

## PRIFYSGOL BANGOR UNIVERSITY

## Scientific Monitoring within the Baie ny Carrickey Closed Area:

### Summary of Progress & Results (November 2013 – July 2016)

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Scientific Report for the Baie Ny Carrickey Consultation Document

#### 1. Introduction

#### 1.1 Background to the Baie Ny Carrickey Closed Area

Baie ny Carrickey is an area (of approximately 8.7 km<sup>2</sup>) off the south coast of the Isle of Man that has been closed to fishing for scallops and queen scallops by any means since 1<sup>st</sup> November 2012. Exploitation of commercially important crustaceans (*Homarus gammarus* and *Cancer pagurus*) continues in the area under commercial licence to seven members of the Baie ny Carrickey Crustacean Fishery Management Association (BNCCFMA) with a total maximum limit of 650 commercial pots (reduced to 440 pots from 1<sup>st</sup> December 2014), as well as the continuation of potting under a recreational licence by hobby potters. Following consultation, the Department of Environment, Forestry and Agriculture (DEFA) sanctioned the commencement of a three-year scientific trial to take place within the Closed Area from November 1<sup>st</sup> 2013 to monitor the impacts of these effort restrictions and other management measures on the crustacean stocks within the area. This report serves to summarise the results from several aspects of data collection during the trial.

#### **1.2 Aims of the Scientific Trial**

<u>Aim 1:</u> To maintain the ecological integrity of the area. Ecological integrity refers to the health of an ecosystem.

<u>Aim 2:</u> To maintain and enhance commercial fisheries resources, primarily crustaceans, within the Closed Area and promote their sustainable use.

#### 1.3 Specific Objectives of the Scientific Trial:

Objective 1: Maintenance and Enhancement of crustacean populations:

- a. Limit and quantify commercial fishing effort
- b. Increase yield per recruit and egg production per recruit
- c. Assess the status (density, size, sex ratio, egg production) of lobster and crab stocks
- d. Assess the size-at-onset of maturity for crab and lobster to assess validity of current Minimum and Maximum landing sizes.
- e. Determine immigration and emigration/spill-over of commercial crustacean species into and out of the Closed Area

Objective 2: Determine habitat distribution and use within the Closed Area

- f. Produce a habitat map
- g. Assess the abundance and distribution of crustaceans in different habitats
- h. Assess the recruitment and habitat use of juvenile brown crab
- i. Assess species composition and biodiversity within the area

#### 1.4 Summary of changes to activity within the Area.

1. A prohibition on the removal of scallops (*Pecten maximus* and *Aquipecten opercularis*) by any means from November 2012.

- 2. A cap on the number of static-gear vessels operating within the area (7 vessels<sup>1</sup>) by way of restricting access to BNCCFMA.
- 3. A cap on the number of pots that each vessel is permitted to fish to a maximum of 100.<sup>2</sup>
- 4. BNCCFMA members are required to submit monthly logbooks specific to capture data within the Area:

Monthly data is collected across all 11 scientific data zones (Fig 1). Records of all catch from **5 standard commercial shellfish pots** (with escape gaps); **5 scientific shellfish pots** (without escape gaps) and **1 prawn pot** will be required from each primary commercial vessel that fishes within the BNC-CA and will include information on:

- Area fished (Zone 1 -11)
- Soak time (hrs)
- Pot type (Scientific/Standard/Prawn)
- No., Size, Sex, Condition & Retention of all caught lobsters and crab
- Bycatch data



Figure 1 The Baie ny Carrickey Closed Area location in the south of the Isle of Man (top right). Scientific data collection zones 1-11 are displayed (left).

- 5. An increase in crab (C. pagurus) MLS to 135 mm CW, commencing November 2013
- 6. An increase in lobster (H. gammarus) MLS to 88 mm CL, commencing November 2013
- 7. An increase in lobster (*H. gammarus*) MLS to 90 mm CL, commencing April 2015

<sup>&</sup>lt;sup>1</sup> Note that one vessel was inactive from the commencement of the trail.

<sup>&</sup>lt;sup>2</sup> Many vessels do not fish their full allocation of pots. The number of pots deployed within the area was estimated at 820 in the Summer of 2012 and was reduced to 440 at the start of the trial.

#### 2.1 Summary of monthly logbook data

Γ

Member (anonymised)	Number of animals measured				
A	2068				
В	115				
С	302				
D	223				
E	331				
F	116				
Total	3155				

Table 1. The relative contribution of scientific data via monthly logbooks by BNCCFMA member.

Table 2a. The number of animals measured and reported via the monthly logbook by BNCCFMA members throughout the trial. Table 2b. the relative numbers of each species recorded throughout the trial with target species highlighted in **bold. NB** Vessels B & F opted to trial electronic monitoring systems, explaining the low data return via logsheets.

	Α		
Year-Month	Number of animals	Common name	Scientific n
013-11	163	European lobster	Homarus g
013-12	104	Edible crab	Cancer pag
014-01	89	Atlantic cod	Gadus mor
)14-02	19	Ballan wrasse	Labrus berg
)14-03	80	Blennie	Blennioidei
14-04	227	Dogfish	Sycliohinus
14-05	140	Gobie	Gobiidae s
14-06	99	Green Crab	Carcinus m
14-07	85	Octopus	Octopus vu
14-08	90	Prawn	Palaemon :
014-09	273	Pollack	Pollachius
14-10	189	Rockling	Gaidropsar
4-11	230	Saithe	Pollachius
L4-12	209	Squat lobster	Galathea s
15-01	99	Velvet Crab	Necora put
5-02	77	Common whelk	Buccinum u
5-03	97		•
15-04	52		
015-05	49		
015-06	47		
15-07	76		
015-08	97		
015-09	121		
)15-10	119		
15-11	22		
16-03	35		
16-04	36		
16-05	25		
otal	2949		

		В
Common name	Scientific name	Numbers
European lobster	Homarus gammarus	1647
Edible crab	Cancer pagurus	487
Atlantic cod	Gadus morhua	2
Ballan wrasse	Labrus bergylta	3
Blennie	Blennioidei spp.	41
Dogfish	Sycliohinus canicula	12
Gobie	Gobiidae spp.	8
Green Crab	Carcinus maenas	15
Octopus	Octopus vulgaris	1
Prawn	Palaemon spp.	370
Pollack	Pollachius pollachius	5
Rockling	Gaidropsarus spp.	5
Saithe	Pollachius virens	5
Squat lobster	Galathea squamifera	11
Velvet Crab	Necora puber	240
Common whelk	Buccinum undatum	10

Member (anonymised)	1	2	3	4	5	6	7	8	9	10	11
А	38	92	55	-	31	73	85	958	293	326	117
В	11	39	-	17	1	19	5	-	13	10	-
С	4	6	54	15	-	26	23	77	5	44	18
D	-	19	24	36	5	18	37	14	17	28	-
E	62	64	44	55	18	8	44	33	-	-	3
F	-	-	-	-	-	116	-	-	-	-	-
Total	115	220	177	123	55	260	194	1082	328	408	138

Table 3. The number of animals sampled within each of the scientific areas (see Fig. 1) by BNCCFMA members.

#### 2.2 Size distribution of commercial species

Data from onboard observations (Fig. 2) and those reported via the BNC monthly logbooks (Fig. 3) do not indicate a significant change in the size distribution of European lobster (*H. gammarus*) since before the effort reduction trial began.

The expected changes in size structure resulting from the MLS increase from 87 mm to 90 mm, which did not come into effect until March 2015, is unlikely to be observable within the data until after the end of the trial. Figure 3 appears to show a general increase in the size of lobster captured within commercial fishing gear since the introduction of the 90 mm MLS; however, due to low sample sizes, it is not possible to make firm conclusions on whether the population has begun to respond to the legislative changes. The general indication from BNCCFMA members is that the stepwise increase (from 87 mm to 88 in November 2013 and then to 90 mm in March 2015) is beginning to have a noticeable effect on the economic returns of the fishery (BNC MAC meeting, 23<sup>rd</sup> February 2016). Specifically, personal communications indicate that one fish box (30 kg of live lobster) is now filled with an average of 42 individual animals with the 90 mm MLS, compared to an average of 55 individual animals with the former 87 mm MLS (*pers. comms.,* I. Quine, 2016), a reduction of 24% in the total number of animals required to maintain landings. N.B this evidence is directly from fishermen that have been operating at a voluntary 90 mm MLS since before the legislative introduction and is not scientifically quantified.



Figure 2. The length distribution of European lobster (*H. gammarus*) observed onboard commercial fishing vessels within the BNC CA before and during the scientific trial. (Data source: onboard observations).



Figure 3. The average size of European lobster (*Homarus gammarus*) sampled within commercial-design pots (blue line) and scientific pots (grey line), along with the relative sampling effort of each (blue and grey columns; right axis) throughout the trial. The red vertical line represents the increase in MLS to 90 mm.

Brown crab (*Cancer pagurus*), which has a MLS of 135 mm CW within the BNC CA, is less desirable as a commercial species. BNCCFMA members generally target lobster with their gear and this is reflected in data. The highly variable, but typically very low sample sizes make it inappropriate to draw conclusions on changes in population structure (see Fig. 4).



Figure 4 The average size of Edible crab (*Cancer pagurus*) sampled within commercial-design pots (blue line) along with the relative sampling effort (blue columns; right axis) throughout the trial. (Data source: BNC CA logbook).

#### 2.3 Fishing effort and productivity (CPUE & LPUE).

The principal aim of the scientific trial was to monitor the response in catches to limiting static-gear fishing effort within the Baie Ny Carrickey, which was achieved initially through the capping of effort and access to the area. The resulting benefits and/or costs in fishing yield, measured using LPUE and CPUE as a proxy, are assessed using both BNCCFMA logbooks alongside DEFA Monthly Shellfish Activity Returns.

Figure 5 shows the CPUE (number of individuals captured in commercial fishing gear) on each day that a single vessel recorded data. The general indication is that CPUE is stable but seasonally variable, which is expected. Improved and longer term monitoring is required to improve our understanding of changing productivity within the area.



Figure 5. The CPUE of European lobster (*H. gammarus*) within the BNC CA by BNCCFMA member 'A'. Red line indicates a 12-point (1 year) moving average. (Data source: BNC CA logbook).

A more reliable method of assessing changes in effort, landings and LPUE is through the use of DEFA Monthly Shellfish Activity Returns (Fig. 6). Figure 6 represents a single vessel known to operate exclusively within the BNC CA. The data indicates that since the effort reduction trial began in November 2013, the average number of pots hauled each day has decreased by approximately 50% and LPUE, while being highly variable according with seasonal fluctuations, show signs of improvement when compared to the long term average (since 2007).

Figure 6 shows a slightly different trend to those described in Figure 5, with declining effort and stable LPUE since the November 2013. The data is representative of all landings into Port St Mary and accounts for all but one member of the BNCCFMA, which operates out of Castletown. The data is not spatially exclusive to the BNC CA and includes data from Scientific subsquares D7i and D7ii (NB the BNC CA is exclusively within D7ii, see appendix 1). Arguably, the data represents the productivity of the wider area and may be indicative of any spill-over benefits from the CA; however, in lieu of movement data (section 2.5) this remains an assertion. What is clear is that despite a significant decrease in fishing effort since the trial, total landings remain at a level comparable to the historical average, i.e an improvement in economic efficiency of the fishery.



Figure 6 The landings (grey columns), Effort (red line) and LPUE (blue line) of a single anonymous BNCCFMA member 2007 – 2016; landings from within BNC CA only. (Data: DEFA Shellfish Activity Returns). Red vertical line indicates the start of the mobile closure and effort reduction trial respectively.(Data Source: DEFA Monthly Shellfish Activity Return).

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Figure 7. A comparison of landings (kg; blue line), fishing effort (Total daily pot lifts; black line) and LPUE (kg pot<sup>-1</sup>; red line) of staticgear vessels between Port St Mary and Port Erin. The red vertical line indicates the start of the effort reduction trial within the BNC CA and is shown throughout for comparison. (Data source: DEFA Monthly Shellfish Activity Returns).



Figure 8. The LPUE (kg pot<sup>-1</sup>) of static-gear vessels landing lobster by Port (anonymised but represented by different colours; Red hashed trend line representing landings into Port St Mary). The trend-lines represent a 24 point (2 year) moving average from October 2008. (Data source; DEFA Monthly Shellfish Activity Returns).

Figures 7 and 8 are used to provide context to the trends described in figure 6 by comparing the same indices (landings, effort and LPUE) at several of the major fishing ports on the Isle of Man targeting lobster.

Figure 8 compares the monthly average LPUE (used here as a proxy for the productivity of the fishery) of static-gear vessels by port (anonymised). All trends indicate a multi-annual cycle that is likely a natural fluctuation based on recruitment rates; however, the LPUE trend in Port St Mary deviates from the trends observed elsewhere with a stable LPUE beyond November 2012 (when the area was closed to mobile fishing). Moreover, the LPUE trend also shows moderate improvement beyond November 2013 at the same time that the productivity of lobster fisheries elsewhere began to decline and may be due to the effort reduction trial in Baie Ny Carrickey.

#### 2.4 Size-at-maturity work

Since September 2015, the BNCCFMA has been making efforts to capture data from juvenile lobsters in a collaborative project to understand size-at-maturity of the species. Local ecological knowledge (LEK) means that members of the BNCCMA are uniquely placed to capture data from very small individuals using prawn pots. Previous studies of this nature have struggled to acquire good sample sizes of 'small', i.e < 50 mm CL, lobsters. The BNCCFMA is therefore a valuable resource for future studies planned by Bangor University and DEFA.

Below is an example of one of the approaches used to assess size-at-maturity of lobster using data collected in the BNC CA (note: the cluster of data points in the bottom-left area of the chart has been supplied by the BNCCFMA and is typically missing from previous studies in Europe, yet are an essential addition to the database). The database thus far remains limited but is a valuable start to ongoing work.



Figure 7. Size-at-maturity of European lobster (initial results). Data shows morphological inflections, i.e allometry, that can infer a *puberty* moult in the female population. (Data course: BCNCFMA member measurements and Bangor University scientist observations).

One approach to assessing the appropriateness of a minimum-landing-size for lobster is to understand the functional maturity of a population through maturity ogives, which show the proportion of the female population that carry eggs by size class (and therefore considered *functionally mature*; CL<sub>50</sub>).

Data supplied by the BNCCMA, via the BNC logbook scheme, has reported the gravid status of lobsters along with the CL. The aggregated data shows the size at functional maturity within the CA to be 88.75 mm CL (Fig 11). The CL<sub>50</sub> result is highly relevant considering that one of the management measures introduced by the BNCCFMA (prior to any maturity analysis) was to increase the MLS to 90 mm. The scientific evidence, collected by industry, affirms that the BNC lobster population is harvested sustainably.



Figure 8. The functional maturity ogive of female lobster within BNC CA. The black lines represent CL50 (= 88.75 mm). The vertical red lines represent the MLS change within the BNC CA (hashed = 87mm CL; solid = 90 mm CL). (Data srouce: BNCCFMA logbooks).

#### 2.5 Movement of crustacean resources (planned tagging)

The BNC CA is an opportune place to conduct a tag-mark-recapture study to better understand the movement and size-fidelity of European lobster. Results from any such experiment would provide valuable evidence for the spatial management of lobster fisheries in the Isle of Man, particularly in the 0-3 nm areas.

The BNCCFMA has successfully applied for Sea-changers funding (£1,000) to conduct a capturemark-recapture experiment, beginning in summer 2016. The success of the BNCCFMA application signifies the scientific interest in this unique approach to Crustacean fishery management. Dependent upon the quality of data that is collected from this multi-annual experiment, it is expected that consequent scientific publications will be a valuable body of knowledge for DEFA. See Appendix 2 for more details.

#### 2.6 Ecosystem mapping & the associations of juvenile shellfish resources with benthic habitat

During the summer 2015, Bangor MSc student Lucy May undertook research within the closed area in close collaboration with DEFA and the BNCCFMA. Her research utilised the data submitted by BNC logbooks as well as deploying camera equipment from commercial vessels. The involvement of the BNCCFMA in research beyond the remit of the effort reduction scientific trial (see also section 2.5) is a demonstration of how valuable the scientific trial has been to the wider evidence-base of marine science in the Isle of Man. May (2015) is publicly available on the Bangor University Fisheries & Conservation Science Group web page and can be accessed at the following link:

[http://fisheries-conservation.bangor.ac.uk/iom/documents/msc may 2015.pdf]

#### 3.1 Future data collection methods

The data collection strategy has been reviewed following the analysis of data collected during the initial scientific trial. In order to simplify the reporting and submission process, whilst improving the quality of data available for scientific analysis, a Baie Ny Carrickey logbook has been designed (see Appendix 3). The logbook does not replace the statutory Monthly Shellfish Activity Logbook, but provides detailed catch and effort data specific to the closed area alongside a simple form to report population data for target species.

Moving forward, the BNCCFMA has expressed interested in trialling the 2<sup>nd</sup> generation of camera technology currently being trialled by the Fisheries & Conservation Science Group in Menai Bridge. When ready, the system will be capable of automatically capturing population data (species ID, size and sex) of commercially targeted animals as they are emptied from fishing gear.

#### Appendix 1.

#### Map of scientific grid used by BNCCFMA in BNC monthly logbooks.



#### Appendix 2.

Sea-Changers funded experiment to be conducted in the BNC closed area (awareness-raising poster).

# **Lobster Tagging Experiment Baie Ny Carrickey**

For more information, **Jack Emmerson** Email: j.emmerso Mobile: 319450 n@bangor.ac.uk Guy Sutton Email: rgsutton@manx.net Mobile: 428332



## tagged lobster..

Co-operation is the key to this projects success. f any potters find a tagged obster in their pot, we need the following info about the re capture

- Tag number Tag colour
- Date
- Location (GPS) Size (CL; nearest mm)
- Sex
- Whether you released it (and where if it was; GPS)

We will be handing out data collection forms to you.

Questions? See contacts

#### WHEN, WHY & WHERE If you catch a Do Lobsters Move?

Industry-led research aims to shed light on highly valued commercial species Thanks to funding from the charity "Sea-changers", the Baie Ny Carrickey Crustacean Fishery Management Association (BNCCFMA) is able to undertake an exciting new research project, which will involve tagging up to 1500 lobsters in the Baie Ny Carrickey Closed Area.

The data collected will identify any seasonal patterns in movement, whether this is linked to spawning migrations and if the closed area is creating any spill-over benefits to surrounding lobster grounds.

The field work element of the project is being undertaken by Guy Sutton, owner of Auk CT25, and is expected to **begin August 2016**. Data will be processed with assistance from Bangor University PhD student Jack Emmerson, who works for the University's Fisheries & Conser-vation Science Group & is based within the Department for Environment Food & Agricul-ture on the Isle of Man



#### Why Is This Important?

The BNCCFMA has already implemented progressive management measures for lobster in the Bay, including a raised minimum-landingsize (MLS) and capping the total number of pots being fished; and the early signals in the data indicate the benefits of this approach. The next step is to understand whether these benefits may be benefiting surrounding areas through natural movements of the lobster population migrationsl

The results will improve our understanding of:

• Lobster home-ranges

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- Seasonal & spawning migrations
- Growth rates & moulting periods



This research project has been funded by Sea-changers and is supported by DEFA and Bango



Appendix 3.

#### Baie ny Carrickey logbook (Aug 2016 onwards)

Na	Mon ame of	th Vessel			-	Year PLN				
	F	Record of	Effort			Record of Catch				
Day	Area	Av. Soak time (hrs)	No of Pots To Hauled of Today Set	Total No of Pots Set in BnC	kept Crab (kg)	discarded Lobster (kg) Landed	Lobster BERRIED COUN			
1	BnC					1				
2	BnC					1	1			
3	BnC					1	1			
4	BnC									
5	BnC									
6	BnC									
7	BnC									
8	BnC									
9	BnC									
10	BnC									
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30	BnC									
31	BnC									
Submitted by: Name in BLOCK LETTERS Signature						for c	official use			

Failure to complete and submit this logbook each month may lead to penalities. This logbook should be send to DEFA alongside the Monthly Shellfish Activity Logbook.

#### **Baie Ny Carrickey Logbook** Please send this to DEFA at the end of Month

It is a requirement of the BnC scientific trial to sample the commercial species caught in 5 Commercial pots (C) & 5 'scientific' pots (S) (i.e. closed escape panels) each month. If you have **Prawn pots (P)** targetting juveniles, please also report here.

Date	Area	Pot Type	Pot No.	Soak	Species	Size	Sex	Eggs	Retained
dd/mm/yy	1 - 11	C/S/P	1 - 5	(hrs)	L/C	(mm)	M/F	√/×	√/×
10000	VH-Sp	11 1000	200	CARA	11111 B	Comments			
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	South D	The	9 10	115	CTT CTT				
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