Labadie, Jones and Cockburn Banks (FU20-21)

2013 UWTV Survey Report

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Abstract

This report provides the main results of the 2013 underwater television survey on the 'Labadie, Jones and Cockburn Banks' ICES assessment area; Functional Unit 20-21. Some exploratory stations were carried out in 2006 and 2012. The survey was multi-disciplinary in nature collecting UWTV, CTD, Multibeam and other ecosystem data. A randomised isometric grid design was employed with UWTV stations at 6.0 nmi intervals. Due to weather and technical downtime only 58 out of the 95 planned stations were successfully completed. The adjusted mean density for 2013 was 0.18/m^2 which can be classified as "low density". Scientific knowledge of the heterogeneous habitat and spatial distribution of the *Nephrops* population in this area is developing. Survey design and burrow identification are particularly difficult in this area due to factors discussed. The occurrence of sea-pens and trawl marks on the UWTV footage is also presented.

Key words: *Nephrops norvegicus*, stock assessment, geostatistics, underwater television (UWTV), benthos.

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Introduction

The prawn (*Nephrops norvegicus*) are common in the Celtic Sea occurring in geographically distinct sandy/muddy areas were the sediment is suitable for them to construct their burrows. The *Nephrops* fishery in VII is extremely valuable with landings in 2012 worth around € 80 m at first sale. The Celtic Sea area (Functional Units 19-22 see Figure 1) supports a large multi-national targeted *Nephrops* fishery mainly using otter trawls and yielding landings in the region of ~5,000 t annually over the last decade (ICES, 2013). The 2012 reported landings from this FU20-21 were estimated to be worth in the region of €6 m at first sale. This ground has become increasingly important to the Irish demersal fleet which now account for over 50% of the FU20-21 *Nephrops* landings. Good scientific information on stock status and exploitation rates are required to inform sustainable management of this resource.

Nephrops spend a great deal of time in their burrows and their emergence behaviour is influenced by several factors: time of year, light intensity, tidal strength, etc. Underwater television surveys and assessment methodologies have been developed to provide a fishery independent estimate of stock size, exploitation status and catch advice (ICES, 2009a & 2012a). This is the second UWTV survey in the Celtic Sea FU20-21 grounds carried out by the Marine Institute, Ireland. The 2013 survey was multi disciplinary in nature; the specific objectives are listed below:

1. To complete ~95 UWTV stations with 6.0 nautical mile (Nmi) spacing stations on the *Nephrops* ground.
2. To obtain 2013 quality assured estimates of *Nephrops* burrow distribution and abundance on this ground.
3. To collect ancillary information from the UWTV footage collected at each station such as the occurrence of sea-pens, other macro benthos and fish species and trawl marks on the sea bed.
4. To collect oceanographic data using a sledge mounted CTD.
5. To collect multibeam data during the survey with the aim to improve knowledge habitat and ground boundaries.

This report details: the survey design, the final UWTV results of the 2013 survey and also documents other data collected during the survey.

Material and methods

The knowledge about the distribution of suitable *Nephrops* habitat in this area is developing. Information so far suggests that *Nephrops* are found in complex channels, which are probably the remnants of fluvial channels related to the deglaciation of the Irish ice sheet at the end of the last ice age. The initial ground perimeter used during this survey (Figure 2) was established using a combination of integrated logbook VMS data (using the methods described in Gerritsen and Lordan, 2011), BGS sediment maps and data collected on observer trips. The total area of this polygon is 9,840 km^2.

In 2013 a randomised isometric grid of 95 stations with a 6.0 nautical mile spacing was planned. Stations depths varied from 95 m to 134 m and the completed stations ranged from 55 to 135 nautical miles (nmi) offshore. The 2013 Celtic Sea survey took place on RV Celtic Voyager between 28th August to 06th September. The survey time also included UWTV operations in FU16 and FU19 reported elsewhere.

The operational protocols used were those reviewed by WKNEPHTV 2007 (ICES, 2007) and employed on other UWTV surveys in Irish waters. These protocols can be summarised as follows: At each station the UWTV sledge was deployed. Once stable on the seabed a 10 minute tow was recorded onto DVD. Time referenced video footage was collected from a video camera with field of view or 'FOV' of 75 cm. Vessel position (DGPS) and position of sledge (using a USBL transponder) were recorded every 1 to 2 seconds. The navigational data was quality controlled using an "r" script developed by the Marine Institute (ICES, 2009b). The USBL navigational data was used to calculate distance over ground or 'DOG' for all of stations. In 2013 the USBL navigational data was used to calculate distance over ground for 98% of stations.

In line with SGNEPS recommendations all scientists were trained/re-familiarised using training material and footage from the 2012 Labadie survey, prior to recounting at sea (ICES, 2009b). As the FU20-21 UWTV survey is in its infancy there is no FU specific reference footage available. All recounts were conducted by two trained "burrow identifying" scientists independent of each other on board the research vessel during the survey. During this review process the visibility, ground type and speed of the sledge during one-minute intervals were subjectively classified using a classification key. In addition the numbers of *Nephrops* burrows complexes (multiple burrows in close proximity which appear to be part of a single complex which are only counted once), *Nephrops* activity in and out of burrows were counted by each scientist for each one-minute interval was recorded. Following the recommendation of SGNEPS the time for verified recounts was 7 minutes (ICES, 2009b).

Notes were also recorded each minute on the occurrence of trawl marks, fish species and other species. Abundance categories of sea-pen species were also recorded due to OSPAR Special Request (ICES 2011) using the scale provided in Table 1. Finally, if there was any time during the one-minute where counting was not possible, due to sediment clouds or other reasons, this was also estimated so that the time window could be removed from the distance over ground calculations. The "r" quality control tool allowed for individual station data to be analysed in terms of data quality for navigation, overall tow factors such as speed and visual clarity and consistency in counts (Figure 3). Consistency and bias between individual counters was examined using Figure 4. There is high variability between counters but no obvious bias or excessive deviations. The high variability between counters is because burrow counting in this area is particularly difficult (see discussion).

The recount data were screened for one minute intervals with any unusually large deviation between recounts. These minutes were re-verified by means of consensus counts. Means of the burrow and *Nephrops* recounts were standardised by dividing by the survey area observed. The USBL data were used to calculate distance over ground of the sledge. The field of view of the camera at the bottom of the screen was estimated at 75cm assuming that the sledge was flat on the seabed (i.e. no sinking). This field of view was confirmed for the majority of tows using lasers during the 2013 survey. Occasionally the lasers were not visible at the bottom of the screen due to sinking in very soft mud (the impact of this is a minor under estimate of densities at stations where this occurred).

An EM3002_478 Multibeam Echosounder was used to collect bathymetric and sediment hardness data during the UWTV survey. The system operates efficiently in max. 150 m depth and can provide total swathe coverage of ~280m. Seabed imagery was monitored in real-time to monitor the habitat at each station with soft muddy substrate producing light grey

colouration whereas hard rock appears black (because an acoustic signal returns strongly from a hard surface and is absorbed in soft sediment).

In addition CTD profile was logged for the duration of each tow using a Seabird SBE 37. These datasets will be processed later.

Results

Due to weather and technical downtime only 58 out of the 95 planned stations were successfully completed (Figure 2). These stations covered the northern part of the survey grid only. Figure 5 and Figure 6 shows the variability in density between minutes and operators (counters) for each station. These show that the variability between minutes and counters is at a similar scale.

A summary of the univariate statistics for adjusted[1] burrow density in FU20-21 by year are presented in Table 3. The adjusted mean density for 2013 was 0.18/m^2 which can be classified as "low density" (ICES, 2013). Extrapolating this density to the entire area of the polygon in Figure 2 would result in an abundance estimate of ~1.5 billion burrows. Extrapolating the density to the area surveyed would result in an abundance estimate of ~0.9 billion burrows. The mean density estimate is significantly lower than the mean density observed in 2006 and 2012 the reasons for this are discussed further later. Histograms of observed burrow densities for FU20-21 are shown in Figure 7. There is a large difference between the density distributions in 2012 and 2013. The modal density in 2013 is in the class 0.1-0.2 burrows/m^2.

The spatial distribution of adjusted mean density (burrows/m^2) at each station by year is shown in Figure 8. In 2013 the highest densities were observed in the central area and the lowest were observed at the northern sector of the ground.

2013 Sea-pen distribution across the surveyed grounds is mapped in Figure 9. All sea-pens were identified from the video footage as *Virgularia mirabilis*. *V.mirabilis* was also present at stations where trawl marks were recorded. Trawl marks were noted at 31% of the stations surveyed with trawl marks present for the entire transect for 11%. It was noted from the video footage that very few *Nephrops* were observed actively outside of the burrows and also very few were visible just within the burrows compared to footage on other *Nephrops* grounds.

Discussion

In response to the WKNEPH 2012 recommendations Ireland reviewed survey effort in FU15, 17 and 22 and reallocated survey effort to FU16, 19 and 20-21 (ICES, 2012). The main aim was to achieve some UWTV survey coverage for the main *Nephrops* grounds fished in ICES sub-area VII whilst maintaining the accuracy and acceptable precision for existing survey series. As is clear from Figure 1 the *Nephrops* fishery in FU20-21 is both geographically extensive and complex in structure.

Developing an UWTV survey for FU20-21 is particularly challenging. Due to a combination of poor weather and some technical down time in 2013 only 61% coverage limited to the northern part of the survey grid was achieved. During exploratory surveys of FU20-21 in

[1] Note the "adjusted" density estimates in this report are adjusted by dividing by 1.3 (Table 2) to take account of edge effect over estimation of area viewed during UWTV transects (see Campbell et al 2009).

2006 and 2012 stations were chosen based on areas with known *Nephrops* directed fishing activity. As already mentioned scientific knowledge of the heterogeneous habitat and spatial distribution of the *Nephrops* population in this area is developing. This is one of the key issues to be addressed when the stock is benchmarked at WKCELT in 2014. In 2013 a randomised isometric grid with stations every 6 nautical miles was planned to ensure wide spatial coverage within the time frame of sea time available. Using a fixed grid also avoids risk of bias due to adjustments in station location based on VMS data or for other operational reasons (e.g. multibeam and/or echosounder information). In retrospect, it seems likely that density estimates in 2006 and 2012 may have been biased by focusing on areas with higher *Nephrops* directed fishing activity and away from more marginal habitats closer to the boundaries of fishing activity.

In addition to the complex nature of the *Nephrops* habitat in FU20-21 burrow counting in this area is also particularly difficult. Irish *Nephrops* UWTV surveys cover a wide variety of ground types and densities from the highest in FU15 to the lowest in FU16. The consensus for the experience burrow counters was that FU20-21 is the most challenging of all areas to count. There are a huge diversity of burrow sizes and shapes on the sea bed in FU20-21. Burrows with the classical *Nephrops* signatures are common but they are interspersed with burrows of various crab and other burrowing megafauna species. The usual approach adopted when counting the *Nephrops* footage of "*if in doubt leave it out*" is likely to mean that the density estimates are a biased underestimate of true density. The diversity in burrows suggests a more diverse species assemblage than in other areas.

An important objective of this UWTV survey is to collect various ancillary information. The occurrence of trawl marks on the footage is notable for two reasons. Firstly, it makes identification of *Nephrops* burrows more difficult as the trawl marks remove some signature features making accurate burrow identification more difficult. Secondly, only occupied *Nephrops* burrows will persist in heavily trawled grounds and it is assumed that each burrow is occupied by one individual *Nephrops* (ICES 2008). The CTD data and multibeam data collected during this survey will be processed at a later stage. This information is relatively easy to collect and over time will augment the knowledge base on habitat and oceanographic regime.

Acknowledgments

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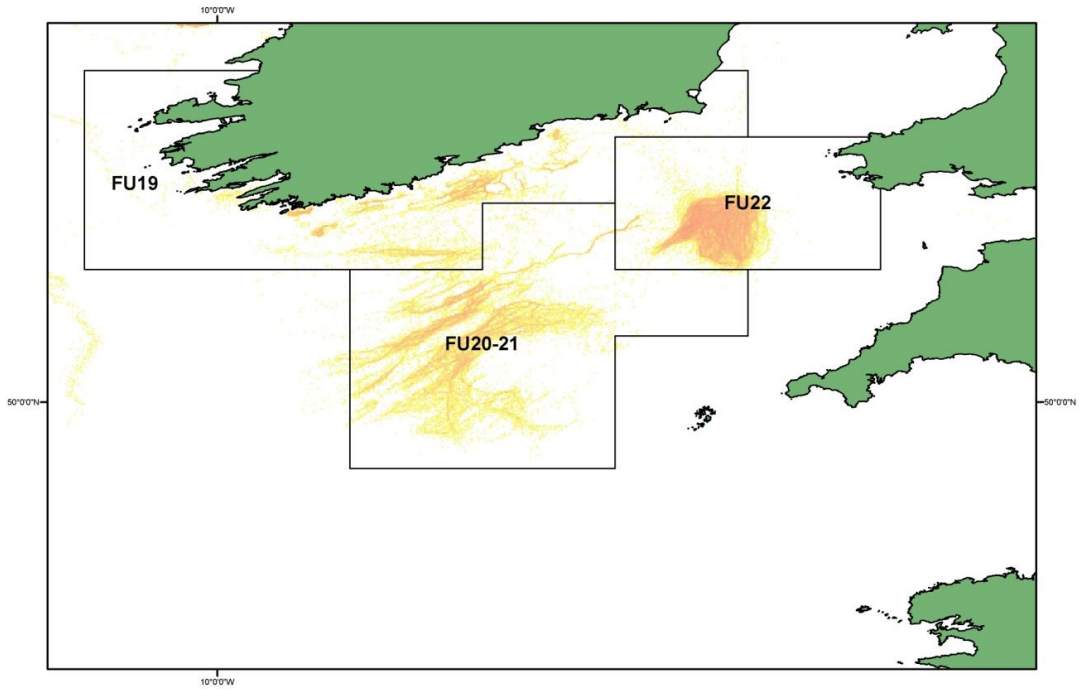

Figure 1: *Nephrops* Functional Units (FUs) in the greater Celtic Sea on heat map of *Nephrops* directed Irish fishing activity.

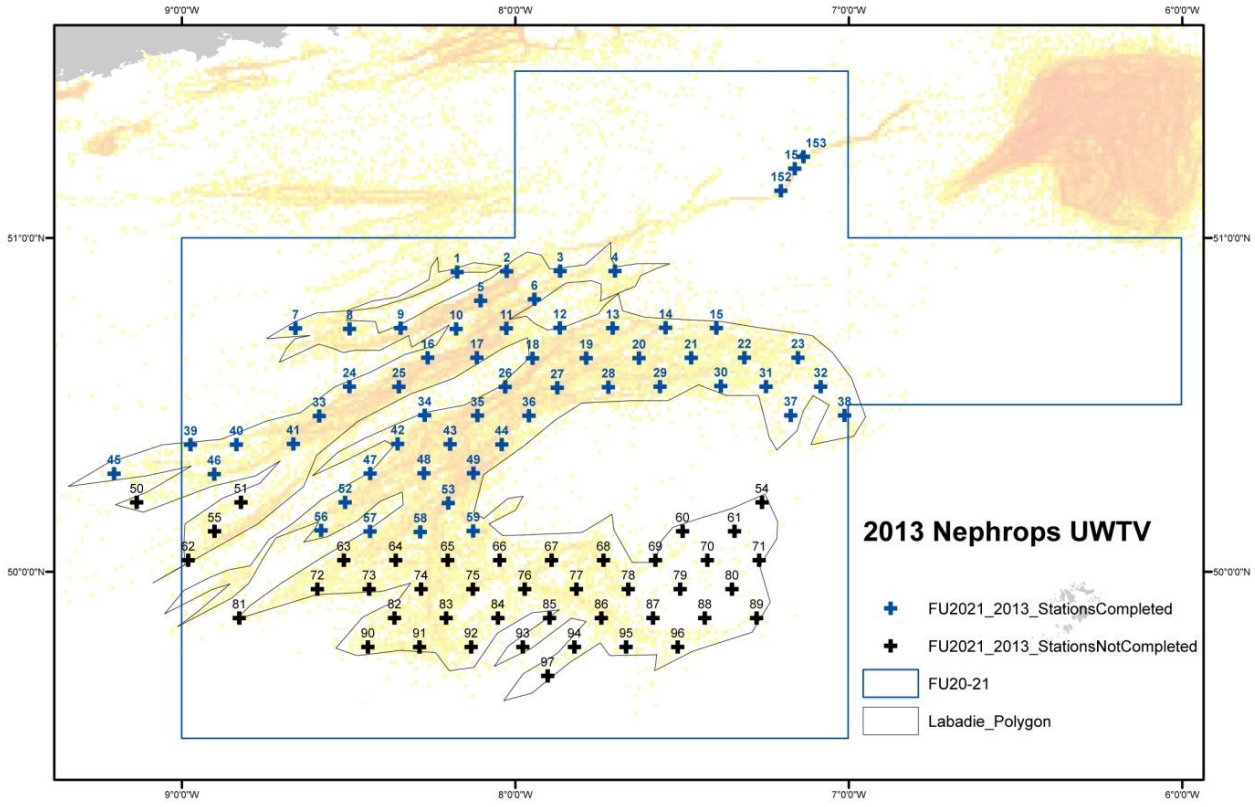

Figure 2: FU20-21: TV stations completed on the 2013 survey overlaid on a heat map of *Nephrops* directed Irish fishing activity .(+) denotes stations not surveyed in 2013.

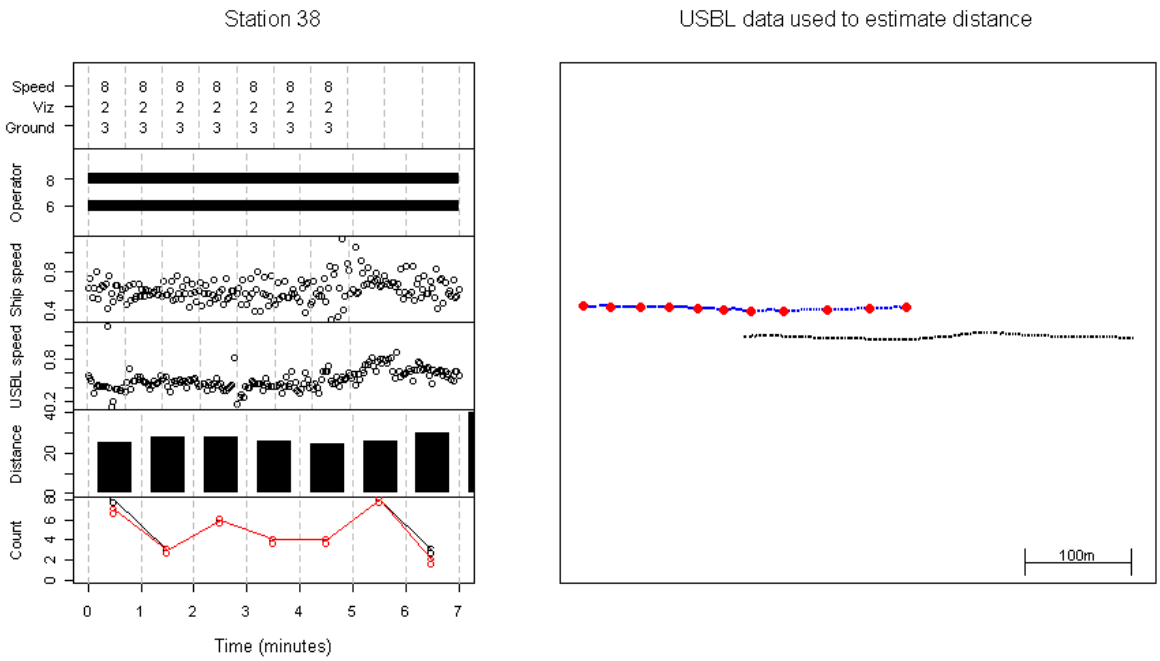

Figure 3 : FU20-21: r - tool quality control plot for station 38 of the 2013 survey.

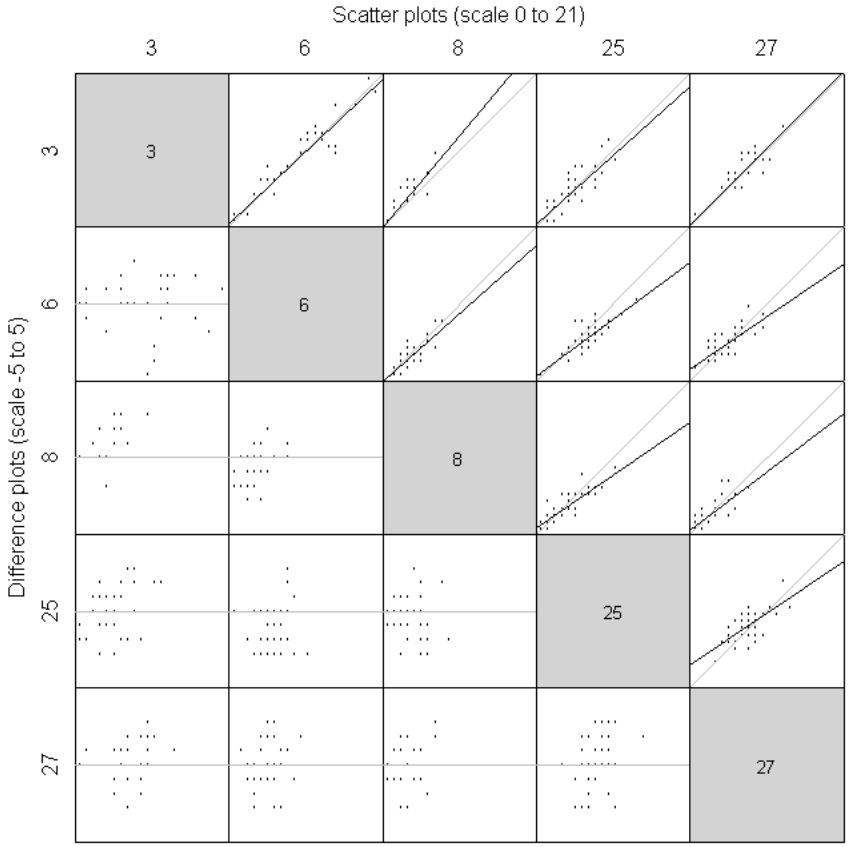

Figure 4 :FU20-21 : Scatter plot analysis of counter correlations for the 2013 survey.

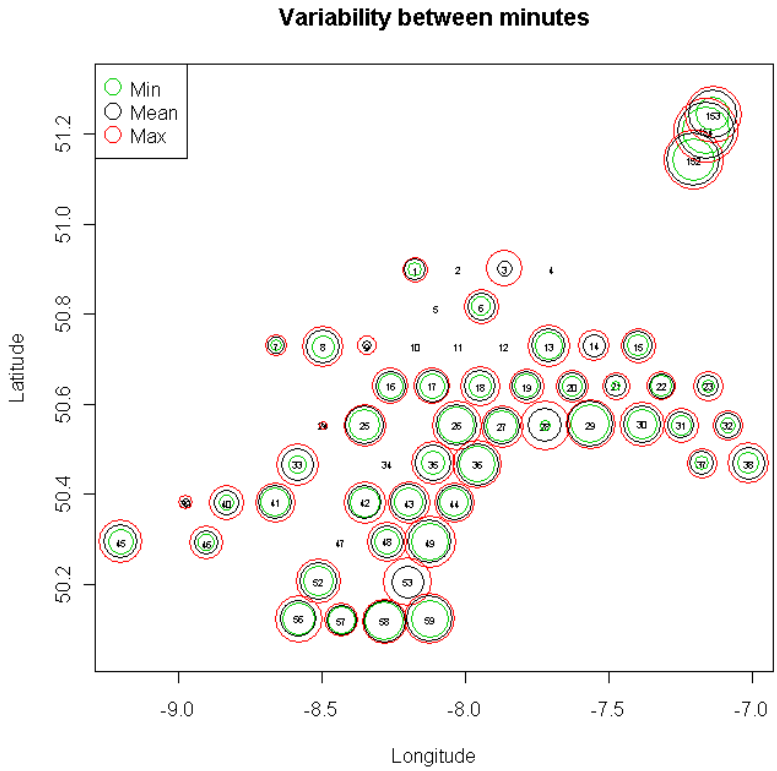

Figure 5: FU20-21: Plot of the variability in density between minutes for each station in 2013.

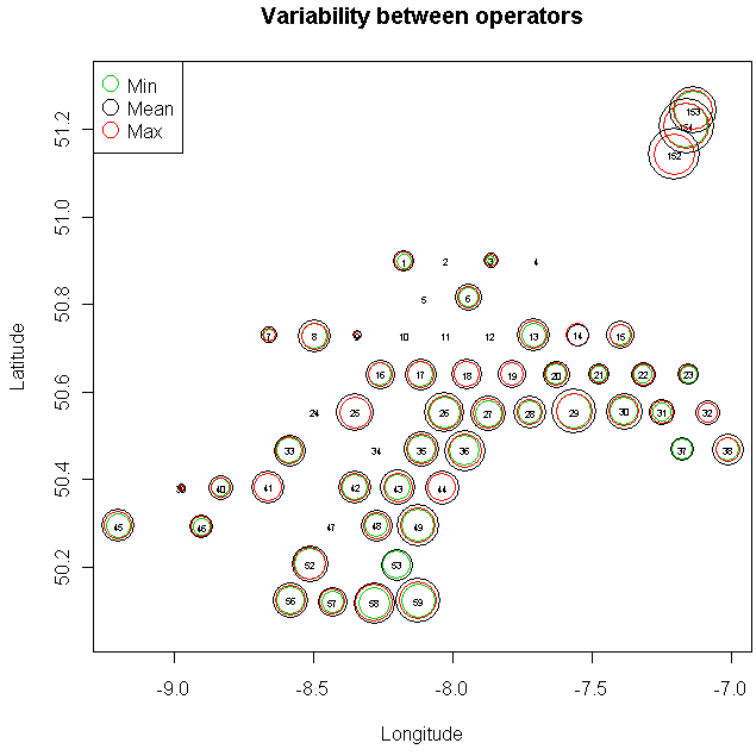

Figure 6: FU20-21: Plot of the variability in density between operators (counters) for each station in 2013.

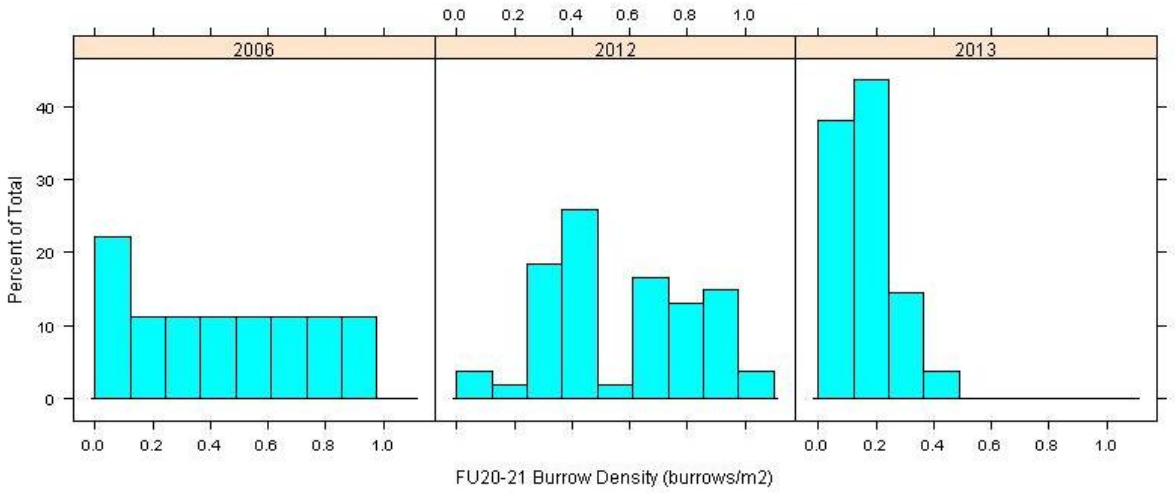

Figure 7: FU20-21: Frequency histograms of observed burrow densities on UWTV surveys in FU20-21.

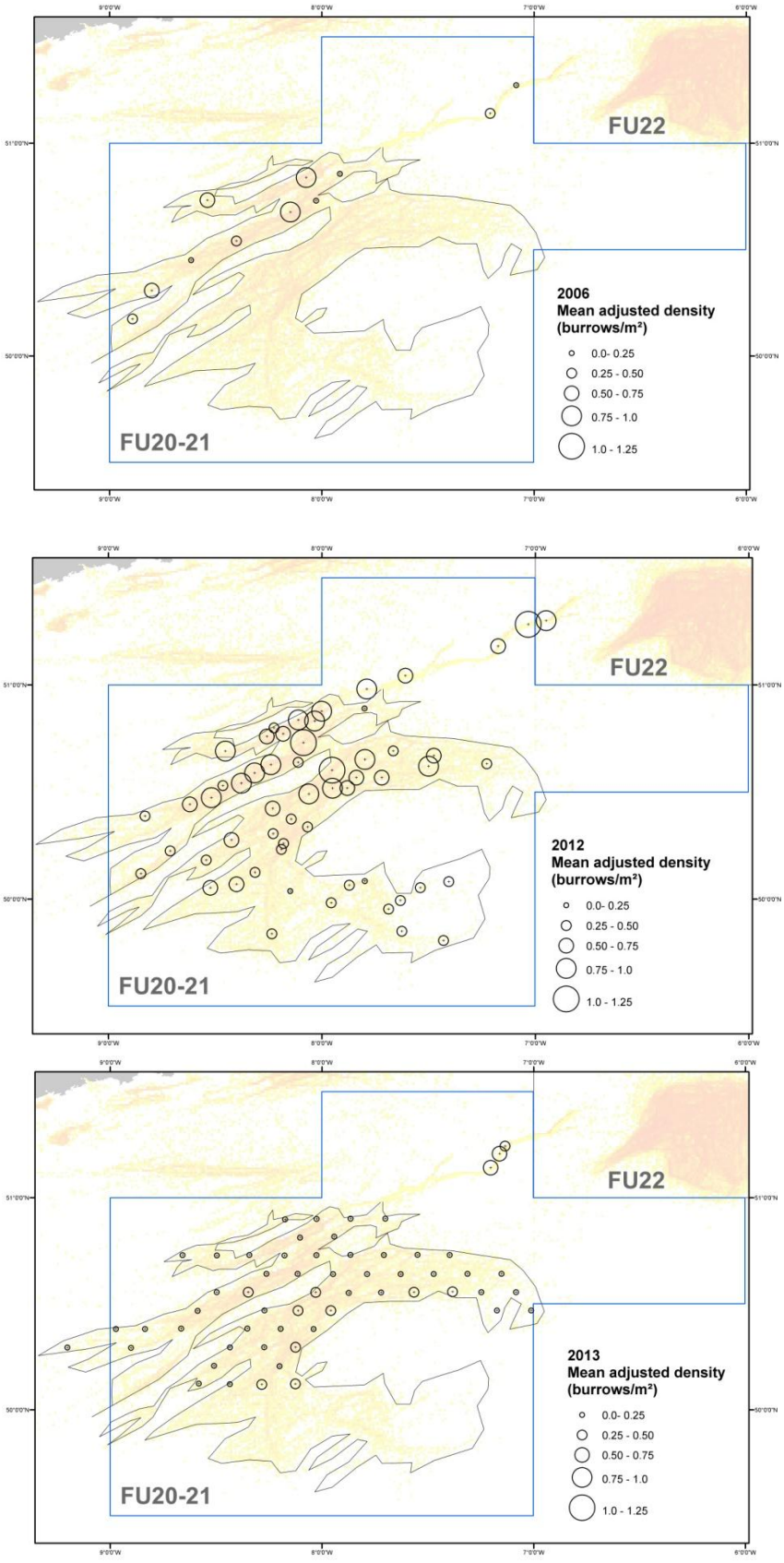

Figure 8: FU20-21: Bubble plots of the mean density (burrows/m²) for UWTV surveys in 2006, 2012 and 2013.

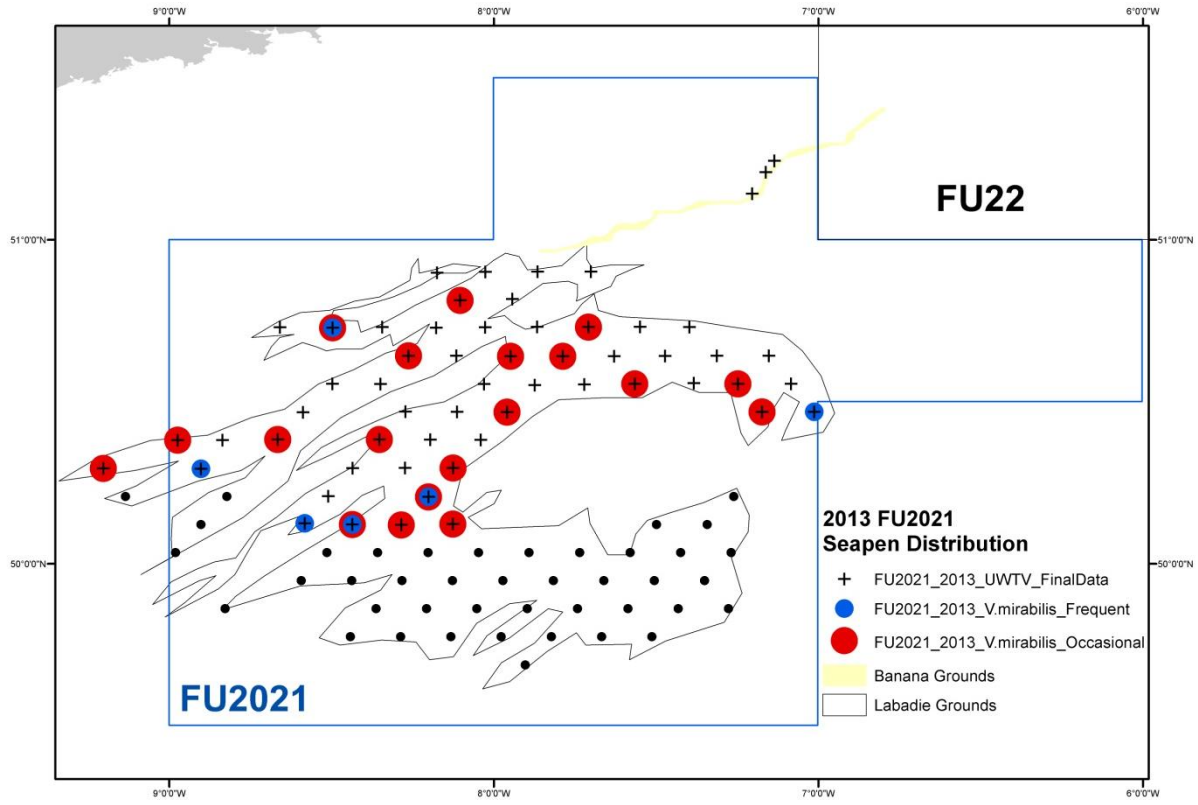

Figure 9 : FU20-21: Stations where *Virgilaria mirabilis* was identified during the 2013 survey overlaid on a heat map *Nephrops* directed fishing activity.

Table 1: Key for classification of Seapen abundance as used on Irish UWTV surveys.

	Number/Min
Common	20-200
Frequent	2-19
Ocasional	<2

Species
Virgularia mirabilis
Pennatula phosphorea
Funiculina quadrangularis

Sea Pens								
V. mirabilis			*P. phosphorea*			*F. quadrangularis*		
C	F	O	C	F	O	C	F	O

Table 2: Cumulative bias factors for each *Nephrops* stock surveyed by UWTV method.

	FU	Edge effect	Burrow detection	Burrow identification	Burrow occupancy	*Cumulative Bias*
3&4 Skagerrak and Kattegat (IIIa)	FU3	1.3	0.75	1.05	1	1.1
6:Farn Deeps	FU6	1.3	0.85	1.05	1	1.2
7:Fladen	FU7	1.45	0.9	1	1	1.35
8:Firth of Forth	FU8	1.23	0.9	1.05	1	1.18
9:Moray Firth	FU9	1.31	0.9	1	1	1.21
10: Noup	FU10	1.31	0.9	1	1	1.21
11:North Minch	FU11	1.38	0.85	1.1	1	1.33
12:South Minch	FU12	1.37	0.85	1.1	1	1.32
13:Clyde	FU13	1.19	0.75	1.25	1	1.19
14: Irish Sea East	FU14	1.3	0.85	1.05	1	1.2
15:Irish Sea West	FU15	1.24	0.75	1.15	1	1.14
16: Porcupine	FU16	1.26	0.95	1.05	1	1.26
17:Aran	FU17	1.35	0.9	1.05	1	1.3
19:South Coast	FU19	1.25	0.9	1.15	1	1.3
20&21 Labadie	FU20-21	1.25	0.9	1.15	1	1.3
22:Smalls	FU22	1.35	0.9	1.05	1	1.3
34: Devil's Hole	FU34	1.3	0.85	1.05	1	1.2

Table 3: FU20-21 Summary of univariate statistics for the burrow density estimates (bias corrected).

Year	**1st Quantile**	**Median**	**Mean**	**3rd Quantile**	**Max**	**No. of Stations**	**StDev**	**CV/Relative Standard error**
2006	0.13	0.42	0.40	0.60	0.91	11	0.31	24%
2012	0.38	0.62	0.58	0.77	1.04	57	0.26	6%
2013	0.10	0.17	0.18	0.24	0.60	58	0.14	10%