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## **Baie ny Carrickey Lobster Tagging Update (2016-2018)**

**M.J. Garratt, G. Sutton, J.A. Emmerson, I.S.M. Bloor & S.R. Jenkins**

*School of Ocean Sciences, College of Environmental Sciences and Engineering,  
Bangor University*

**Report to Isle of Man Government, Department of Environment, Food and Agriculture**

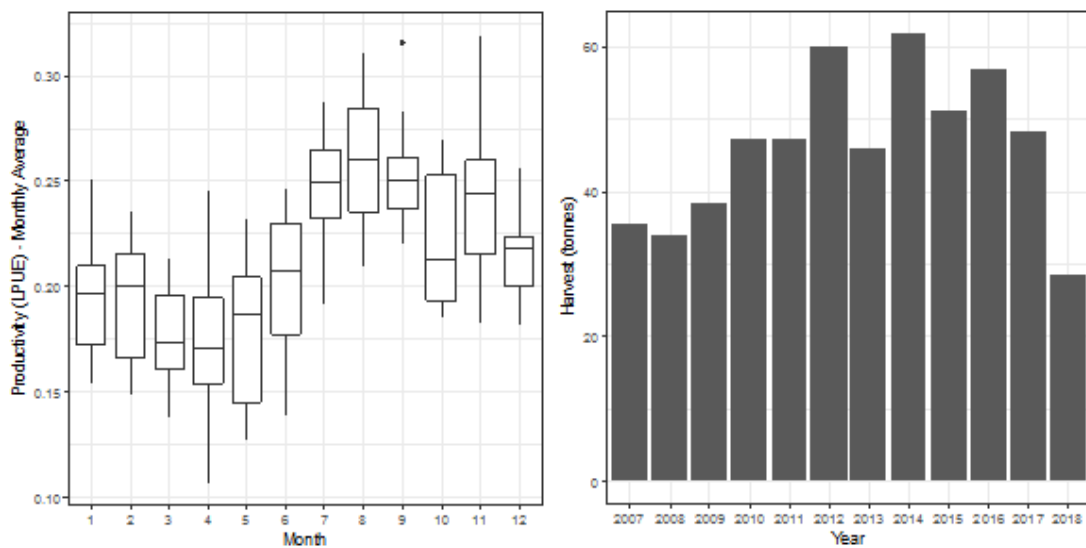
**Contact:** [j.emmerson@bangor.ac.uk](mailto:j.emmerson@bangor.ac.uk)

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## Introduction

The Isle of Man European lobster (*Homarus gammarus*) fishery is well-established and is currently worth more than £500,000 per annum (Duncan and Emmerson, 2018). As one of the main species targeted by pot fishing in the inshore waters of the Isle of Man territorial sea, monitoring of the fishery is essential. Landings data has demonstrated strong seasonal fluctuations, with most lobster captured during late summer and early autumn when the water is warmest, as well as variation from year to year (Figure 1). However, in comparison to other important commercial fisheries around the Isle of Man such as scallops and whelk, the lobster and other crustacean fisheries are ‘data poor’ with regard to growth and spatial movement patterns.



**Figure 1.** Mean monthly landings per unit effort (left) and total annual landings (right) of *Homarus gammarus* in Manx waters.

In 2016, the Baie ny Carrickey Crustacean Fishery Management Association (BNCCFMA) received funding from “Sea-Changers” to undertake a lobster tagging project, the first of its kind in Manx waters. The aim of the project was to study lobster movement and growth in the Baie ny Carrickey Marine Nature Reserve, an important lobster fishing area, and to identify any connectivity with surrounding areas or spill-over effects from the reserve. In doing so, this information will provide a better understanding of the lobster population and how to manage it effectively. This report provides a preliminary analysis of the data gathered thus far over the two years the project has been underway.

## Methods

### **Fieldwork:**

The Baie ny Carrickey lobster tagging project began in August 2016 and has continued successfully through to August 2018, with a total of 315 lobsters tagged to date, thanks to the efforts of commercial fisherman Guy Sutton (Auk CT25) (Figure 2). Any lobsters caught in pots throughout the

area that were not of commercial value were tagged and released, including those under minimum landing size (87 mm), berried females and cripples. The KoBoToolbox ([www.kobotoolbox.org](http://www.kobotoolbox.org)) data collection app was used to record key pieces of information when each lobster was tagged or recaptured, including the date and time, GPS location, tag number, sex, carapace length (CL), and details regarding whether the lobster was berried or damaged. Hallprint© streamer tags, each marked with a unique ID number, have been used throughout the work, and were carefully attached to the membrane at the base of the carapace on the dorsal side of the abdomen (Figure 2), so that the tags were not lost during ecdysis (moulting).



**Figure 2.** 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.

### **Sex Ratios:**

The sex ratios of the tagged and recaptured populations were calculated by dividing the total number of tagged females by the total number of tagged males, and the number of recaptured females by the number of recaptured males.

### **Growth Analysis:**

Because the carapace length (CL) of each lobster was measured upon tagging, those that were recaptured could be analysed for growth. However, because lobsters do not exhibit continuous growth, only those that had undergone ecdysis between captures could be examined. The % change in size exhibited by each lobster as a result of moulting was calculated by dividing the size increase

(CL) by the initial size, and average growth rates by dividing the size increase by the difference in date (expressed in months) between the two captures.

### **Spatial Analysis:**

Using the GPS data recorded at each capture, a map was created in ArcGIS (10.4.1) displaying the locations of all tag and recapture events. The movements of individual lobsters between captures were displayed assuming straight line distances between points (points to line). R was then used to calculate the distances in meter units (distHaversine, CRAN: geosphere) between each recapture event, as well as the overall net displacement of each lobster (distance between tag and final recapture locations). To explore the net direction in which lobsters were moving, the bearings (degrees) between tag and final recapture coordinates were calculated (bearing, CRAN: geosphere), and a wind rose diagram was created including the net distance that each lobster moved from where it was tagged.

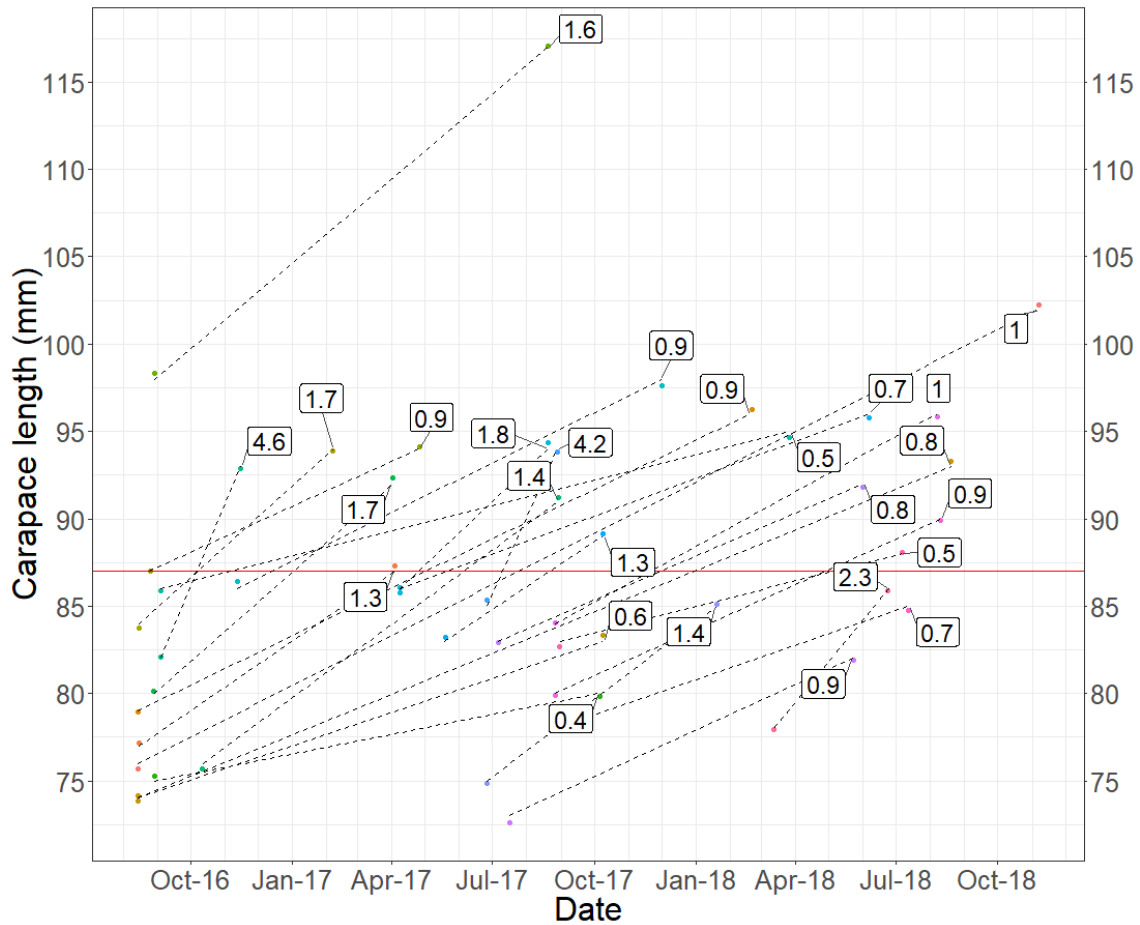
## **Results**

### **Sex Ratios:**

Of the 315 lobsters that were tagged between August 2016 and 2018, 158 were male and 154 were female, representing a sex ratio of 103 males to every 100 females. The sexes of the remaining 3 lobsters were uncertain. 75 lobsters (24% of those tagged) were recaptured on at least one occasion, including 37 males, 35 females (106 males to every 100 females), and the 3 individuals of unknown sex.

### **Growth Analysis:**

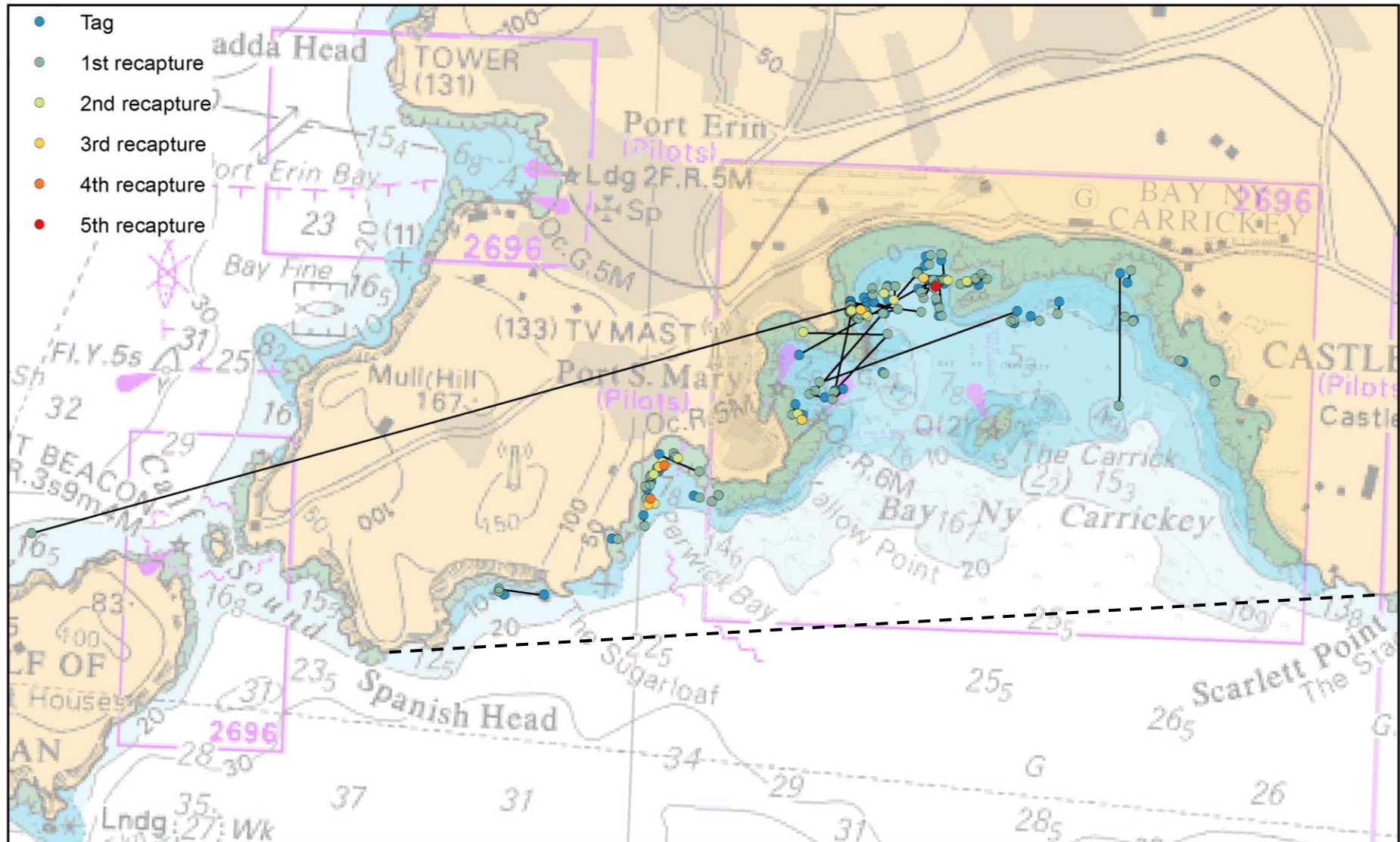
Of the 75 lobsters that were recaptured, 26 had grown and were therefore assumed to have moulted on at least one occasion (Figure 3). The minimum increase in carapace length was 5 mm. Lobsters that moulted grew by 13% on average, with the average size increase being 11 mm. The median growth rate in the bay was 1 mm per month, with all individuals exhibiting similar rates (Figure 3).



**Figure 3.** Temporal changes in the carapace lengths of lobsters which moulted between captures. The average growth rate of each lobster is labelled in  $\text{mm month}^{-1}$ , and minimum landing size (87 mm) indicated by the red line.

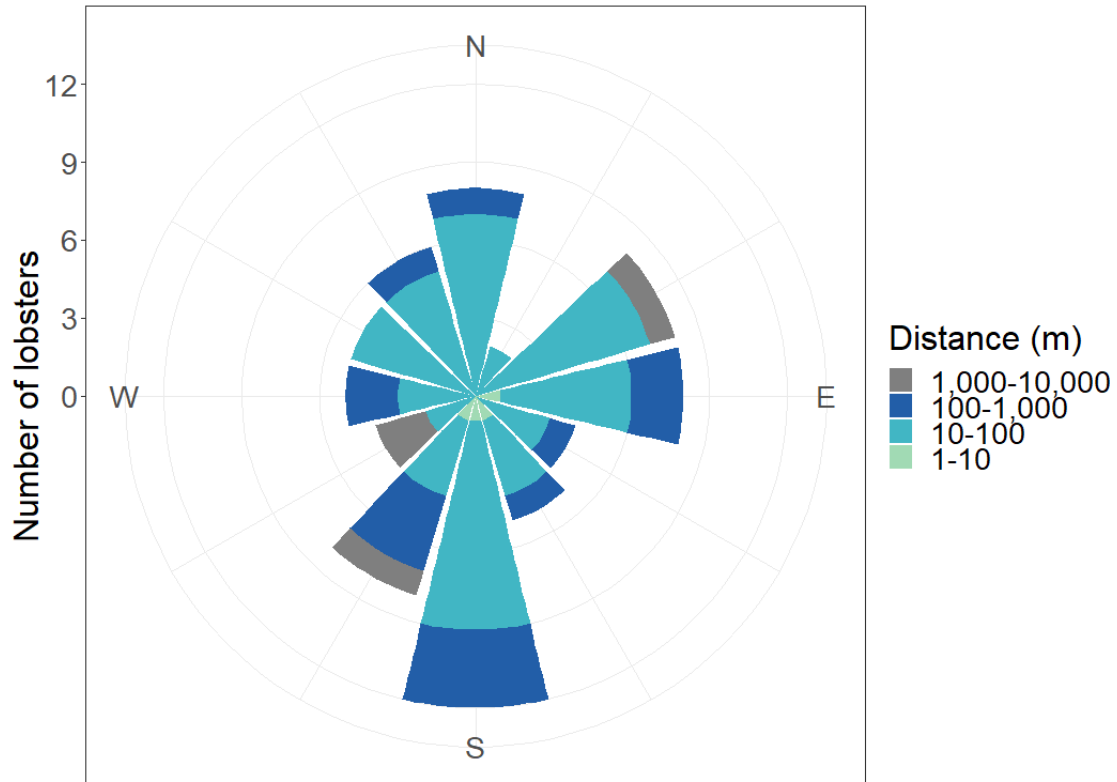
### Spatial Analysis:

All lobsters were recaptured within the Baie ny Carrickey Marine Nature Reserve, with the exception of one individual that was recaptured off the Calf of Man, more than 6 km away from where it was tagged (Figure 4). Overall, 75% of the lobsters that were recaptured were within 100 m from where they were originally tagged and released (Figure 5), and only 11% were found further than 500 m away in any recapture. The median distance travelled between capture events 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 5), with both the number of lobsters and median distance travelled greatest towards the south (Table 1).



**Figure 4.** Movement of recaptured lobsters between pots on the south coast of the Isle of Man (2016-2018). Tagging and recapture locations are displayed for the 75 lobsters that were recaptured on at least one occasion, with different colours for successive recaptures. The distances between captures of individual lobsters are displayed as black lines, with the boundary of the Baie ny Carrickey Marine Nature Reserve marked by the dotted line.





**Figure 5.** Wind-rose-style diagram indicating the net distances and directions travelled by all recaptured lobsters.

**Table 1.** The proportion of recaptured lobsters moving in different directions, and the median net distances travelled.

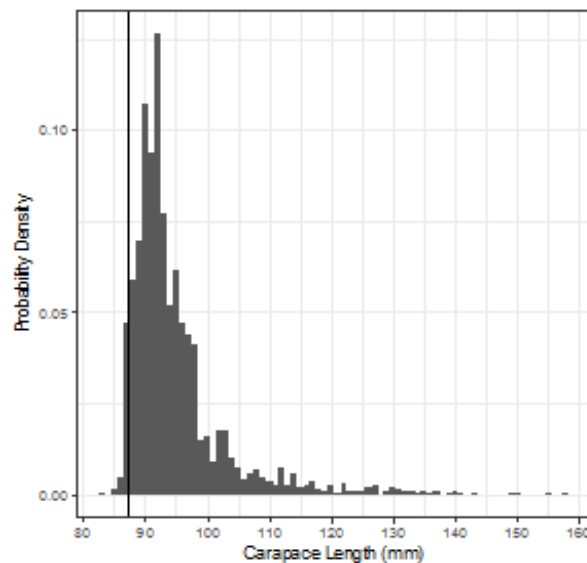
Direction	Proportion	Median distance
North (315-45°)	21%	54 m
East (45-135°)	27%	61 m
South (135-225°)	33%	71 m
West (225-315°)	19%	50 m

## **Discussion**

The ongoing Baie ny Carrickey lobster tagging project has provided the first data on the growth and movement patterns of European lobster (*Homarus gammarus*) in Manx waters. A good recapture rate (24%) has been achieved so far, with 4% recaptured twice or more. These rates are comparable to other studies (James-Pirri and Cobb, 2000; Agnalt et al., 2006).

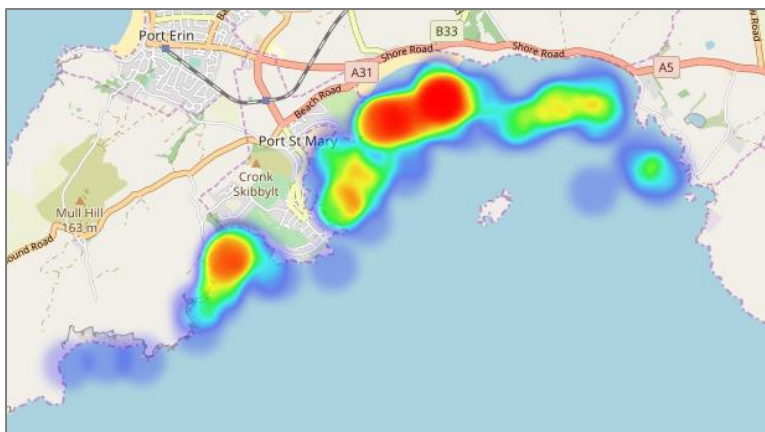
Based on the average % growth in this study (13%), it can be assumed that lobsters in the bay at CL > 77 mm will recruit into the fishery (87 mm CL) after ecdysis. This knowledge is important for future monitoring of the population and designing stock assessment surveys. Sampling lobsters down to a

size of 77 mm (CL) is required in order to forecast recruitment into the next season, with the Manx lobster fishery largely dependent on individuals just above the minimum landing size (Figure 6).



**Figure 6.** Size distribution of all lobster landings in the Isle of Man territorial sea in 2017.

With regard to spatial patterns, the large majority of lobsters only travelled short distances and remained local to different regions of the Baie ny Carrickey Marine Nature Reserve. Similar site fidelity has been identified in other lobster tagging studies, for example Agnalt et al. (2006) found 96% of recaptures within 1 km of release locations, compared to 95% in this study, and Bannister et al. (1994) recaptured lobsters up to a distance of 6 km away, which was the furthest distance travelled in this study. However it is important to note that the data collected so far is spatially limited to the areas where G.S routinely fishes (inshore Baie ny Carrickey – Figure 7), as no usable data has been reported by other pot fishermen, with the exception of the lobster recaptured off the Calf of Man more than 6 km away from the reserve. This suggests that there is likely to be connectivity between the reserve and surrounding areas that is not represented in the data, with the potential for larger individuals to travel outside of the reserve. To capture this potential connectivity, and explore any spill-over effects from the reserve, it is necessary to expand the project in the future by achieving the cooperation of other commercial pot fishermen.



**Figure 7.** Heatmap of all lobster tagging data collected from 2016-2018.



Although hitherto limited to the Baie ny Carrickey Marine Nature Reserve, this study has been successful for two years at a local scale. The KoBoCollect app proved to be a simple and efficient way of recording data during routine fishing activities, with 315 lobsters tagged and 97 recaptures achieved through the cooperation of a single commercial fisherman. With the involvement of the Manx lobster fishing fleet, similar data could be collected all around the Isle of Man.

## **References**

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