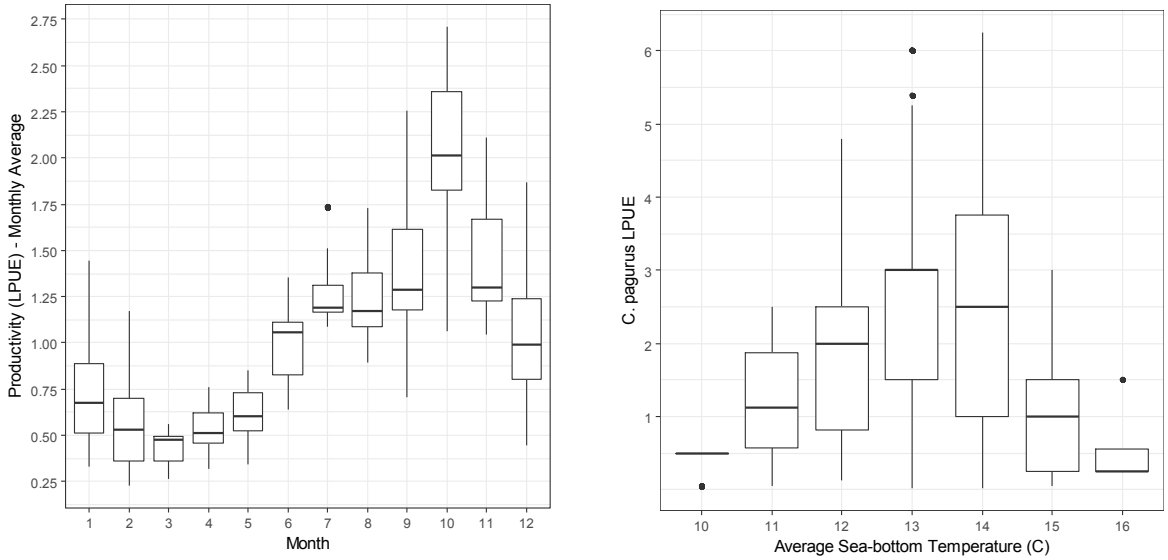

Figure 24. The average landings-per-unit-effort (LPUE) of crab (*C. pagurus*) by month (2007-2018) (left). The average LPUE by temperature (°C) (2018 only).

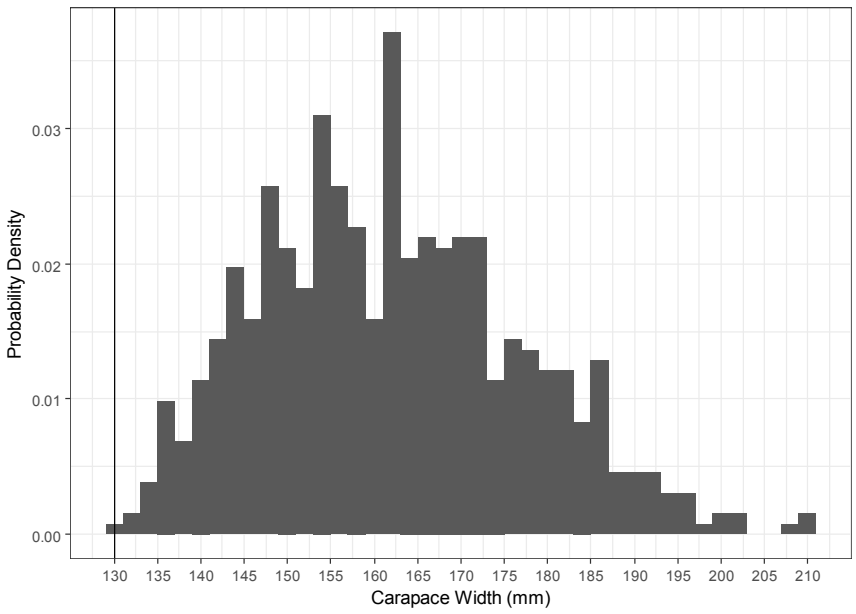

Figure 25. The size (CL, mm) distribution of crab (*C. pagurus*) sampled at processors in 2018.

Monitoring the status of the fishery also includes monitoring the population structure of the animals that are landed ashore.

The average size of crab landed is well above the current minimum landing size (MLS) of 130 mm carapace width. This is indicative of a fishery that is operating at a 'healthy' capacity. Moreover, the size distribution of animals harvested in 2018 (shown in Figure 25) has not shifted significantly from when the population was studied in depth 5 years ago.

European Lobster (*Homarus gammarus*) Fishery Update

The European lobster fishery in the Isle of Man territorial sea produces between 40 and 60 tonnes of lobster annually (Figure 26). The low volume of lobster landings in 2018 can be explained by the higher-than-average price of edible crab, which represents an *opportunity cost* for fishers that target both species and creels were preferentially set in areas targeting crab. The fishery has trends that follow seasonal patterns, which like crab data are strongly correlated to temperature. Most lobster is landed during the summer months and peak-lobster LPUE correlates with when the waters are warmest during late summer and early autumn (Figure 26).

Sampling of landed catch is also a method of monitoring the health of the fishery. If the abundance of larger 'older' animals begins to decrease, this may be an indication of high fishing mortality.

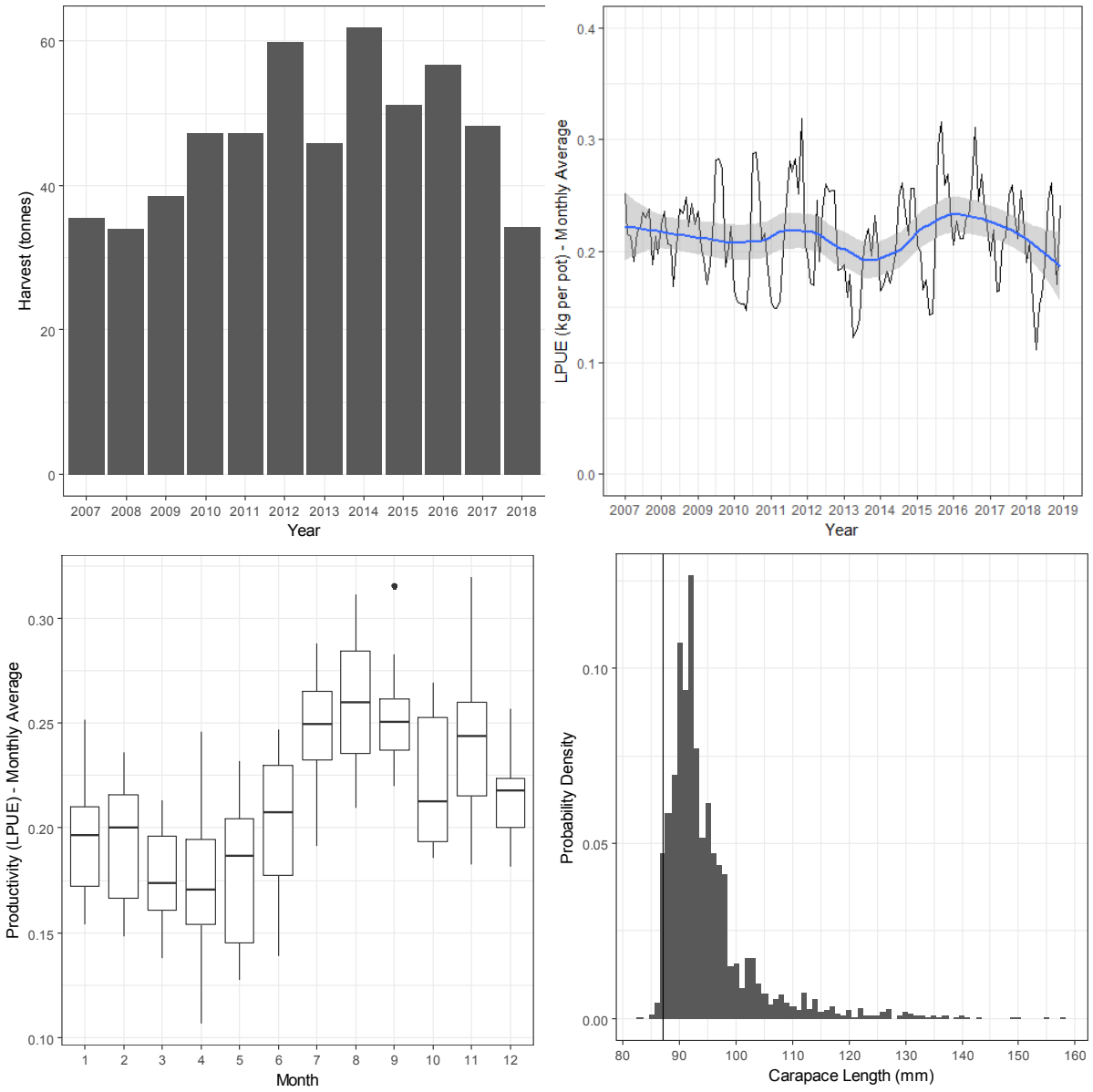

Figure 26. The harvest (tonnes) of lobster (*H. gammarus*) by year (top left). The landings-per-unit-effort (LPUE) of lobster through time (2007-2018) (top right). The average LPUE of lobster by month (2007-2018) (bottom right). The size (carapace length) distribution of lobster samples in 2018 at processors.

ICES Working Group on Crab Biology and Life History, Jersey, 2018

The ICES (International Council for the Exploration of the Sea) Working Group on Crab met this year from November 5th—8th in Jersey, hosted by the State of Jersey's Marine Resources team. The working group included scientists and researchers from across the North Atlantic and focuses on a range of crab and lobster species knowledge gaps and stock assessment methodologies.

A key theme across most of the discussions was the observation of changing ocean chemistry on stocks throughout the ICES Area. Jack Emmerson (below) made valuable contributions to the forum on how in-situ 'technology can be used to monitor fisheries and the marine environment' together.

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Lobster Tagging

A lobster tagging project was established in the Baie ny Carrickey marine nature reserve in August 2016, with the aim of identifying the movement patterns and growth rates of the lobster fishery within the bay – useful data for management purposes. Thanks to the continued efforts of commercial fisherman Guy Sutton, a further 51 individuals were tagged (Figure 27) this year and added to the database, and 41 recaptures took place.

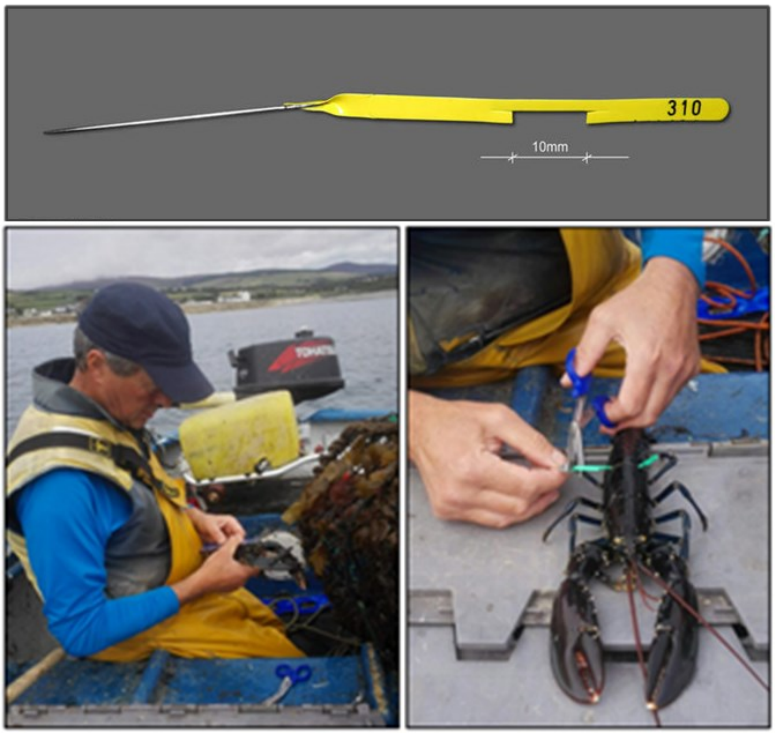


Figure 27. Top: The type of tag used in the study (Hallprint.com); Bottom: Guy Sutton tagging a lobster in the Baie ny Carrickey Marine Nature Reserve.

Lobster Tagging continued...

Since the start of the project in 2016, a total of 315 lobsters have been tagged, with the lobster population displaying an even sex ratio (51% male, 49% female). 75 of these lobsters have been recaptured on at least one occasion, representing 24% of the tagged population and displaying the same sex ratio (51% male, 49% female). 26 recaptured lobsters had moulted, increasing in size by 13% on average (measured as carapace length [CL]), and exhibiting similar growth rates (Figure 28). Based on the average growth increment (13%), it can be assumed that lobsters in the bay at CL > 77 mm will recruit into the fishery (87 mm CL) after a single moult.

75% of the lobsters that were recaptured were within 100 m from where they were originally tagged and released (Figure 28). Only 11% were found further than 500 m away in any recapture, suggesting that lobsters do not generally move large distances within the bay. The median distance lobsters travelled between captures was 54 m, with a median rate of movement of 30 m per month. Although the direction of lobster movement exhibited large variation, there was a general southerly trend (Figure 28), with both the number of lobsters and median distance travelled greatest towards the south (Table 3).

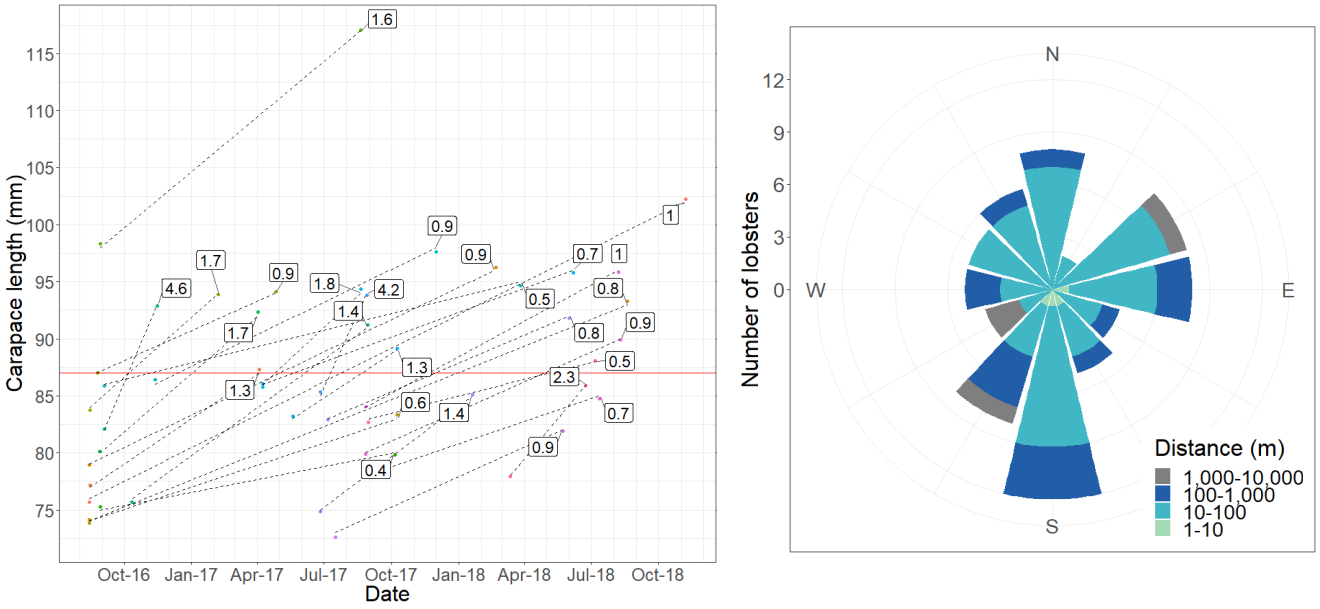


Figure 28. Left: Average growth rates of lobsters due to moulting; Right: Wind-rose-style diagram indicating the net distances and directions travelled by all recaptured lobsters.

Table 3. The proportion of recaptured lobsters moving in different directions, and the median net distances travelled.

Direction	Proportion	Median distance
North (315-45°)	21%	54 m
East (45-135°)	27%	61 m
South (135-225°)	33%	71 m
West (225-315°)	19%	50 m

Electronic Monitoring Trial

In the 2017 Annual Report, a preliminary trial using Zebra-tech© equipment to monitor static-gear fisheries was described. With part funding from DEFA's Agriculture and Fisheries Grant Scheme, the MFPO and Bangor University collaborated to test whether this equipment could effectively monitor:

- Daily geo-referenced catch data (landed catch with GPS);
- Daily geo-referenced effort data (effort data with GPS);
- Environmental data for each string (Depth and SBT (°C) range);
- Other data, such as soak time, sea state & tidal strength.

The trial proved the technology to be capable and DEFA and Bangor have since been working with a sentinel fleet of vessels that operate across the geographical extent of the Isle of Man's primary fishing grounds. The data (examples of non-commercially sensitive data shown in figure 29 and 30) began to be collected in August 2018 and the sentinel fleet have been provided with individual feedback reports of the data they are collecting. So far, the system looks extremely promising and is helping to build a much more comprehensive picture of the relationship between the fishery and the abiotic marine environment.

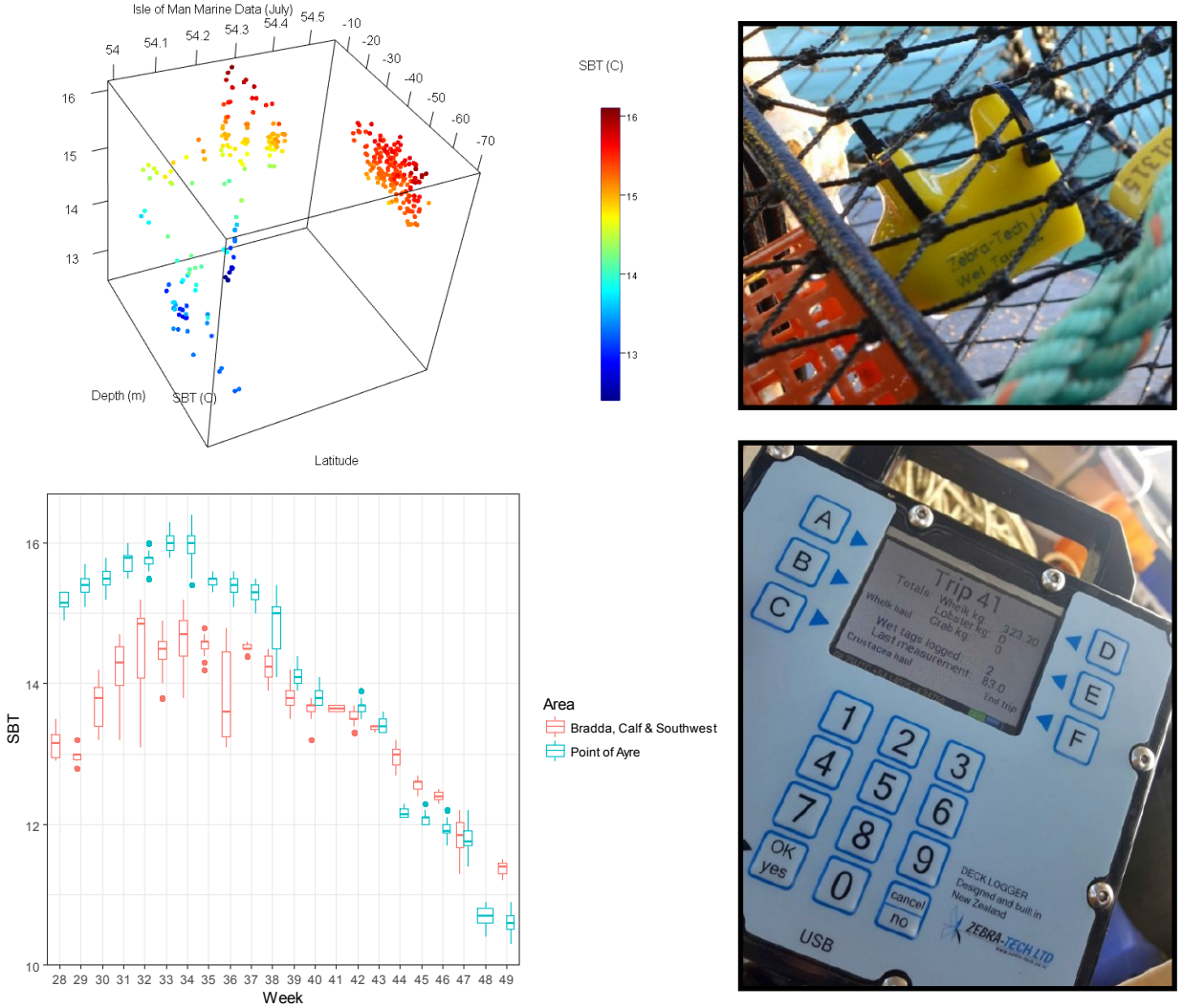


Figure 29. A 3D plot of temperature, depth and latitude in July, 2018 (top left). A time series of average sea bottom temperature by week in 2018 (bottom left). A Zebra-Tech wet-tag (top right) and deck logger (bottom right) used to collect the

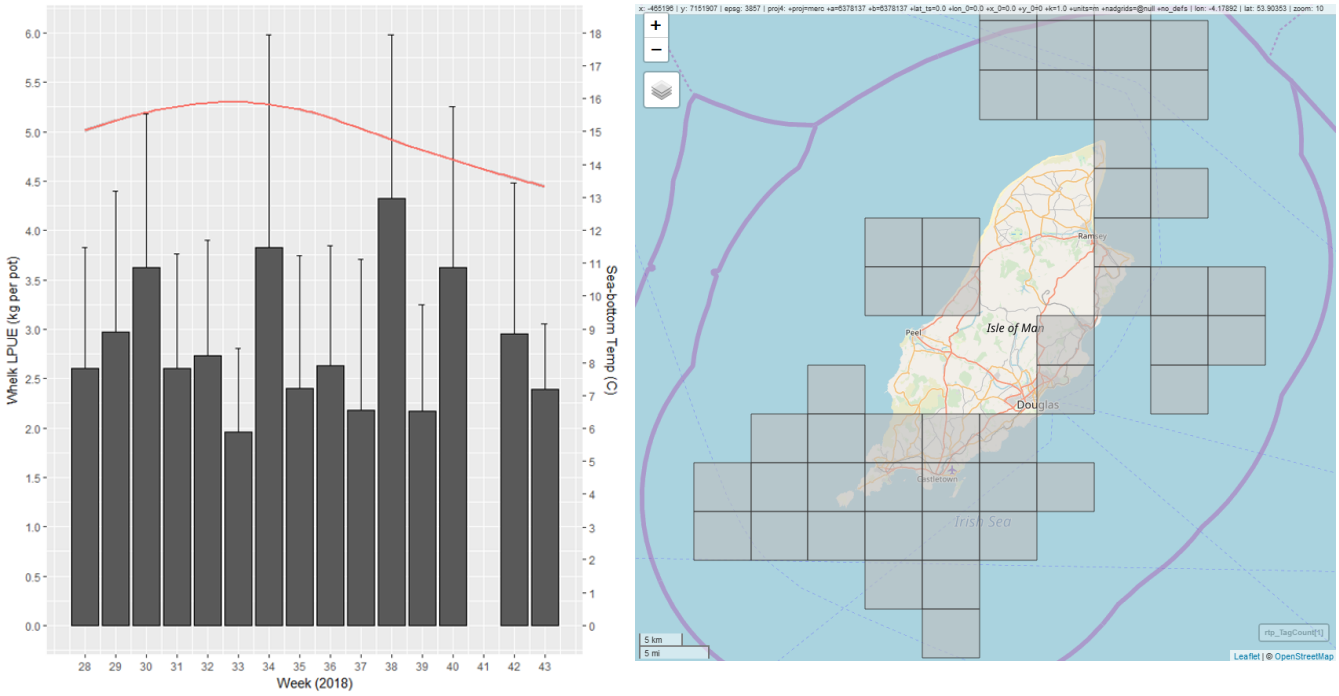


Figure 30. The average whelk (*Buccinum undatum*) LPUE ± s.d by week (bars) with sea bottom temperature (°C, red line) (left). An indication of the areas sampled (fished) by the sentinel fleet using Zebra-tech equipment.

Pot Fisheries Research Priorities for 2019

- **Continue the 12 month electronic monitoring project and extend / expand as appropriate**

  The environmental, catch and effort data from the electronic monitoring project is incredibly valuable. Participation has been good, but data gaps are appearing in certain areas of the territorial sea. We are hoping to fill these data gaps by expanding the project.

- **Crab tagging to complement Scottish IFGs**

  Scottish inshore fisheries groups are currently engaged in a nation-wide tagging project. Early results indicate they may move large distances and the west coast may be connected to the northern Irish Sea. IOM participation would supplement the project.

- **Continue & expand lobster tagging**

- **Publish whelk size-at-age research**

Manx Fishing Industry Conference

The Manx Fishing Industry Conference (MFIC) took place this year on the 26th of June 2018 at the House of Mannanan in Peel. For the first time, an external key note speaker was invited (Dr Bryce Stewart) who gave an informative talk on Brexit and the potential impacts for UK and Manx fisheries. Professor Michel Kaiser, who has led the Bangor University science contract in the Isle of Man since 2007, also gave a talk on a decade of fisheries science in the Isle of Man. This was Mike's last official engagement with our contract as he is off to work at the Marine Stewardship Council and we would like to take this opportunity to thank him for his leadership and expertise over the last decade. Other talks included Dr Isobel Bloor (Bangor) on scallop fisheries, Jack Emmerson (Bangor) on pot fisheries and David Beard (MFPO) on the Ramsey Bay Fisheries Management Zone. The conference finished with an open panel discussion where the audience was invited to put any questions to a representative panel (Karen McHarg—Director of Fisheries at DEFA, Peter Duncan—Senior Marine Environment Officer at DEFA, Isobel Bloor—Fisheries Scientist at DEFA, Neil Milsom—Sea Fisheries Policy Manager at DEFA).

We would like to thank everyone that attended and presented at the 2018 Manx Fishing Industry Conference for making the event a success. We will be hosting another conference on **Monday 24th June 2019 at the Masonic Hall in Peel**. The 2019 conference will have a similar format and we hope to continue to increase attendance and involvement at the event with more external speakers.

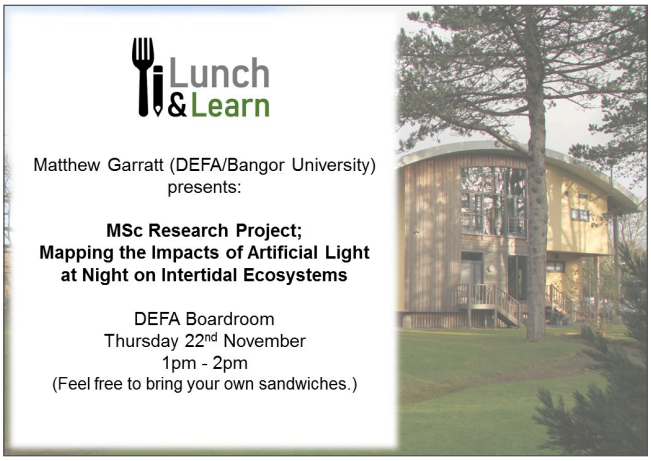
Figure 31. *Top left: Bryce Stewart key note speaker; Right: Poster and agenda for the conference; Bottom left: Mike Kaiser*

Lunch and Learn Series

In March 2018 we started a monthly Lunch and Learn session held at DEFA during the lunch hour. All staff are invited and encouraged to bring along their lunch and listen to a different speaker each month. The presentations are around 30—45 minutes long with time for a lively and interesting discussion afterwards.

2018 has seen a positive response to these sessions and a good variety of speakers and topics from Bangor University, DEFA and external speakers:

- **March**: Jack Emmerson (Bangor) — Whelk Fisheries in the Isle of Man
- **April**: Dr Isobel Bloor (Bangor) — The Prince Madog and the Annual Stock Assessment Survey
- **May**: Claire Lambden (Bangor) on her 12 month placement with DEFA
- **June**: Dr Peter Duncan (DEFA) — Horse Mussels: The Animal and the Habitat
- **July**: Laura McCoy and Jude Dicken (Manx Natural Heritage) on a summary of Manx Wildlife Week 2018 and looking to the future
- **August**: Kevin Kennington (DEFA) on Hydrographic Fronts in the Manx Territorial Sea - Implications for Coastal Zone Management
- **September**: Neil Morris (Manx Bird Life) on The Isle of Man Seabird Census 2017-2018: Results and Implications
- **October**: Laura McCoy (Manx National Heritage) — How to Move a Giant, the Sei Whale at the Manx Museum
- **November**: Matthew Garratt (Bangor) on his Masters research project - “Mapping the Impacts of Artificial Light at Night on Intertidal Ecosystems”
- **December**: David Burnett on the Geology of the Isle of Man - “Half a Billion Years in 45 Minutes”.



We would like to thank everyone who has given a presentation at the Lunch and Learn series during 2018 and everyone who has attended and participated in the discussions to make this series a success. We will be continuing in 2019 and if anyone would like to volunteer to present please contact i.bloor@bangor.ac.uk.

Matthew Garratt: Graduate Placement (October—December 2018)

Having completed my Masters in Marine Environmental Protection from Bangor University in September 2018, I moved to the Isle of Man to live with my parents while applying for jobs, and had the great fortune of being offered the opportunity to undertake a short placement with Bangor scientists Dr Isobel Bloor and Jack Emmerson, based at DEFA's fisheries department. Over the 3-month period, I was involved in a variety of tasks and gained valuable experience in both practical and analytical aspects.

The main project I was involved in during my placement was the experimental research area (ERA) off the east coast of the Isle of Man. This area was closed to scallop fishing in July 2017 with the aim of testing the viability of artificial spat receptors in the area. In October 2018 I helped to plan and then participated in 3 baseline surveys of the ERA from the FPV Barrule including a beam trawl survey, dredge survey and drop-down camera survey. During this time, I gained practical experience of processing trawl and dredge catches at sea, including measuring and aging scallops and identifying epibenthic species. As preparation for these surveys, I assisted Jack in obtaining size and age data of scallops caught for Dr Kennington's research, and later went out to sea on a dredge survey to collect this data by myself, which was great experience. I also had the opportunity to assist in collecting shellfish data (scallops, lobsters and crabs) onshore in industrial environments (Island Seafare Ltd. and Isle of Man Seafood Products Ltd.), and completed SEAFISH sea survival and health & safety training as part of my placement, which is certain to open further opportunities in my future career.

Back in the office I was responsible for inputting and analysing the data from the trawl, dredge and camera surveys in the ERA, and produced a report for DEFA presenting the methods and results of the baseline surveys. Following this work, I began research into scallop spat settlement and potential methods and materials for increasing recruitment, as background research for formulating a specific approach for the ERA. I also worked on analysing and writing a report on the data from the Baie ny Carrickey lobster tagging project, and had the opportunity to present my MSc project work during a Lunch & Learn session at DEFA, as well as creating a logo and poster for the series.

I couldn't be more grateful for having had this opportunity and the skills I have gained, even over such a short period, have been integral to the job interviews I have had so far. Although having little prior knowledge with regard to fisheries, I have thoroughly enjoyed my placement and as a result am aiming to continue my career in the fisheries sector. I'd like to thank Isobel and Jack for being great supervisors and colleagues, and for providing me with such diverse and applicable experiences in fisheries research, and to everyone at DEFA for being so incredibly welcoming.

Claire Lambden: Undergraduate Placement (June 2017—May 2018)

For my applied placement I moved to the Isle of Man in June 2017 to begin working with Bangor scientists Dr Isobel Bloor and Jack Emmerson at the Department of Environment, Food and Agriculture (DEFA). During my time with DEFA I was able to partake in several different projects and surveys, including working with inland fisheries to complete electrofishing and broodstock surveys on trout and salmon populations in local rivers around the Island. I was also involved in two different outreach projects: The Fun Palace in Ramsey and the Festival of the Sea in Port Erin. I spent over 200 hours working at sea on the RV Prince Madog, FPV Barrule and commercial fishing vessels, completing the annual scallop survey, queen scallop fishery bycatch trials and queen scallop spat survey. I had an incredible time working with DEFA and I will treasure the experience I gained there.

I would like to thank Isobel Bloor, Jack Emmerson and Karen McHarg for their support during my placement and for giving me some incredible opportunities. I would also like to thank Michel Kaiser for supervising me and encouraging me to push myself. Finally, I would like to thank all the incredible people who work for DEFA who made me smile and feel at home whilst I completed my placement.

Figure 32. Top left: Inland fisheries survey; Top right: Ramsey Bay Fun Palace; Bottom left: Queen scallop bycatch trials; Bottom middle: Fish dissection; Bottom right: Measuring lobsters at the processors.

During 2018 the Isle of Man research team (staff and students) have communicated the findings of the scientific work undertaken to interested stakeholders. These communications include advisory reports to the Isle of Man Government, peer reviewed publications in scientific journals, presentations at international conferences and during attendance at national and international committees, working groups and meetings.

Training Events:

- Bangor University Stock Assessment Methodology Workshop Isle of Man (8th—12th Jan 2018)

Government Reports:

- Bloor, I.S.M., Emmerson, J. and Kaiser, M.J. (20180. The Isle of Man *Aequipecten opercularis* stock assessment 2018. Fisheries and Conservation Report No. IOM 75. Bangor University pp.1-18.
- Bloor, I.S.M. (2018. Isle of Man king scallop (*Pecten maximus*) stock advice: A data-limited approach for setting a total allowable catch for the 2018/2019 fishing season and preliminary quantitative stock assessment for the Isle of Man Territorial Sea. Fisheries and Conservation Report No. IOM 73, Bangor University. Pp. 1-16.
- Garratt, M.J., Bloor, I.S.M., Emmerson, J.A. and Jenkins, S.R. (2018). East Douglas Experimental Research Area: Baseline status (2017/2018). Fisheries and Conservation Report No. IOM 76, Bangor University.. Pp. 1-15.
- Garratt, M.J., Sutton, G., Emmerson, J.A., Bloor, I.S.M. and Jenkins, S.R. (2018). Baie ny Carrickey Lobster Tagging Update (2016—2018). Fisheries and Conservation Report No. IOM 78, Bangor University. Pp. 1-9.

Meetings and Committees:

- International Council for Exploration of the Seas (ICES) Working Group on Scallop Stock Assessment, York, , 10^{th} – 12^{th} October 2018 (Attended by Dr. Isobel Bloor).
- International Council for Exploration of the Seas (ICES) Working Group on Crab and Lobster Biology, St Helier, Jersey. 5th—9th November 2018 (Attended by Jack Emmerson).

Presentations:

- Bloor, I., Emmerson, J. and Kaiser, M. Isle of Man King Scallop Fishery and Stock Assessment: 2018 Update. ICES Working Group Scallop Stock Assessment, 9th - 12th October 2018, University of York.
- Bloor, I., Emmerson, J. and Kaiser, M. Isle of Man Queen Scallop Fishery and Stock Assessment: 2018 Update. ICES Working Group Scallop Stock Assessment, 9th - 12th October 2018, University of York.
- Emmerson, J.A. Biology and management of the Manx whelk fishery. Nature's Value Conference, Isle of Man, 21 April 2018, Manx Museum.
- Emmerson, J.A. Technological innovations in monitoring static-gear fisheries. Shellfish Association of Great Britain Annual Conference, 1-2 May 2018, Fishmongers Hall, London & ICES Working Group for Crab Life and Biology, 5th-9th November 2018.

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Bangor University 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

Professor Stuart Jenkins:

I graduated in Zoology from Cambridge University in 1990 and undertook my PhD at Port Erin Marine Laboratory between 1991 and 1995. I remained at Port Erin for a further 6 years, working first on intertidal rocky shores and then with Dr Andy Brand and colleagues at Seafish, examining the effect of scallop dredging on the wider marine ecosystem. In 2001 I moved to Plymouth to the Marine Biological Association where I developed a research group in coastal ecology and in 2007 moved to the School of Ocean Sciences, Bangor University. My research interests are varied, addressing questions in both fundamental and applied ecology. I have particular interests in recruitment dynamics, non-native species, the role of key species over large geographic scales and effective management of marine resources.

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 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. 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 all their commercial fisheries.

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*".

Matthew Garratt:

I graduated from Bangor University in 2017 with a BSc in Ocean Science before completing an MSc in Marine Environmental Protection in 2018. I then began a work placement on the Isle of Man based at DEFA as a research assistant for Bangor University. Over the last 3 months I have been involved in a variety of offshore surveys, primarily focusing on the scallop fishery within the East Douglas experimental closed area, gaining much practical experience (including sea survival training) as well as honing skills in data analysis, presenting and report writing. I hope, with the experience I have gained during my placement, to continue working in fisheries science in the future.