

Porcupine Bank *Nephrops* Grounds (FU16) 2025 UWTV Survey Report and catch scenarios for 2026

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Abstract

This report provides the results of the fourteenth underwater television on the 'Porcupine Bank *Nephrops* grounds' ICES assessment area; Functional Unit 16. The survey was multidisciplinary in nature collecting UWTV and other ecosystem data. In total 69 UWTV stations were successfully completed (100% of the planned stations) in a randomised 6 nautical mile isometric grid covering the full spatial extent of the stock. The mean burrow density observed in 2025, adjusted for edge effect, was 0.17 burrows/m². The final kriged abundance estimate was 1220 million burrows with a CV of 3%. The 2025 abundance estimate was 27% lower than in 2024. Using the 2025 estimate of abundance and updated stock data imply that catches in 2026 should be between 1750 and 2169 tonnes, according to the EU MAP and ICES MSY approach (assuming that all catch is landed). Four species of sea-pen (*Virgularia mirabilis*, *Funiculina quadrangularis*, *Pennatula phosphorea* and the deepwater sea-pen *Kophobelemnion stelliferum*) were observed during the survey. Trawl marks were also observed on 65% of the stations surveyed.

Key words: *Nephrops norvegicus*, Porcupine Bank, stock assessment, geostatistics, underwater television (UWTV), sea-pens, benthos.

1. Introduction

Nephrops norvegicus are common around the Irish coast occurring in geographically distinct sandy/muddy areas where the sediment is suitable for them to construct their burrows. The *Nephrops* fishery in ICES Subarea 7 is extremely valuable with Irish landings in 2024 worth around €57 million at first sale. The *Nephrops* fishery on the Porcupine Bank takes place on a large area approximately 7130 km² of complex muddy habitat between depths of 330 to 580m. The fishery typically yields very large individual *Nephrops* that attain very high market prices relative to other fisheries around Ireland. International landings from the fishery peaked in the early 1980s around 4000 tonnes, declining since then with some fluctuations (ICES, 2025a). The total estimated Irish landings in 2025 were 2 032 tonnes.

In the past sustainability of the Porcupine Bank *Nephrops* stock has been a major concern. Consequently, a spatio-temporal closed area was developed and proposed by the North Western Waters Advisory Council (NWWAC) and implemented between 1st June and 31st July in 2010-2012. Since 2013 Irish fishing has closed for one month from 1st to 31st of May. Since 2011 a functional unit catch limit (actually landings) has also been in place as part of the TAC regulation (ICES, 2014). These measures were introduced due to negative trends in the various indicators used to assess the stock and ICES advised for a closure of the fishery in 2009 and 2010. The stock situation is known to have improved since 2010 following good recruitment. Scientific information for this area improved with the introduction of a dedicated Irish fisheries-science partnership trawl survey between 2010 and 2012 and the provision of commercial grade data by the Irish fishing industry from 2010 to 2019 (ICES, 2014).

Nephrops spend a great deal of time in their burrows and their emergence behaviour is influenced by many factors; time of year, light intensity and tidal strength. Assessment methodologies, based on underwater television surveys, have been developed by ICES to provide a fishery independent estimate of stock size, exploitation status and catch advice (ICES, 2009 & 2013). Since 2012, UWTV surveys have been used to assess and provide catch scenarios and advice for this stock (ICES, 2013).

This was the 14th UWTV survey of the Porcupine Bank *Nephrops* grounds (FU16). The 2025 survey was multi-disciplinary in nature. The specific objectives are listed below:

1. To obtain 2025 quality assured estimates of *Nephrops* burrow densities from a randomised isometric grid of UWTV stations at 6 nautical mile spacing over the known spatial and bathymetric distribution of the stock (Figure 1).
2. To collect ancillary information from the UWTV footage collected at each station such as the presence of sea-pens, other macrobenthos and fish species and trawl marks on the sea bed.
3. To collect oceanographic data using a sledge mounted temperature-depth profiler.

This report details the final UWTV results of the 2025 survey and also documents other data collected during the survey. Operational survey details are available in the form of a survey narrative from the scientist in charge (JD). The 2025 abundance data are used to generate

catch options for 2026 in line with the recommendations and procedures outlined at the 2013 ICES benchmark (ICES, 2013) and in the stock annex (ICES, 2013) and using the F_{MSY} reference points proposed by FMSYREF4 (ICES, 2016).

2. Material and methods

UWTV

A randomised isometric grid of stations at 6 nautical mile or 11.1km intervals was planned for the area. The boundary used to delineate the edge of the ground was based on VMS (Vessel Monitoring System) data of fishing activity between 2006-2011 targeting *Nephrops* (Lordan *et al.* 2012). The grid spacing was determined based on a time constraint of getting the survey completed within a time window of around 5-6 days. This resulted in 69 planned stations and were generated using the “spsamp” function in the “sp” package (Pebesma & Bivand, 2005) of “R” (R Core Team, 2022). Data on bathymetry and backscatter were also available from the Irish National Seabed Survey and INFOMAR project (<http://www.infomar.ie/>). The stations ranged from 343m to 561m in depth with an average depth of 448m (Figure 1). Survey timing has generally been standardised to June each year. In 2015 the national research vessel broke down prior to the survey and the survey was not carried out despite several attempts to get to this ground. In 2025, the FU16 survey was carried out between the 6th of June and the 13th of June on the RV. *Tom Crean* during the TC25012 Marine Institute survey.

In 2025 image data were collected by a custom built camera system recording High Definition (HD) still image data at 12 frames per second with a camera angle of 75 °. The digital images were stored on a server and were reviewed ashore through an in-house developed image annotation R Shiny app (Aristegui, 2020). This app allows each reviewer to annotate burrows for each randomly assigned station in an efficient manner. The survey process is now paperless. Video guide of the review app is available [here](#).

The operational protocols used were those reviewed by WKNEPHTV 2007 (ICES, 2007) and follow internationally agreed standards as recommended in the Manual for the *Nephrops* Underwater TV Surveys (TIMES) (Dobby H., *et al.*, 2021) and in the use of UWTV surveys for determining abundance in *Nephrops* stocks throughout European waters (Leocádio A., *et al.*, 2018). These protocols are employed on other UWTV surveys in Irish waters and can be summarised as follows: At each station the UWTV sledge was deployed. Once stable on the seabed a 10-minute tow was recorded. Time-referenced HD image data were captured. The field of view (FOV) was calibrated using a chessboard exercise following recommendations by the international coordination group for *Nephrops* underwater television and trawl surveys (ICES, 2025b). A reference board with 5 x 5 cm squares markings was attached to the sled and lowered into the water, allowing direct measurement of both the FOV and the laser spacing (Table 1). Calibration was carried out at the start of each survey to verify measurements and adjust camera alignment. Vessel position (DGPS) and position of sledge (using a USBL transponder) were recorded every 1 or 2 seconds. The navigational data were quality controlled using an “R” script developed by the Marine Institute (ICES, 2009b). In 2025 the USBL navigational data were used to calculate distance over ground for 100% of the stations.

In line with recommendations of the Workshop on *Nephrops* Burrow Counting (WKNEPS), all scientists were trained/re-familiarised using HD image data for training material and a reference set (ICES, 2018). All counts were conducted by five trained scientists independent of each other during the survey. The numbers of *Nephrops* burrow systems were counted, where multiple burrows in close proximity which appeared to be part of a single system were counted as one. *Nephrops* activity in and out of burrows were counted and recorded for each station.

Following the recommendation of ICES Study Group on *Nephrops* Surveys (SGNEPS) the time for verified recounts was seven minutes (ICES, 2009) but this was increased to nine minutes for the Porcupine until 2022. This was because at the lower densities observed the relative scale of variation between minutes was higher than typical compared to *other Nephrops* grounds. Therefore, counting more minutes resulted in a more stable mean density estimates for each station. Since 2023 seven minutes have been counted in each station due to a burrow density increase at the Porcupine in the recent years, following the SGNEPS recommendation.

Presence / absence for the occurrence of trawl marks, fish and other species were also recorded at each station. Presence / absence of sea-pen species were recorded to fulfil an OSPAR Special Request (ICES 2011) using an in-house identification guide available [here](#).

Finally, if there was any time during each minute where counting was not possible due to sediment clouds or other reasons, this time was recorded and removed from the distance over ground calculations. The “R” quality control tool allowed for the data quality of navigation, speed, visual clarity and consistency in counts to be checked (an example is given in Figure 2).

In 2025 survey count data were screened to check for any unusual discrepancies using Lin’s Concordance Correlation Coefficient (CCC) with a threshold of 0.6. Lin’s CCC (Lin, 1989) measures the ability of counters to reproduce each other’s counts on a scale of 1 to -1, where 1 is perfect concordance (i.e. a pairwise plot will have all points lying along the 1:1 line; a value of -1 would be generated by all points lying on the -1:1 line and a value of 0 indicates no correspondence at all). Lin’s CCC quality control plots of survey count data for stations 53 to 55 are shown in Figure 3. When the count data fell below the threshold of 0.6 a third review was carried out. The paired count data that passed the Lin’s CCC threshold was used in the analysis. When the paired counts did not pass the threshold an average of the three reviewers was deemed appropriate to use in the analysis. In 2025, 10% of stations were not verified by Lin’s CCC due to very low counts (< 1.5 burrow systems per station) where this method will fail on such low numbers. Additionally, inspection of violin and box plots of verified survey counts and calculated distance over ground data are carried out where this quality control document is available as a “Rmarkdown” document from the scientist in charge.

Mean density was calculated by dividing the total number of burrow systems by the survey area observed. In 2025, the field of view of the camera at the bottom of the screen was calculated using a chessboard calibration exercise. This direct measurement gave a FoV of 1.07 metres assuming that the sledge was flat on the seabed (i.e. no sinking).

From 2012 to 2014 to account for the spatial co-variance and other spatial structuring a geostatistical analysis of the mean and variance was carried out using SURFER Version 10.7.972 and the kriged estimation variance or coefficient of variance (CV) was carried out using the EVA: Estimation Variance software (Petitgas and Lafont, 1997).

Since 2016, the geostatistical analysis has been carried out using the “*RGeostats*” package version 11.1.1 (Renard *et al.*, 2015) in R, following the procedure documented in the ICES Stock Annex (ICES, 2015). In 2025, this analysis was implemented using the package “*gstlearn*” version 1.7.4 (MINES Paris – PSL University), the successor to *RGeostats*. A comparison of results produced for 2024 and 2025 using both *RGeostats* and *gstlearn* confirmed that the kriging outputs from the two software were highly consistent (Table 2, Figure 4). The same basic steps were applied as in previous years: construction of the experimental variogram, fitting of an exponential variogram model, creation of a kriged grid file using all data points as neighbours, estimation of the domain area using the same boundary, and calculation of mean density, total burrow abundance, and survey precision.

Bottom Temperature Data

For each UWTV station temperature-depth was logged for the duration of each tow using a sled mounted and calibrated RBRbrevio (rated to 2000 m depth). This data will be processed at a later stage. This data will be processed in-house at a later stage, contributing to an emerging time series.

Data

Nephrops UWTV survey data used for stock assessment and in this report can be accessed through the [Marine Institute Data catalogue](#) (Marine Institute, 2025). GIS shapefiles of the *Nephrops* Functional Units and survey polygon area used for stock assessment and in this report can be accessed through the [ICES spatial facility](#).

3. Results

In 2025, 69 stations were completed successfully on the Porcupine Bank (Figure 1). Figure 5 shows bubble plots of the variability between minutes for each station.

A combined violin and box plot of the observed burrow densities is presented in Figure 6. This shows that median, mean burrow densities and inter-quartile ranges were similar in most years, and have decreased in 2025. The mean burrow density observed in 2025, adjusted¹ for edge effect, was 0.17 burrows/m².

The final modelled density surfaces from 2012 to 2014 and 2016 to 2025 are shown as a heat map in Figure 7. The 2025 burrow surface shows a decrease in burrow densities in the centre of the ground compared with 2024, but it is still higher than in previous years. The abundance estimate derived from the kriged burrow surfaces (and adjusted for edge effect) decreased by 27% from 1677 million burrows in 2024 to 1220 million in 2025 (Table 3, Figure 8) with an

¹ Note the “adjusted” density estimates in this report are adjusted by dividing by 1.26 to take account of edge effect over estimation of area viewed during UWTV transects (see Campbell *et al.*, 2009).

estimated area of the ground or domain area of 7,165 km². The estimation CV on the abundance was around 2.9% in 2025.

Trawl marks were observed at 45 out of the 69 surveyed stations (65%). The distribution of the various sea-pen species observed on the UWTV footage is shown in Figure 9. Three seapen species occur in the deep mud habitats around the coastal British Isles and are usually observed in the UWTV surveys: *Virgularia mirabilis*, *Pennatula phosphorea* and *Funiculina quadrangularis* (Hughes, 1998). The distribution over time of a fourth sea-pen, *Kophobelemnon stelliferum*, is shown in Figure 10. This species has been recorded at the Porcupine Seabight in depths to 1600 m (Rice *et al.*, 1992).

The UWTV abundance data together with data from the fishery; landings, removals in number, and mean weight in the landings are shown (Table 4). The basis to the catch options table is given in Table 5. The catch and landings options calculated using the 2025 survey abundance estimate and updated stock data, imply that catches in 2026 should be between 1750 and 2169 tonnes, according to ICES MSY approach (assuming that all catch is landed) (Table 6).

4. Discussion

This was the systematic UWTV *Nephrops* survey of the Porcupine Bank. The distance from shore (~ 120 nautical miles), exposed nature of the area, the significant water depths involved (350m to 582m) and relatively large size of the area (>7100km²) presents significant logistical, and technical challenges. The Marine Institutes carries out UWTV surveys in three pre-planned survey legs (of 12, 11 and 10 days). Priority was given to the Porcupine Bank, which was successfully surveyed during the second leg of the 2025 campaign, alongside UWTV operations in FU17 to maximise survey efficiency. The visibility and footage quality was normally excellent; burrow morphology and size were similar to other areas and burrow identification was relatively easy.

The survey design, with a randomised 6 nautical mile isometric grid and fixed ground boundary, was the same as that used previously (Lordan, *et al.*, 2012).

A review of the 2024 and 2025 kriging procedures showed that results from both “RGeostats” and “gstlearn” software packages were very similar, indicating that the transition in packages does not affect the robustness of the assessment outputs.

The total abundance estimate has increased. Catch scenarios for 2025 have been calculated using updated landings mean weight data from WGNPEH (ICES, 2025a). These data are usually estimated using the graded landings information for the fishing industry and sampling data carried out at sea by scientific observer. However, since 2020, due to low sampling levels caused by Covid-19 restrictions, sampling was adapted and mean weights estimated from catch samples. An average over the last three years (2022-2024) is used to account for the mean weight in the landings estimated in the recent past. The resulting catch advice for 2025 fishing at the F_{MSY} point is a decrease of 38%) due to the lower abundance estimate compared to last year. Carrying out annual UWTV surveys to generate catch advice, while challenging, should be continued annually given the limited number of UWTV observations to date and evolving knowledge base on the spatial and temporal dynamics of this stock.

In addition to estimating *Nephrops* stock abundance UWTV surveys can be used to monitor the presence of certain benthic fauna (ICES, 2011). Sea-pens and burrowing megafauna communities have been included in the OSPAR list of threatened and/or declining species and habitats (OSPAR, 2010). As previously observed, all three sea-pen species which occur on mud habitat around Ireland are found on the Porcupine Bank, and also the deepwater sea-pen *Kophobelemnion stelliferum*. Data of the four sea-pen species from FU16 are submitted as part of an annual ICES data call to Working Group on Deep-water Ecology (WGDEC). This dataset provides information regarding the impact of fisheries on components of the ecosystem. The occurrence of *F. quadrangularis* in particular is significant owing to its particularly vulnerability to trawl mortality. *F. quadrangularis* is largely absent from other *Nephrops* grounds around Ireland, although there are catches on groundfish surveys in areas where *Nephrops* are not commercially fished (Power and Lordan, 2012). The majority of the Porcupine Bank is fished at least once annually based on the methods described in Gerritsen, *et al.* (2013). The observation that 65% of stations showed some trawl marks is higher than previous years.

5. References

- Aristegui, M. 2020. Image annotation R Shiny app. Marine Institute. <http://doi.org/d24n>
- Campbell, N., Dobby, H., and Bailey, N. 2009. Investigating and mitigating uncertainties in the assessment of Scottish *Nephrops norvegicus* populations using simulated underwater television data. ICES Journal of Marine Science 66: 646–655. doi: 10.1093/icesjms/fsp046.
- Dobby, H., Doyle, J., Jónasson, J., Jonsson, P., Leocádio, A., Lordan, C., Weetman, A., and Wieland, K. 2021. ICES Survey Protocols – Manual for *Nephrops* underwater TV surveys, coordinated under ICES Working Group on *Nephrops* Surveys (WGNEPS). ICES Techniques in Marine Environmental Sciences Vol. 65. 44 pp. <https://doi.org/10.17895/ices.pub.8014>.
- EU. 2019. Regulation (EU) 2019/472 of the European Parliament and of the Council of 19 March 2019 establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. Official Journal of the European Union, L 83: 117. <http://data.europa.eu/eli/reg/2019/472/oj>.
- Gerritsen, H.D., Minto, C., and Lordan, C. 2013. How much of the seabed is impacted by mobile fishing gear? Absolute estimates from Vessel Monitoring System (VMS) point data. ICES Journal of Marine Science. doi: 0.1093/icesjms/fst017.
- Hughes, D. J. 1998. Sea Pens and Burrowing Megafauna. An overview of dynamics and sensitivity characteristics for conservation management of marine SACs. Scottish Association for Marine Science.
- ICES. 2007. Report of the Workshop on the use of UWTV surveys for determining abundance in *Nephrops* stocks throughout European waters (WKNEPHTV). ICES CM: 2007/ACFM: 14 Ref: LRC, PGCCDBS.
- ICES. 2009. Report of the Study Group on *Nephrops* Surveys (SGNEPS). ICES CM 2009/LRC: 15. Ref: TGISUR.
- ICES. 2011. Protocols for assessing the status of sea-pen and burrowing megafauna communities. ICES Advice 2011, Book 1, 2011.
- ICES. 2013. Report of the Benchmark Workshop on *Nephrops* Stocks (WKNEPH), 25 February–1 March 2013, Lysekil, Sweden. ICES CM 2013/ACOM:45. 230 pp.
- ICES. 2014. Report of the Working Group for Celtic Seas Ecoregion (WGCSE). ICES CM: 2014/ACOM:12.
- ICES. 2016. EU request to ICES to provide FMSY ranges for selected stocks in ICES subareas 5 to 10. In Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 5, Section 5.2.3.1.
- ICES. 2018. Report of the Workshop on *Nephrops* burrow counting (WKNEPS). 2-5 October 2018, Aberdeen, UK. ICES CM 2018/ EOSG:25.47 pp.

- ICES. 2024. Report of the Working Group for Celtic Seas Ecoregion (WGCSE). ICES ICES Scientific Reports. 6:44. <https://doi.org/10.17895/ices.pub.25866667>
- ICES. 2025a. ICES. 2025. Working Group for the Assessment of *Nephrops* stocks (WGNEPH). ICES Scientific Reports. 7:51. <https://doi.org/10.17895/ices.pub.30477911>
- ICES. 2025b. Working Group on *Nephrops* Surveys (WGNEPS; outputs from 2024 meeting). ICES Scientific Reports.
- Lin, L. I. 1989. A Concordance Correlation Coefficient to Evaluate Reproducibility. *Biometrics* 45, 255-268.
- Lordan, C., Doyle, J., Dobby, H., Hehir, I. Fee, D., Allsop, C. and O'Neil, R. 2012. Porcupine Bank *Nephrops* Grounds (FU16) 2012 UWTV Survey Report and catch options for 2013. Marine Institute UWTV Survey report. <http://hdl.handle.net/10793/832>
- Marine Institute. (2025) *Nephrops (Nephrops norvegicus)* Underwater TV Surveys, Marine Institute Ireland, 2002 – Present. Marine Institute, Ireland. <https://doi.org/10/n4dj>
- MINES Paris – PSL University (2025). *gstlearn: Geostatistics and Machine Learning toolbox* (version 1.7.4). Available at: <https://gstlearn.org>
- OSPAR. 2010. Background Document for Seapen and Burrowing megafauna communities. OSPAR Commission 2010, London. Publication number: 481/2010
- Petitgas, P., and Lafont, T. 1997. EVA (Estimation VAriance). A geostatistical software on IBM-PC for structure characterization and variance computation. Version 2.
- Power, J., and Lordan, C. 2012. A review of the effects of bottom trawling on soft sediments; sea pens and burrowing megafauna biotope complexes. Marine Institute internal report Version 1, 30 July 2012.
- Renard D., Bez N., Desassis N., Beucher H., Ors F. and Laporte F. 2015. RGeostats: The Geostatistical package [version:11.0.3]. MINES ParisTech. Free download from: <http://cg.ensmp.fr/rgeostats>
- Rice A.L., Tyler P.A. and Paterson G.J.L. 1992. The Pennatulid *Kophobelemnon stelliferum* (Cnidaria:Octocorallia) in the Porcupine Seabight (north-east Atlantic Ocean). *Journal of the Marine Biological Association of the UK* 72(02):417 - 434 · May 1992.
- R Core Team. 2022. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>

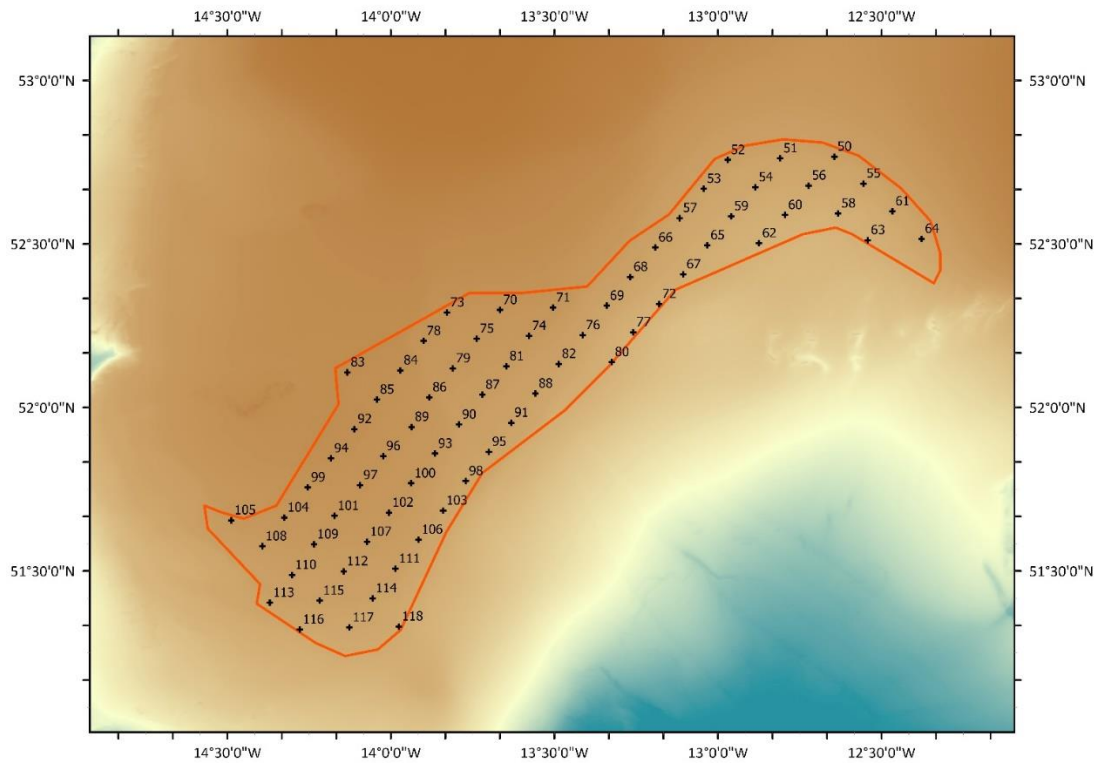


Figure 1: FU16 UWTW 2025. UWTW map of station positions and bathymetry (source: INFOMAR*). Orange line indicates survey ground polygon.

*INFOMAR is the Department of Communications, Climate Action and Environment (DCCA) funded national seabed mapping programme, jointly managed and delivered by Geological Survey Ireland and Marine Institute.

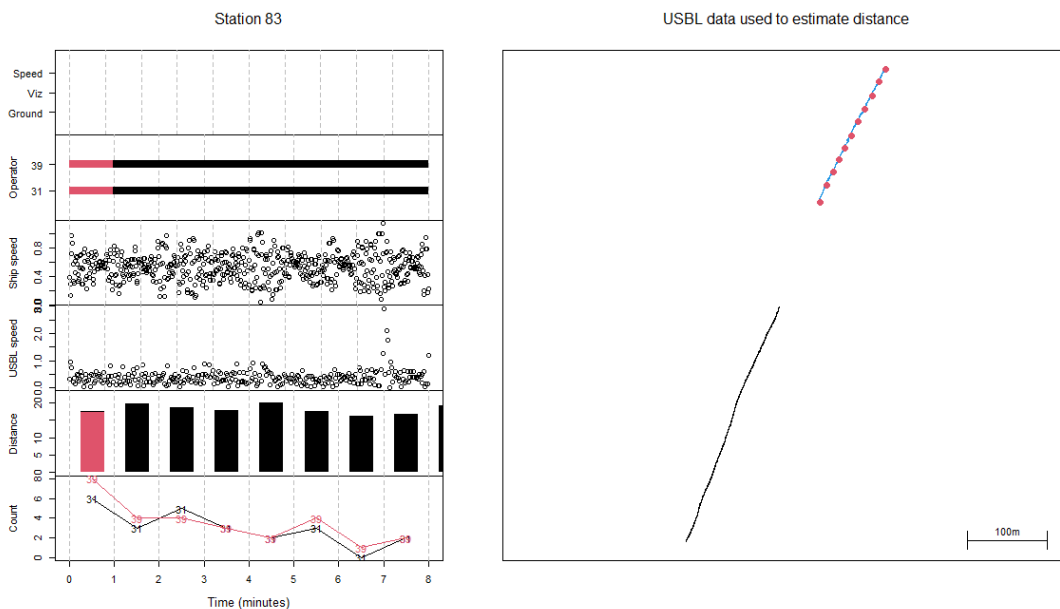


Figure 2: FU16 UWTW 2025. UWTW example quality control plot of station 83 for the navigational and recount data.

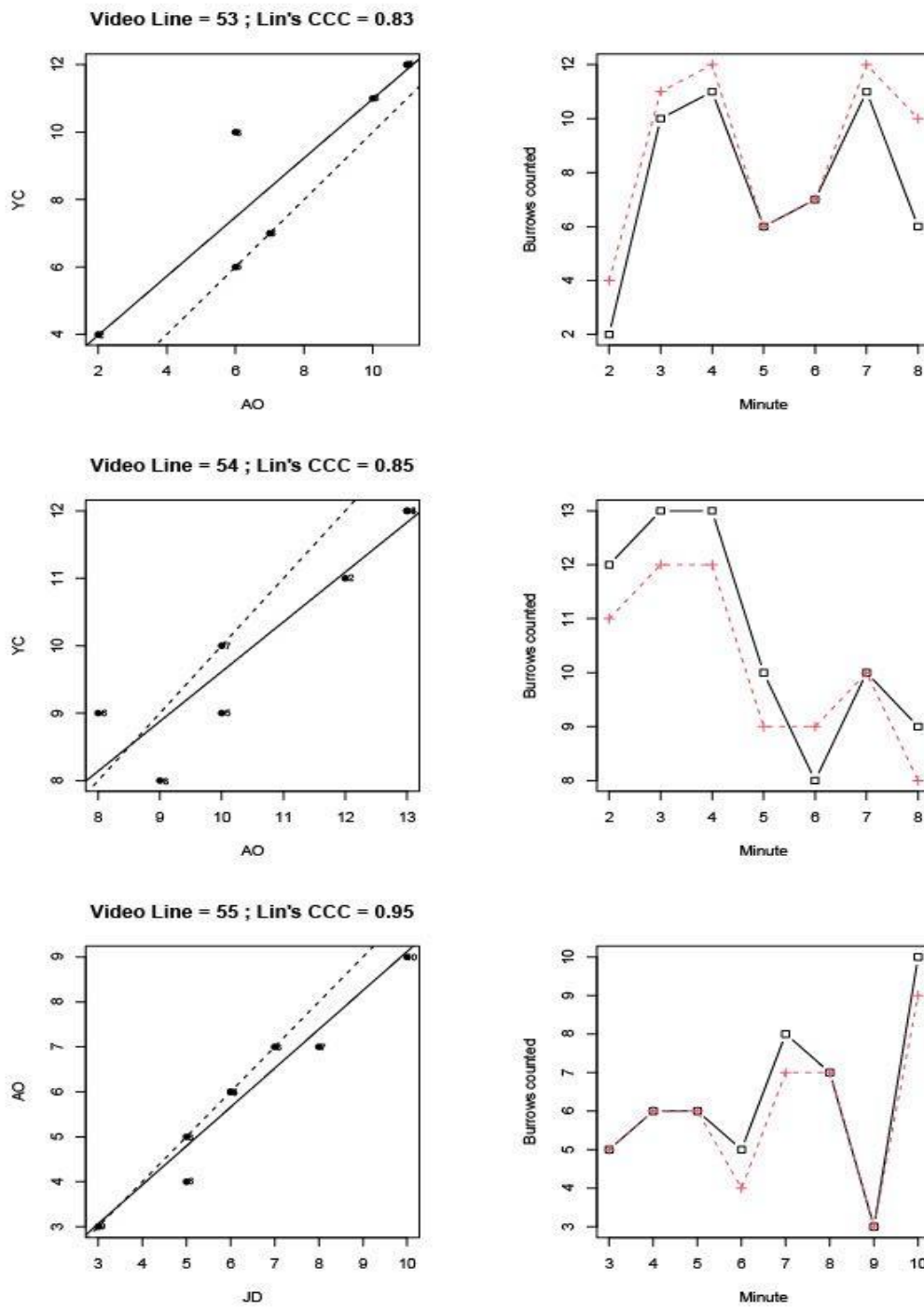


Figure 3: FU16 UWTV 2025. Lin's CCC quality control plot of count data for stations 53 to 55 from the 2025 survey.

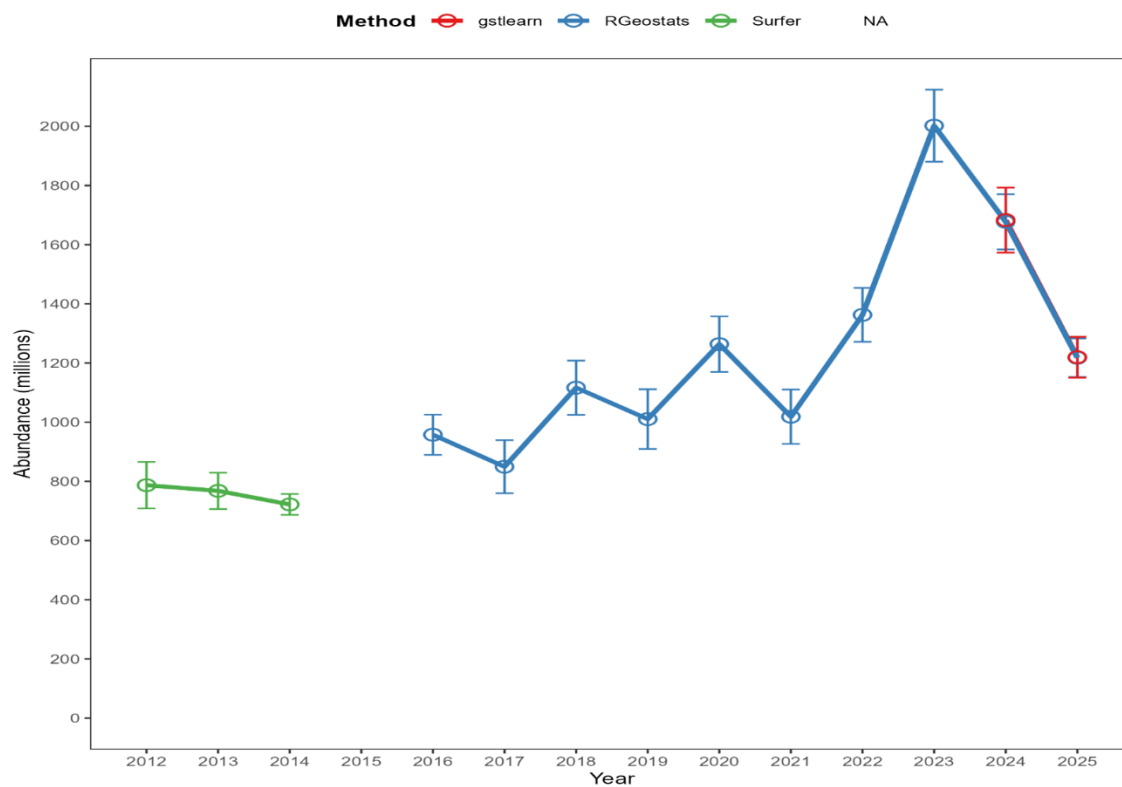


Figure 4: FU16 UWTV 2025. Comparison of the 2024 and 2025 abundance estimates (millions of burrows) and confidence intervals by software package.

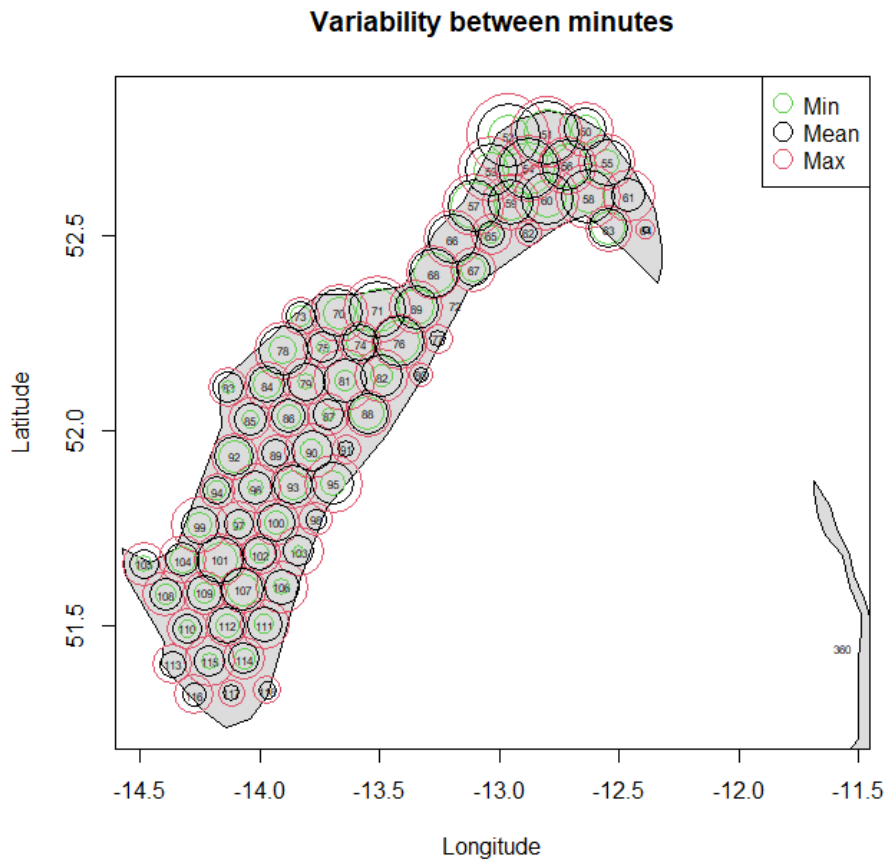


Figure 5: FU16 UWTV 2025. UWTV quality control plot showing variability between minutes for each UWTV station.

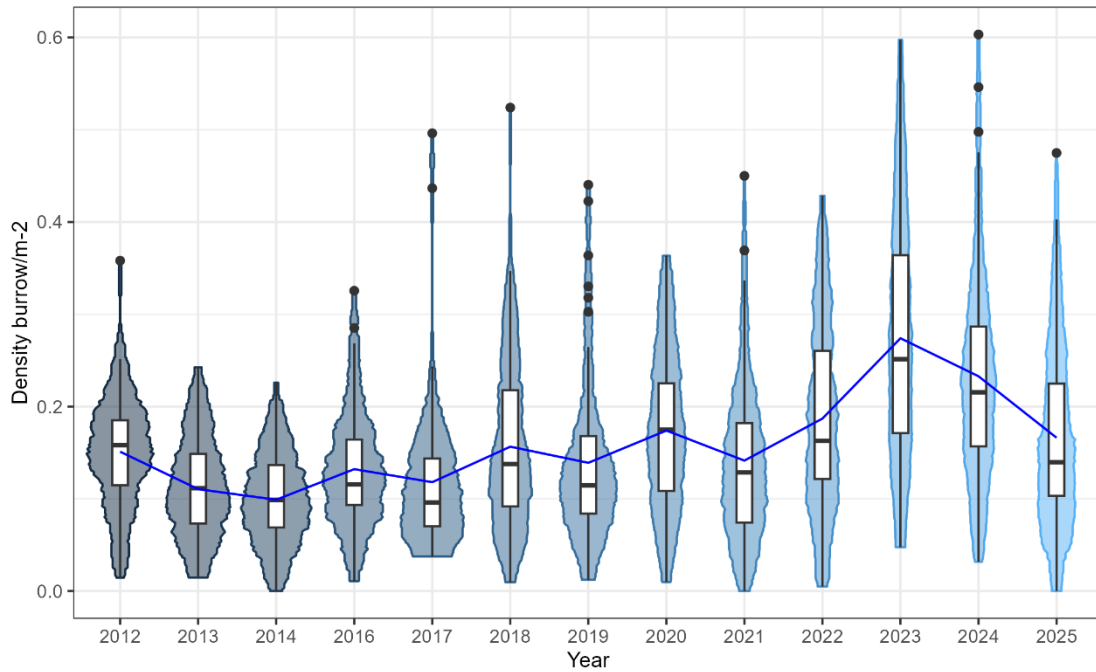


Figure 6: FU16 UWTV 2025. Violin and box plot of adjusted burrow density distributions by year from 2012-2025. The blue line indicates the mean density over time. The horizontal black line represents the median, white box is the inter quartile range, the black vertical line is the range and the black dots are outliers. No UWTV survey in 2015.

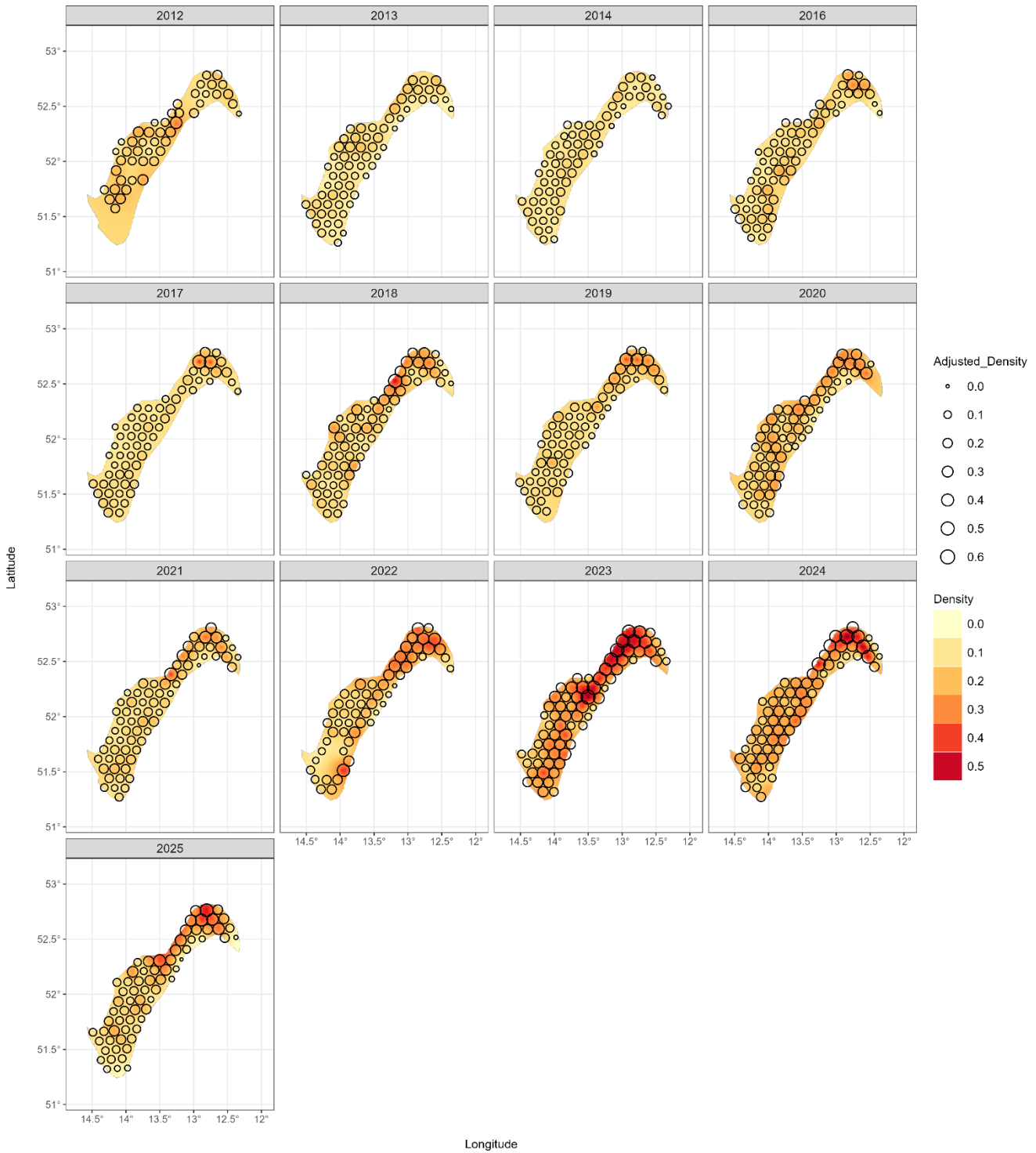


Figure 7: FU16 UWTV 2025. Heat map of *Nephrops* burrow density observations from 2012 to 2025.

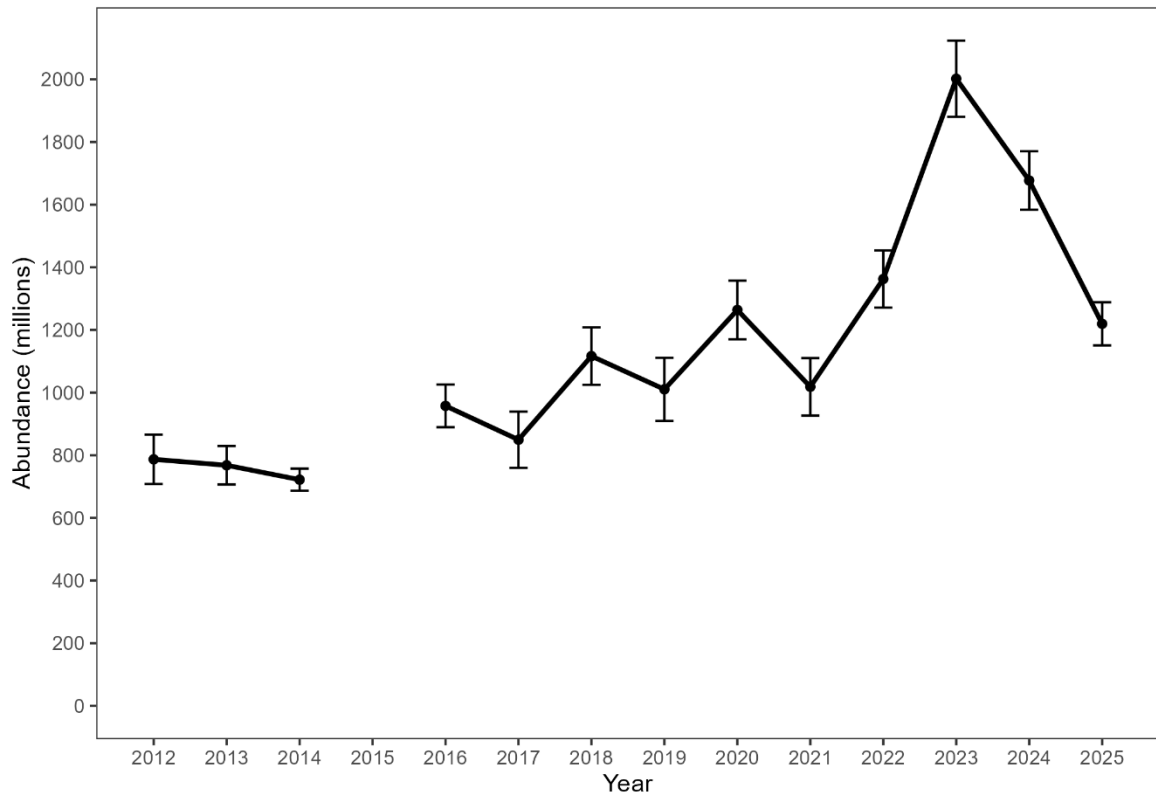


Figure 8: FU16 UWTV 2025. Time series of total abundance estimates for FU16 and 95% confidence intervals. No UWTV survey in 2015.

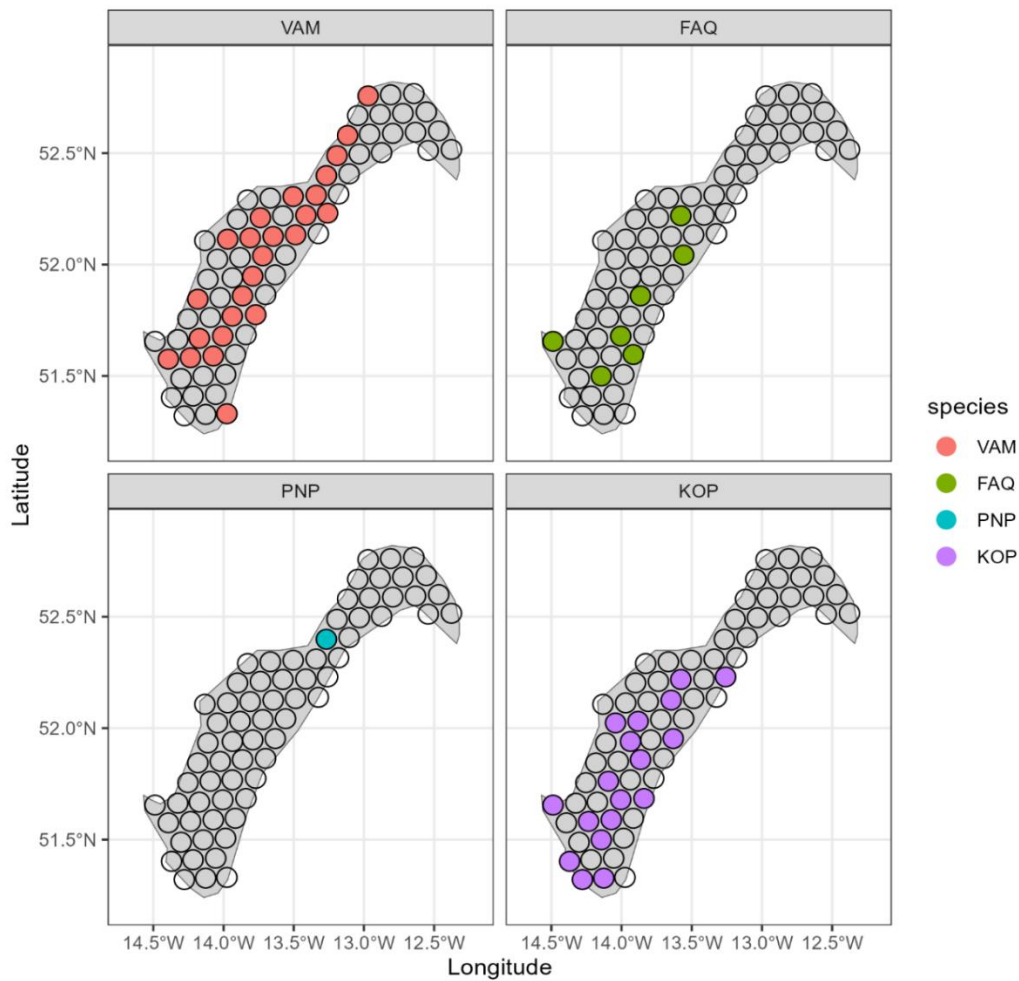


Figure 9: FU16 UWTV 2025. Stations where sea-pens *Virgularia mirabilis* (VAM), *Funiculina quadrangularis* (FAQ), *Pennatula phosphorea* (PNP) and *Kophobelemnion stelliferum* (KOP) were identified from video footage. Coloured circles denote presence in the TV station and empty circles denote TV stations with no sea-pen observations.

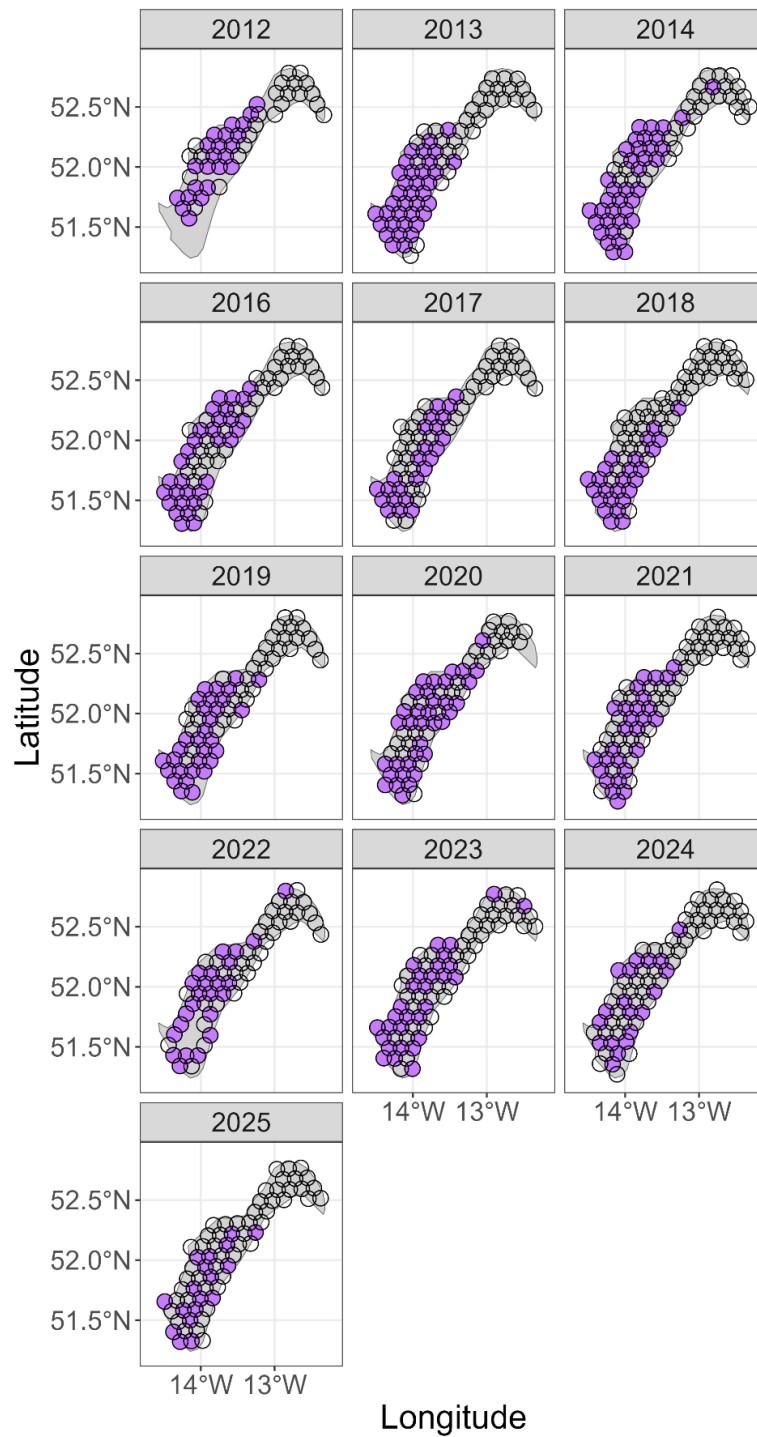


Figure 10: FU16 UWTV 2025. The presence/absence distribution of the deep-water sea-pen species *Kophobelemnon stelliferum* (KOP) was assessed from video footage collected between 2012 to 2025.

Table 1: FOV estimates (metre), FOV method, camera system and angle (°) for the UWTV survey times series.

Camera ID	StartDate Camera Usage	EndDate Camera Usage	Camera Type	FOV Multiplier (metres)	FOV Method	Camera Angle °
1	01/01/2000	31/12/2018	SD*	0.75	Deck measurement	45
2	01/01/2019	31/12/2020	HD**	1.01	Object tracking - Median value	75
3	01/01/2021	31/12/2021	HD	1.03	Object tracking - Median value	75
5	01/01/2022	31/12/2022	HDF***	1.05	Object tracking - Median value	75
4	01/01/2000	31/12/2018	SDF****	1.00	Deck measurement	45
6	01/01/2022	31/12/2022	HD	1.00	Object tracking - Median value	75
7	01/01/2023	31/12/2023	HD	1.02	Object tracking - Median value	75
8	01/01/2024	31/12/2024	HD	1.01	Object tracking - Median value	75
9	01/01/2025	31/12/2025	HD	1.07	Chessboard	75

*SD denotes Standard definition camera.

**HD denotes High definition camera.

***HDF denotes High definition camera forward facing.

****SDF denotes Standard definition camera forward facing.

Table 2: FU16 UWTV 2025. Comparison of the univariate statistics and geostatistics by software package for 2024 and 2025 burrow density estimates (bias corrected).

Year	Mean density adjusted (burrows/m2)	Number of Stations	Standard Deviation	Domain area (km ²)	Adjusted Abundance lower (millions)	Adjusted Abundance (millions)	Adjusted Abundance upper (millions)	Coef. Of Variation	Method
2024	0.232809	68	0.017288	7127.134	1583.727	1677.125	1770.524	0.028413	RGeostats
2024	0.232809	68	0.017288	7165.032	1573.196	1682.944	1792.692	0.033271	gstlearn
2025	0.166211	69	0.012915	7132.282	1152.464	1217.834	1283.205	0.027387	RGeostats
2025	0.166211	69	0.012915	7165.032	1150.741	1219.613	1288.486	0.028811	gstlearn

Table 3: FU16 UWTV 2025. Summary of univariate statistics and geostatistics for the burrow density estimates (bias corrected) on the Porcupine Bank UWTV survey in 2012-2025. No TV survey in 2015.

Year	Univariate Statistics					Geostatistics		
	Number of Observations	Min	Max	Mean	Standard Deviation	Adjusted abundance estimate (millions)	Domain area (km ²)	Coef. Of Variation
2012	47	0.014	0.358	0.151	0.063	787	7108	0.049
2013	68	0.012	0.233	0.106	0.051	768	7108	0.044
2014	67	0	0.226	0.099	0.049	722	7108	0.025
2015	0							
2016	65	0.011	0.325	0.132	0.0055	958	7108	0.036
2017	63	0.037	0.496	0.118	0.0082	850	7134	0.054
2018	69	0.095	0.524	0.156	0.011	1117	7130	0.042
2019	65	0.012	0.440	0.139	0.011	1010	7131	0.051
2020	65	0.0097	0.364	0.174	0.0097	1264	7133	0.038
2021	71	0	0.450	0.141	0.0096	1018	7129	0.046
2022	58	0.0050	0.428	0.190	0.0131	1363	7124	0.034
2023	71	0.047	0.598	0.274	0.0224	2002	7130	0.031
2024	68	0.032	0.603	0.233	0.0173	1677	7127	0.028
2025	69	0	0.475	0.166	0.0129	1220	7165	0.029

Table 4: FU16 UWTV 2025. Assessment summary.

Year	Low	Underwater TV (UWTV) abundance estimate*	High	Landings In number	Total discards in Number*	Removals In number	Harvest rate (by number) ***	Landings	Total discards**	Discard rate (by number)	Dead discard rate (by number)	Mean weight in discards	Mean weight in discards
	millions						%	tonnes	%		grammes		
2012	708	787	866	25	0	25	3.2	1258	0	0	0	50.36	
2013	707	768	829	20	0	20	2.6	1141	0	0	0	57.54	
2014	687	722	757	17.3	0	17.3	2.4	1189	0	0	0	68.54	
2015	No survey			27	0	27	3.3***	1394	0	0	0	50.86	
2016	890	958	1026	53		53	5.6	2154				40.29	
2017	760	850	939	85		85	10.0	2632				31.01	
2018	1025	1117	1208	66		66	5.9	2751				41.55	
2019	910	1010	1111	42		42	4.1	2229				53.38	
2020	1170	1264	1358	50		50	3.9	1899				38.26	
2021	927	1018	1110	58		58	5.7	2476				42.77	
2022	1271	1363	1454	92		92	6.8	2846				30.81	
2023	1880	2002	2124	111		111	5.6	3011				27.06	
2024	1584	1677	1771	125		125	7.5	3524				28.20	
2025	1151	1220	1288										

* For Norway lobster greater than 17 mm carapace length.

** Discarding up to 2015 was considered to be negligible. Discard estimates are not available since 2016 and are therefore not included in the assessment.

*** Values since 2016 onwards may be underestimated owing to insufficient discard data.

**** The harvest rate is estimated based on a linear interpolation of abundance (840 million), as no survey was carried out in this year.

Table 5: FU16 UWTV 2025. The basis for the catch advice and scenarios.

Variable	Value	Notes
Stock abundance (2026)	1 220	Underwater TV (UWTV) survey 2024; individuals in millions
Mean weight in projected landings (2026)	28.13	Average 2022–2024; in grammes
Mean weight in projected discards (2026)	-	Unknown
Projected discards rate (2026)	-	Unknown
Discards survival rate (2026)	-	Not applicable

Table 6: FU16 UWTV 2025. Annual catch advice and scenarios.

Basis	Total catch	Projected landings (PL)	Projected discards (PD)	% harvest rate*	% advice change**
	PL + PD			For PL + PD	
ICES advice basis					
EU MAP [^] : F _{MSY}	2 169	2 169	0	6.2	-38
EU MAP [^] : F _{MSY lower}	1 750	1 750	0	5.0	-38
EU MAP [^] : F _{MSY upper}	2 169	2 169	0	6.2	-38
Other scenarios					
Maximum sustainable yield (MSY) approach	2 169	2 169	0	6.2	-38
F ₂₀₂₄	2 608	2 608	0	7.5	-25

* By number.

** Advice values for 2025 relative to the corresponding 2024 values (MAP advice of 4 627, 3 732, and 4 627 tonnes, respectively); other option values are relative to 4 627 tonnes.

[^] EU multiannual plan (MAP) for the Western Waters (EU, 2019).