WGNEPS 2016 REPORT

ICES SSGIEOM COMMITTEE

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REF ACOM AND SCICOM

Interim Report of the Working Group on *Nephrops* Surveys

7-8 November 2016

Reykjavik, Iceland

ICES CIEM

International Council for the Exploration of the Sea

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Executive summary

The Working Group on *Nephrops* Surveys (WGNEPS), formerly known as SGNEPS until 2012, is the international coordination expert group for *Nephrops* underwater TV (UWTV) and trawl surveys within ICES areas and in a preliminary and exploratory way in some Geographical subareas (GSA) in the Mediterranean and has a quality assurance and development role.

The WGNEPS 2016 meeting took place on 7–8 November 2016 and was kindly hosted by Jónas Jónasson at Marine Research Institute (http://www.hafro.is/index_eng.php) in Reykjavik, Iceland. The meeting was chaired by Ana Leocádio (Cefas, UK) and in total included the participation of 19 colleagues from the following countries: Ireland, Portugal, Denmark, Sweden, Northern Ireland, Scotland, Iceland, Spain, France, Croatia, and Italy.

The WG meeting was reduced this year to 2 days due to WKNEPS 2016 Burrow training workshop which took place in the following 3 days.

WGNEPS adopted a new multiannual ToRs this year. This year's meeting was focused to review any changes to design, coverage and equipment for the various *Nephrops* UWTV surveys (ToR a); to review the design, coverage, results and uses of *Nephrops* trawl surveys in consultation with the Working Group on Improving use of Survey Data for Assessment and Advice (WGISDAA) (ToR b); to review video enhancement, video mosaicking, automatic burrow detection and other new technological developments (ToR c); and to have initial discussions to develop an international database which will hold burrow counts, ground shape files and other data associated with UWTV surveys (ToR f). At the end of both WGNEPS and WKNEPS the SISP document will be revised accordingly.

To address ToRs a) and b) the group presented the national survey updates on survey design and gear changes for 2015–2016 and planning for 2016–2017. Additionally, *Nephrops* benchmarks outcomes were presented for the Gulf of Cadiz, Bay of Biscay and Kattegat/Skagerrak. This allowed the expert group to ensure quality and coverage are maintained as well as to endorse proposed changes to the design for the surveys coordinated by WGNEPS. Coordination between surveys across countries and laboratories was also carried out at the meeting as part of the role of WGNEPS is to support and coordinate survey activity and improve collaborations. To address ToR c) a review was given on the latest developments on video enhancement, video mosaicking, and automatic burrow detection. As a preparation for next year work there was an initial discussion to formulate the requirements to the ICES Data Centre for an UWTV database, this will address ToR f).

1 Administrative details

Working Group name
WGNEPS – Working Group on *Nephrops* Surveys

Year of Appointment within the current cycle
2016

Reporting year within the current cycle
1

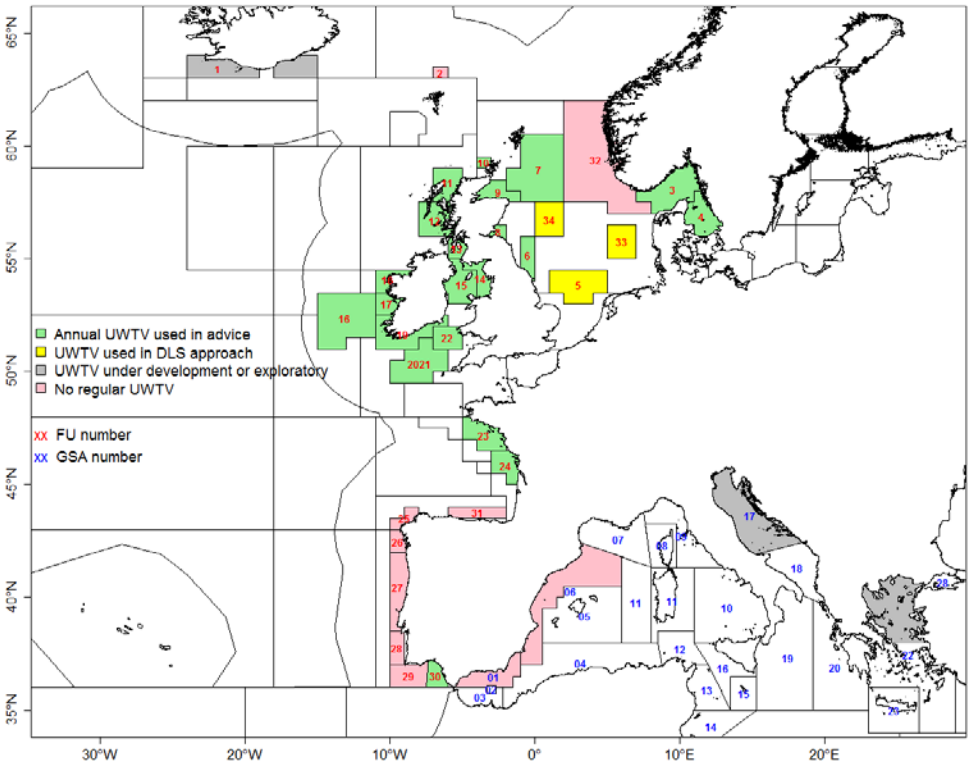
Chair(s)
Ana Leocádio, Cefas, UK

Meeting venue
Marine Research Institute, Reykjavik, Iceland

Meeting dates
7–8 November 2016

Reference Map

Nephrops FU UWTV surveyed areas.



2 Terms of Reference a) – h)

ToR descriptors	Description	Background	Science Plan Topics addressed	Duration	Expected Deliverables
	Review SISP guidelines	SSGIEOM have developed guidelines for the SISPs, and it is important to update those guidelines to reflect the use of the protocol by the EGs	28,31	Year 1	Review the current SISP guidelines.
a	To review any changes to design, coverage and equipment for the various *Nephrops* UWTV surveys.	To ensure surveys used by WKNEPH, WGCSE, and WGNSSK are fit for purpose.	28,31	Recurrent annual update	Survey summary including and description of alterations to the plan, to relevant assessment-WGs (WKNEPH, WGCSE, WGNSSK,) and SCICOM. Planning of the upcoming surveys for the survey coordinators and cruise leaders, and update the SISP accordingly.
b	To review the design, coverage, results and uses of *Nephrops* trawl surveys in consultation with WGISDAA.	There are trawl surveys for *Nephrops* in some area and trawling activity also takes place with UWTV surveys. These activities need review and coordination.	28,31	Recurrent annual update	Survey summary including and description of alterations to the plan, to relevant assessment-WGs (WKNEPH, WGCSE, WGNSSK, WGHMM,) and SCICOM. Planning of the upcoming surveys for the survey coordinators

					and cruise leaders, and update the SISP accordingly.
c	To review video enhancement, video mosaicking, automatic burrow detection and other new technological developments.	WGNEPS should periodically review emerging technologies that might improve survey methodologies.	28	Recurrent annual update	To update the SISP based on conclusions. Other publications when appropriate.
e	Discuss the utility of UWTV and trawl *Nephrops* surveys as platforms for the collection of data for OSPAR and MFSD indicators.	*Nephrops* UWTV surveys have a role in relation to benthic habitat monitoring and the collection of other environmental and ecosystem variables.	9	Year 2	To update the SISP based on conclusions
f	Develop an international database which will hold burrow counts, ground shape files and other data associated with UWTV surveys. Develop an international database on trawl surveys.	There is a need to centralize UWTV data in a single international database. Ensure data are available externally.	25	Year 2/3	ICES database
g	Review of existing datasets to evaluate possible factors affecting (i.e. currents, light, etc.) burrow emergence.	Recent behaviour aspects have been investigated in the laboratory. Important to investigate correlation with field data.	25	Year 2/3	Review paper

h	Developing R scripts for UWTV survey data processing including functions to QC, analyse and visualize data, and interface the tools with the database (ToR f).	Improving standarisation of data QC and data processing. Support new developing surveys on data analysis.	25,27	Year 3	Document and R packages for UWTV survey data.

3 Summary of Work plan

Year 1	The main task will be to carry out a burrow counting training workshop at a European level, this will take place in Reykjavík, Iceland. This WG will be extended for 1 day to accommodate the training course in the same week. Around 2 days will be allocated to review any changes to design, coverage and equipment for the various *Nephrops* UWTV/trawl surveys and to review video enhancement, video mosaicking, automatic burrow detection and other new technological developments and the remaining 3 days will be allocated to the burrow counting training workshop. The facilities and equipment will be provided by the Marine Research Institute in Iceland; additional equipment might be provided by other Institutes if required.
Year 2	TOR a, b and c will be addressed annually. This year will focus on exploring the utility of UWTV and trawl *Nephrops* surveys as platforms for the collection of data for OSPAR and MFSD indicators (ToR e). Additionally, ToRs f and g will also be addressed and plans for ToR h will be made. Decision will be made in relation to the need of further training on burrow counting. If necessary, this will take place on year 3.
Year 3	TOR a, b, and c will be addressed annually. Work will focus on ToRs f, g, and h as well as reviewing any relevant changes to survey procedures. SISP will be updated accordingly.

4 List of Outcomes and Achievements of the WG in this delivery period

- Review of changes to design, coverage and equipment for the various *Nephrops* UWTV surveys.
- Update of the mosaicking work currently being undertaken by DTU Aqua (Denmark) to create video mosaics from UWTV survey footage.
- Start drafting the data structure and requirements for the UWTV database for *Nephrops*.
- Review the current SISP.
- Equipment specification summary

5 Progress report on ToRs and workplan

5.1 ToR a. To review any changes to design, coverage, and equipment for the various *Nephrops* UWTV surveys.

This section provides an update for the various UWTV currently undertaken in the North Sea and Mediterranean areas, this includes any modifications done on survey design, coverage, and procedures. Updates are provided by country with conclusions and respective recommendations.

5.1.1 Ireland

Review of the results of existing surveys:

Since 2012 Ireland has modified sampling intensity and increased survey coverage based on the recommendations of SGNEPS 2012. The total numbers of stations for 2016 remains broadly similar ~330 to previous years (Figure 5.1.1.1). The numbers of stations in FU15, FU17, and FU22 were reduced since 2012 to allow for survey development in FU16, FU19 and FU20-21. 100% coverage of all the *Nephrops* grounds was achieved in 2016. In addition, the survey design was change from a randomized square grid to a randomized isometric grid where all stations were equidistant. The CVs for surveys where sampling intensity was reduced either had no or minor decreases in relative precision and are well below the 20% limit as recommended by SGNEPS 2012 precision (Table 5.1.1.1.). In 2016 the survey count data for FU19 and FU22 were screened to check for any discrepancies using Lin's Concordance Correlation Coefficient (CCC) with a threshold of 0.5. Burrow counts for FU16 are individually timestamped and any discrepancies are consensus agreed. FU17 and FU20-21 survey counts are inspected for discrepancies using an agreed threshold and then consensus agreed.

Table 5.1.1.1. 2016 UWTV mean density, abundance estimate and CV (relative standard error) by FU.

UWTV Survey	Mean density adjusted (burrow/m²)	Adjusted Abundance Estimate (millions of individuals)	CV (Relative standard error)
FU16	0.13	958	4%
FU17 Aran Grounds	0.29	343	3%
FU19	0.2	399	13%
FU20-21	0.18	1879	5%
FU22	0.31	866	7%

In recent years, there has been a good flow of staff exchange on UWTV surveys in ICES area 7 mainly on the collaborative UWTV survey in the Irish Sea (FU14 and FU15). In 2016, staff from Ifremer joined one survey in the Celtic Sea which also promotes protocol and technology transfer.

The individual survey reports and further details of the survey design and numbers of stations are available from the Marine Institute Open Access Repository at: http://oar.marine.ie/handle/10793/59.

The adjusted mean density for each station in ICES Area 7 is presented in Figure 5.1.1.2 and it shows the general overall pattern which is mainly higher densities observed in FU15 and lower densities in FU16 and FU20-21.

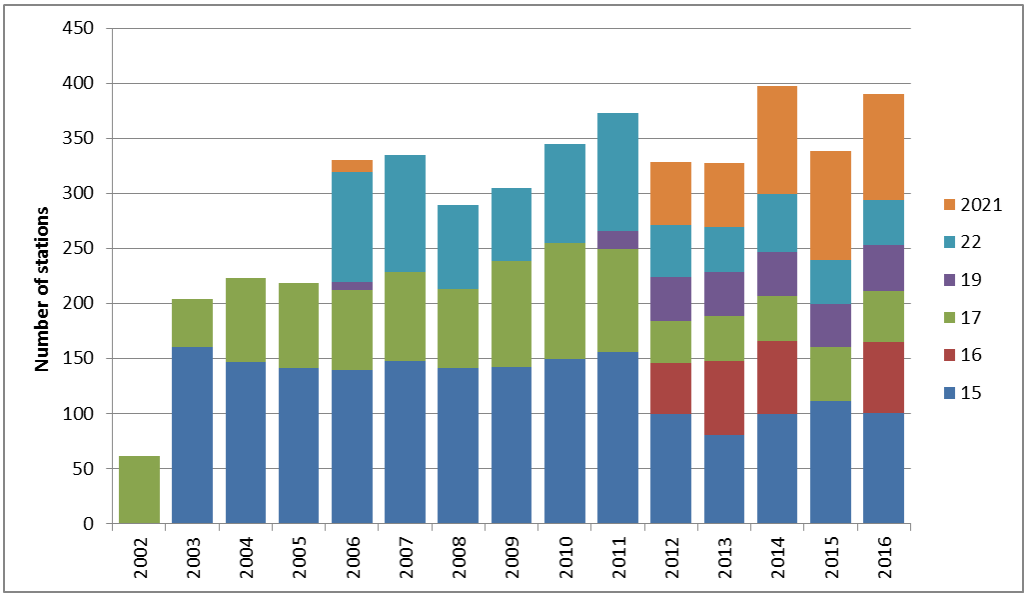


Figure 5.1.1.1. Time-series of the total number of UWTV stations carried out by Ireland by Functional Unit (Stations in FU15 are carried out in collaboration with AFBI in UK-NI).

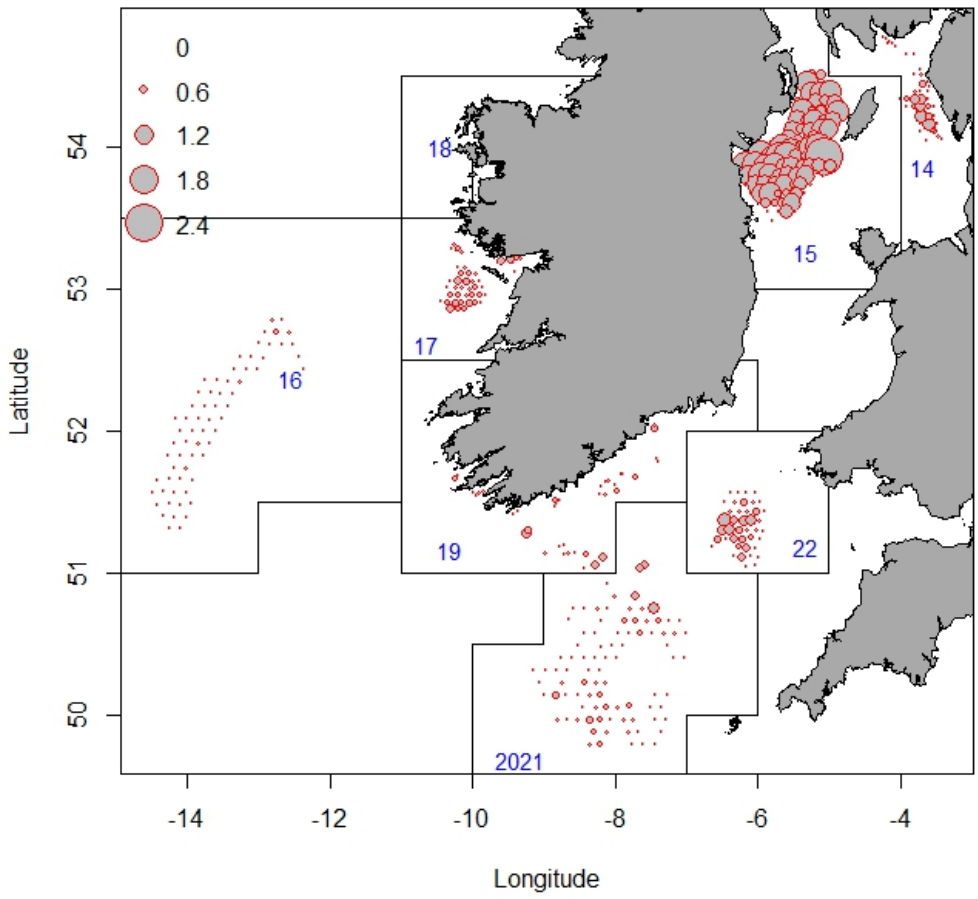


Figure 5.1.1.2. 2016 Mean density adjusted estimates (burrow/m²) by station for all *Nephrops* grounds in ICES Area 7.

UWTV Survey FU19

In 2016 UWTV stations for FU19 were randomly picked within each using the "Create Random Points" tool in ArcToolbox of ArcGIS10. The sampling effort, i.e. numbers of stations, on each ground was determined by relative area. The 2016 survey achieved full coverage of the stock area defined at WKCELT using VMS linked logbook information for Ireland, mutlibeam backscatter and bathymetry data (ICES, 2014). Area of this ground is calculated at 1973 km². Two UWTV stations were completed at Kenmare Bay in 2016. Lin's CCC analysis was used to quality control the survey counts using a threshold value of 0.5. Further details on this survey available at: http://oar.marine.ie/handle/10793/59

UWTV Survey FU22: Smalls

The 2016 survey achieved full coverage. A randomized isometric grid of 41 stations with a 4.5 nautical mile spacing was planned for the survey. The precision, with a CV of 7%, was well below the upper limit of 20% recommended by SGNEPS 2012. Lin's CCC analysis was used to quality control the survey counts at sea using a threshold value of 0.5. Nine valid beam trawls were also carried out where the *Nephrops*, fish and benthic catches were fully sampled. Further details on this survey available at: http://oar.marine.ie/handle/10793/59

UWTV Survey FU20–21: Labadie, Jones and Cockburn Banks

In February 2014 WKCELT concluded that full survey coverage was needed before *Nephrops* in FU20-21 could be moved into a full UWTV survey category for assessment and advice (ICES, 2014).

The 2016 survey achieved full coverage of the stock area for the third successive time. Area of this ground is calculated at 10 014 km² which is the largest *Nephrops* ground in ICES Area 7 (ICES, 2014). Within this area a randomized isometric grid of 93 stations with a 6.0 nautical mile spacing was planned for the survey. Reference set was available for the first time and used to train counters prior to counting survey footage. The density estimates in 2013 to 2016 are relatively similar and would be considered low (mainly ~0.2 m²). Further details on this survey available at: http://oar.marine.ie/handle/10793/59

UWTV Survey FU17: Aran grounds, Galway Bay and Slyne Head.

In 2016 a total of 45 UWTV stations were successfully completed, 34 on the Aran Grounds, 7 on Galway Bay and 4 on Slyne Head patches. Four valid beam trawl tows were conducted randomly across the Aran grounds once TV operations were successfully completed. All *Nephrops* caught were sorted by sex and maturity category, weighed and measured using the NEMESYS electronic measuring system. The fish and benthic catches were also fully sampled. Further details on this survey available at: http://oar.marine.ie/handle/10793/59

UWTV Survey FU16: Porcupine.

The 2016 survey achieved full coverage of the stock area. Within this area a randomized isometric grid of 65 stations with a 6.0 nautical mile spacing was planned for the survey. The 2016 abundance estimate was 32% higher than in 2014. There was no UWTV survey in 2015 due to vessel breakdown prior to survey. The deep-water seapen *Kophobelemnon stelliferum* was also observed on the footage and its presence/absence

mapped from the available time-series. Further details on this survey available at: http://oar.marine.ie/handle/10793/59

Conclusion / Recommendations:

- WGNEPS recommends defining the area of the Kenmare Bay *Nephrops* patch using similar methods presented at WKCELT (2014) and IBPNeph (2015).
- WGNEPS recommends to scope out use of high definition camera and monitors with existing fibre optic cable to stay current with technical developments in UWTV technology and to replace existing older equipment where possible.
- WGNEPS recommends that reference footage from all survey areas be reviewed by at least one international experienced counter when the change to high definition camera is fully completed.
- WGNEPS recommends that fill-in procedures for areas which could not be surveyed be reviewed by relevant Working Groups when required.
- WGNEPS recommends promoting and facilitating when possible on UWTV surveys, staff exchange from national laboratories.
- WGNEPS recommends promoting and facilitating when possible on UWTV surveys, staff exchange from other institutes who may use survey data.

Review of full kriging procedure for FU22 Smalls

The full kriging procedure for FU22 Smalls ground from 2006 to 2015 was reviewed and presented in r- markdown document to compare the geostatistical estimates from RGeostats to the historical Surfer estimates (Lordan and Doyle, WD1). Surfer does not provide the krigged estimation variance or CV and EVA software - Estimation variance software estimates (Petitgas and Lafont, 1997) was used historically to provide these and used in this review. Further details on previous survey analysis available at: http://hdl.handle.net/10793/1138

The geostatistical analysis was carried out using RGeostats package version [11.0.3] (Renard D. *et al*., 2015). The steps are; construction of experimental variogram, a model variogram $\gamma(h)$, was produced with an exponential model (Figure 5.1.1.3), create krigged grid file using all data points as neighbours, the same boundary was used to estimate the domain area as has been used historically, mean density, total burrow abundance and finally calculate survey precision.

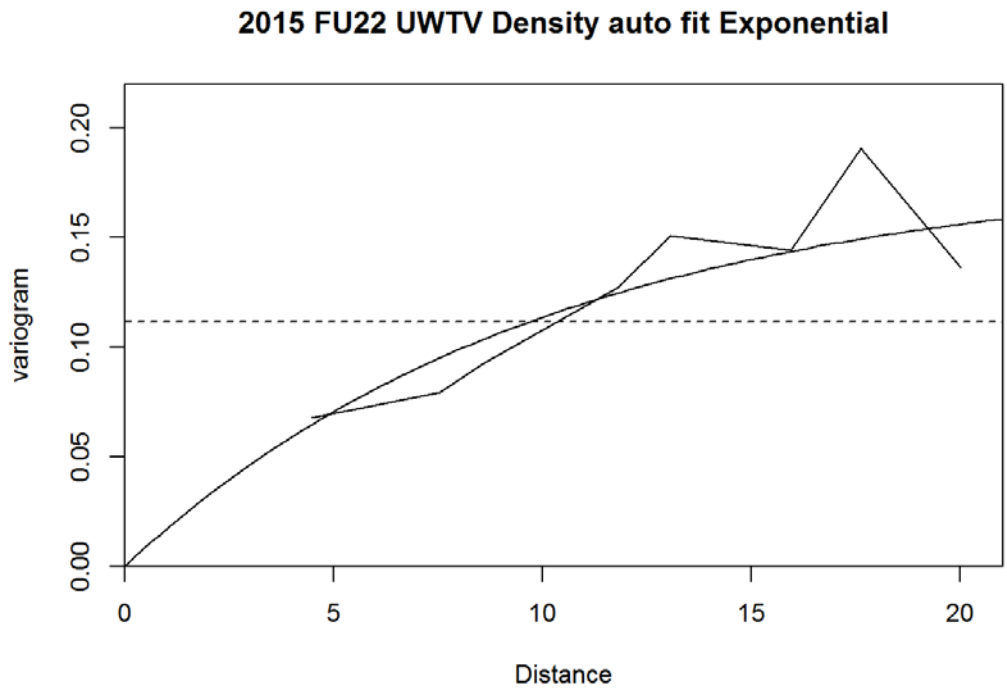


Figure 5.1.1.3. Fitting an experimental variogram to the 2015 data pairs.

The main results of this analysis are shown here. Figure 5.1.1.4 shows the mean densities follow the same trend at the start and the end of the series. The Surfer mean density estimates are lower than the Rgeostats method for the period 2008 to 2010. Figure 5.1.1.5 shows the same trend for the total adjusted abundance estimates. Table 5.1.1.1. and Figure 5.1.1.6. show the abundance estimates and CV (or relative standard error) which is well below the recommendation of 20% by SGNeps (ICES, 2012).

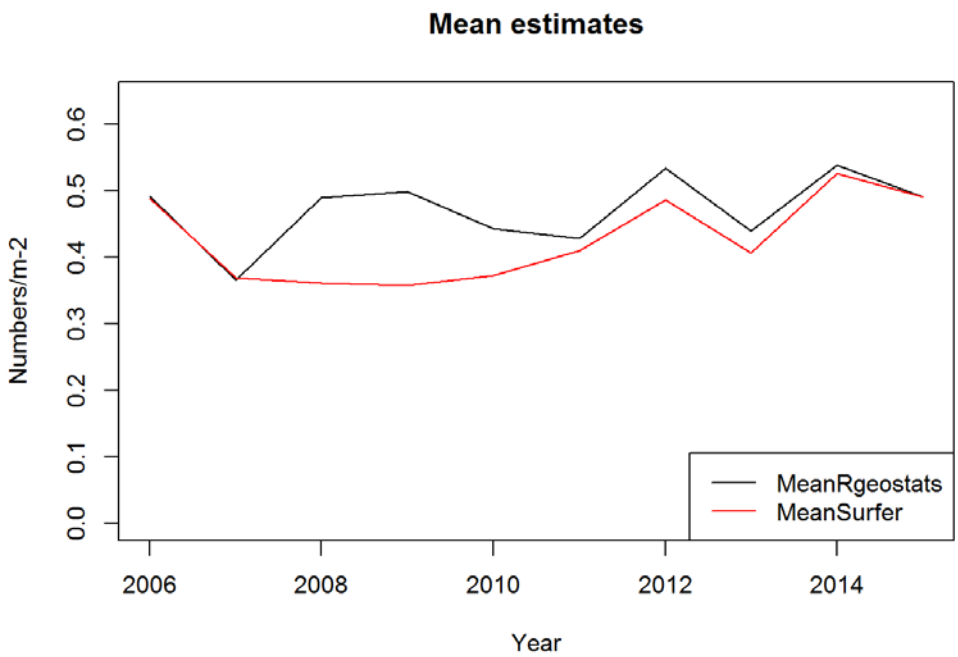


Figure 5.1.1.4. FU22 Mean density estimates (n/m²) from 2006 to 2015 by kriging method.

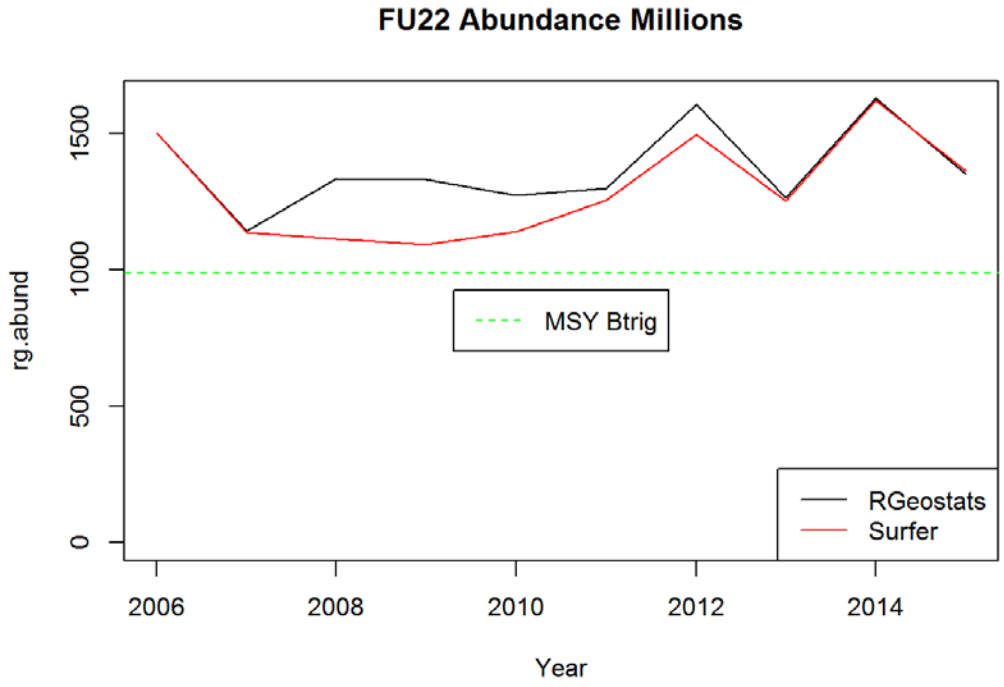


Figure 5.1.1.5. FU22 time-series of adjusted abundance estimates (in millions of burrows) by kriging method from 2006 to 2015. MSY $B_{trigger}$ is dashed green line (990 million individuals).

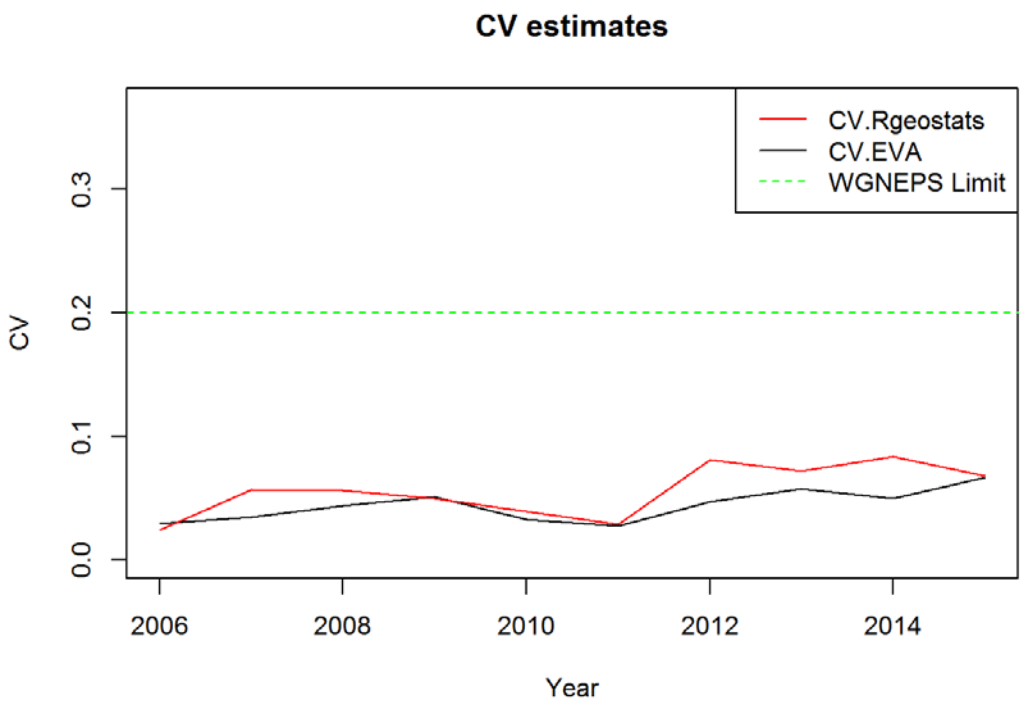


Figure 5.1.1.6. Krigged estimation variance or CV estimates by kriging method. Dashed green line denotes the SGNeps 20% limit.

Conclusions:

- Given that the results from Rgeostatistical kriging method are very close to the recent historical Surfer estimates and the CVs are well below the SGNeps limit this method will be used to carry out the full kriging process for FU22 in future.

Recommendations:

- WG agrees that the use of r markdown is a useful way to present exploratory data analysis for peer reviews and recommends that this package should be used if possible to document the kriging process.
- WG recommends that the review of kriging procedure be carried out for other UWTV surveys and to present these reviews at WGNEPS and other relevant ICES working groups or benchmarks.

5.1.2 UK Northern Ireland

This was the 14th survey in a time-series of UWTV surveys in the Irish Sea (ICES Division 7a) carried out jointly by the Agri-Food and Biosciences Institute (AFBI), Northern Ireland (UK), the Marine Institute, Ireland, and Cefas, UK. The survey took place on RV Corystes between 25 July and 3 August 2016. The survey covered the western Irish Sea (FU15) (reported in this section) and the eastern Irish Sea (FU14) (reported under UK-England).

The specific objectives of the survey are listed below:

1) To complete a randomized fixed isometric survey grid of 100 UWTV with 4.5 nautical mile (nm) spaced stations on the western Irish Sea *Nephrops* ground (FU15);

2) To obtain 2016 quality assured estimates of *Nephrops* burrow distribution and abundance for FU15. These will be compared with those collected previously;

3) To collect ancillary information from the UWTV footage at each station such as the occurrence of sea-pens, other macro benthos and fish species, and trawl marks on the seabed;

4) Technology, staff and protocol transfer between AFBI, the Marine Institute and Cefas.

5) To adopt application of Lin's concordance correlation coefficient with a threshold of 0.5 agreement between recounts per station to determine which stations required third (or further) recounts to ensure agreement between counts.

From 2003 to 2016 a randomized fixed square grid for the western Irish Sea (FU15) *Nephrops* ground has been used. An adaptive approach is taken whereby stations are continued past the known perimeter of the ground until the burrow densities are zero or very close to zero. The initial ground perimeter has been established using a combination of integrated logbook-VMS data (using the methods described in Gerritsen and Lordan, 2011), British Geological Survey (BGS) and other sediment maps, and previously collected UWTV data. The same ground boundaries have been used throughout the time-series. The grid spacing from 2003 to 2011 was 3.5 nautical miles (nm). Following a review (Doyle *et al.,* 2013) the grid design was changed from a 3.5 nm to 4.5 nm in 2012. In 2013, the grid spacing was increased further to a 5.0 nm iso-

metric grid, whereas a 4.5 nm isometric grid was used again in 2014, 2015, and 2016 to ensure all edge of ground areas were represented adequately.

The main motivation to increase the grid spacing was to achieve full spatial coverage of FU15 while giving the option to reallocate ship time to increase coverage in other Functional Units (FU16, FU20–21 and FU19); also in line with SGNEPS recommendations (SGNEPS, 2012). Reducing the number of stations is not expected to have significantly affected the accuracy of the survey estimate given the apparent spatial autocorrelation in density across the area. Doyle *et al.* (2013) assessed the impact of increasing station spacing on the accuracy of the resulting abundance estimates using a removal analysis, and found that increasing up to 7 nm station spacing did not affect the accuracy of the result. The precision (measured by the coefficient of variation) does not appear to have been significantly reduced in 2012–2016 by comparison to earlier years, with a CV of 3% which was in line with previous estimates (varying between 2–4%), which are all well below the SGNEPS 2012 recommendation of 20%.

The 2016 design consisted of a randomized isometric grid of 100 stations at 4.5 nautical mile intervals out over the full known extent the stock. At each station, the UWTV sledge equipped with standard definition camera with a known field of view (0.75 m) was deployed and once stable on the seabed a 10-minute tow was recorded onto DVD. The sled had additional floats and new, wider and lighter runners to reduce sled sinkage into the soft mud areas, which worked effectively. Vessel position (dGPS) and position of sledge (using an USBL) were recorded every 1 to 2 seconds. All stations were successfully surveyed with 10 re-do stations due to visibility issues on first attempts. Issues with damage to camera cables and malfunctioning DVD recorders resulted in total downtime of approximately 5 hours, but as spares were carried on board replacements were made at sea and survey work continued. Six additional tows were completed opportunistically in Belfast Lough over grounds identified as *Nephrops* ground from the 2015 survey.

The navigational data were quality controlled using an "R" script developed by the Marine Institute (ICES, 2009b). In 2016, the USBL navigational data were used to calculate distance over ground for 100% of stations.

Within the western Irish Sea, the average burrow density (adjusted to account for bias factors) was 0.84 burrows/m^2. This is a 15% increase from the 2015 figure of 0.73 burrows/m^2. The summary statistics from the geo-statistical analysis show in 2016 a final abundance estimate (adjusted to account for bias factors) of 5.1 billion burrows, which is close to that estimated in 2007 and 2012. The overall burrow abundance trend is fairly stable although the abundance did decline between 2007 and 2008, and between 2012 and 2013. The survey precision as measured by the coefficient of variation for 2016 was 3% indicating a very precise survey in line with CVs observed previously. A comparison of geostatistical analysis using "R-Geostats" and the usual "Surfer" method was made, with little difference between results.

Notes were also recorded on the occurrence of trawl marks, fish species and other species. Semi-quantitative assessment of sea-pen species were also recorded according to OSPAR Special Request (ICES, 2011). All sea-pens were identified from the video footage as *Virgularia mirabilis*; 17% of the 2016 survey stations had *V. mirabilis* present. Trawl marks were noted at 23% of the stations surveyed.

Within Belfast Lough, average burrow density was 0.36 burrows/m^2 (adjusted to account for bias factors) and sea-pens (*V. mirabilis*) were present in one out of the six stations. Burrow systems appeared notably larger in size than those viewed over the majority of the western Irish Sea.

A trawl survey was also completed on 9–13 August, with 24 trawl stations across FU15 sampled by *Nephrops* trawl and four stations sampled by a 2 m beam trawl: 14 075 *Nephrops* were measured to generate length frequencies for males and females and establish the sex ratio. A number of UWTV stations were problematic due to the density of other burrowing species, these were clearly identified due to discrepancies between counts between counting scientists as measured by Lin's concordance correlation coefficient, and required four sets of recounts to reach acceptable consensus (Lin's CCC of 0.5). These stations were targeted during the RV Corystes autumn Groundfish Survey with a beam trawl; a number of co-occurring burrowing species were found in large numbers, such as *Goneplax rhomboides*, *Calocaris macandreae* and *Lesueurigobius friesii*, which substantiates the issues of burrow identification between these species and small *Nephrops*. UWTV footage from these sites has been used in WKNEPS and advice sought from experts in burrow identification on how to improve burrow discrimination in these challenging areas.

Future developments:

The FU15 survey still uses a standard definition/analogue camera, with a non-load-bearing cable which requires cable-tying to the winch wire for each deployment. A business case has been submitted to update the camera system availing of newer high definition (HD) technology, and replace the cable with a load-bearing cable and new winch, pending funding. It is hoped that HD footage would improve burrow discrimination in areas where co-occurring burrowing species are found, and in high density stations, and that a load-bearing cable would reduce deployment and retrieval time thereby making the survey more efficient.

In addition, AFBI is updating the database used during the survey to streamline data queries and processing, to reduce potential user error and increase efficiency.

5.1.3 UK Scotland

Marine Scotland Science (MSS) conducted three UWTV surveys in 2016. There were no significant changes to the equipment or survey design to any of the cruises. The standard arrangement on the sledge involved a Konesberg 14 366 analogue video camera, two Subsea LED lamps, altimeter, odometer and recovery device. The odometer and recovery device were not fitted when the drop frame was used. The cruise reports and associated data collected during these surveys are available from MSS upon request.

MRV Alba-na-Mara, 8-22 January 2016.

Initially in very difficult working conditions, this survey was carried out in the area to the South of Mull, in FU12. The work was the being undertaken for the third consecutive year in the South Minch, and was aiming to map the muddy *Nephrops* habitat that is not covered by the British Geological Survey dataset.

Due to the unknown benthic type at the various stations the drop frame was used to drift over the ground throughout this aspect of the survey. 57 deployments were carried out along with collecting 52 sediment samples at these positions. The area was well covered and provided detailed and valuable data. No *Nephrops* trawls were carried out during this cruise.

While in FU12 the vessel also carried out three trawls in an attempt to obtain *Atrina fragilis* (fan mussel) larvae in an area near Canna, which is known for the established beds of adult mussels.

In the Moray Firth on the return journey, a series of standard UWTV deployments were made with the sledge, each 50 m apart. The same ground was then surveyed again using the drop frame. These comparative trials have been ongoing for a number of years and once a satisfactory number of trials have been obtained, it is hoped that a correlation between the abundance values obtained from the two methods can be calculated, which would then allow the drop frame to be used in areas where potential entanglement (creels) or damage to the UWTV system, or a fragile benthic environment, is a concern.

A Go Pro Hero 3+ was attached to the drop frame on two deployments, and programmed to take a still image every five seconds. This generated a large amount of data, although many images were discarded due to water clarity and poor quality due to the speed over ground. However, a number of stills provided excellent results for presentation purposes.

MRV Scotia, 1–20 June 2016.

This cruise covered Fladen (FU7), the North and South Minch (FU11 and FU12) and the Clyde, including the Sound of Jura (FU13). Due to logistical problems it was not possible to survey Devils Hole (FU34).

The UWTV sledge was used throughout the survey, and was deployed at 207 stations. 200 sediment samples for particle size analysis were gathered from these stations, with the grab failing to activate or encountered hard ground at seven of the stations. In total only six trawls were carried out with 380 *Nephrops* sampled for LFDs and a further 180 for morphometric, weight/length and maturity measurements.

As always the cruise was open to visitors and this year a PhD student from the University of Strathclyde took part in the cruise for three days in the Clyde, to assist in her studies.

As standard procedure all marine litter was recorded and returned to shore, in accordance with MSFD guidelines.

MRV Alba-na-Mara, 7–23 August 2016.

This survey was conducted on the east coast of Scotland in the Firth of Forth (FU8) and the Moray Firth (FU9). The UWTV sledge was used in 52 deployments in FU8 and 56 in FU9, with 106 sediment samples collected in total. One trawl was carried out in FU8 and two in FU9, with a total of 568 *Nephrops* sampled for LFDs. Animals that were fully intact were subsampled for biological, morphometric and weight/length data.

In addition to the standard abundance work, comparative trials were carried out between the sledge and the drop frame on two different sites. These data will add to the slowly growing dataset comparing the *Nephrops* abundance densities found on the exact same ground between the two methods of video capture.

On two deployments a Go Pro Hero 3+ camera was attached to the UWTV cable (rather than the sledge) and provided a novel view of the sledge throughout a typical deployment. This offered an insight into various aspects in which the way the sledge per-formed while in use.

As standard procedure all marine litter was recorded and returned to shore, in accordance with MSFD guidelines.

Conclusion/Recommendation

- Other than not being able to survey Devils Hole, all the 2016 cruises met their objectives, and in some areas even exceeded expectations. The cruise programmes continued to include additional, indirectly related work, increasing the variety of tasks undertaken during the trips and illustrating the importance of the UWTV surveys, as well as introducing new skill sets to the staff involved. By implementing new management plans while on board, many aspects of each cruise were completed more efficiently than in previous years, and this will be continued and developed in coming years.
- During the Scotia cruise new staff were involved in the TV work which was informative from the point of view of both parties, and a practice that would benefit all involved if it was to continue. Likewise taking a visitor on board presented a new outlook on the work being carried out, which was enlightening.
- Comparative trials continued in 2016 and will require to continue to do so in future before statistically robust analysis can be carried out.

5.1.4 UK England

UK England is currently responsible for the assessment of 3 different FU, although only two have regular UWTV surveys (FU6 and FU14), being FU5 classified as data-limited stock.

FU5: Botney Gut – Silver Pit

Due to funding constraints Cefas (UK) is no longer covering this ground, although the possibility of having a collaborative survey in future is being discussed with the Netherlands. More information regarding future options to reinstate this survey will be discussed in the near future and this information will be passed on to the WGNEPS.

FU6: Farn Deeps

Several gear improvements were made for the 2016 UWTV. OLED monitors (Sony 25-inch professional PVM-A250) were purchased to replace the failing CRT monitors. In addition, a Kongsberg camera (720p, 24fps), green fan lasers (rated to 3000 m, 520 nm wavelength), lights (20 w LEDs) and on-board control system were purchased. The Rochester armoured cable was used as in previous years, although only the coax components were required for delivery of power and control of all peripherals.

The 2016 survey was conducted from 21 to 28 June, sampling all 110 stations. An additional 19 stations were completed, not forming part of the standard survey (Figure 5.1.4.1.). These additional stations form part of an UWTV conducted by NEIFCA (Northeast Inshore Fisheries and Conservation Authority) in autumn each year on grounds within 6 nm from the coast. The stations were included to allow comparisons of the burrow densities before and after the peak moulting period, this analysis has not yet been completed, the results of which will be presented at a future working group. The work was all undertaken according to the standard protocols which include pre-survey training and standardization of counter's performance. All counters must count the reference footage to a predetermined standard before being given access to the current survey footage.

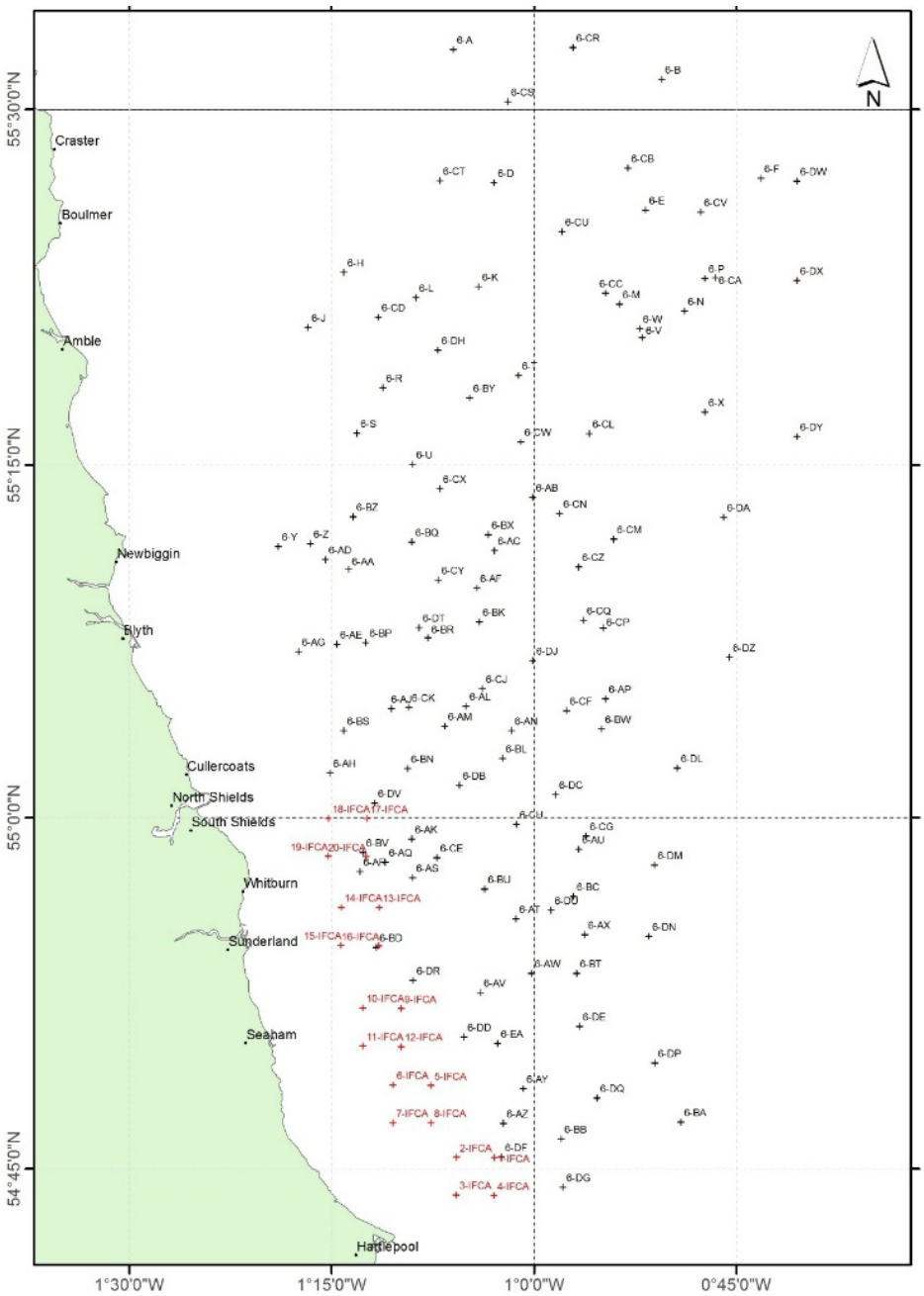


Figure 5.1.4.1 – FU6 UWTV survey stations (black) and the additional stations surveyed during the 2016 survey (red).

The visibility was, as with the previous two years, very good, 47% of footage was classed as "Excellent", 45% as "Good", and 8% as "Moderate".

Of the 110 stations completed, 38% failed the CCC threshold of 0.7, of these 7 were counted by 4 counters and a consensus count was achieved. All stations were used in the assessment

FU14: East Irish Sea

The 2016 Irish Sea *Nephrops* UWTV survey took place on RV Corystes between 25 to 3 August. The departure and arrival port was Belfast. This survey covered both western (FU15) and eastern (FU14) side of the Irish Sea. The survey in the East Irish Sea

area is of a fixed grid design and is carried out using the same protocols used in UWTV surveys in the western Irish Sea.

A burrow counting training day was set up on Tuesday 24 August to brief scientific staff with procedures and revised reference counts results.

In 2016 new stations were added to the Wigtown Bay area (TVID 14-BA, 14-AY, 14-AZ, Figure 5.1.4.2.). This was done to account for an increase in effort in this area, the result of effort displacement from an area at the southern boundary of FU14 where Walney offshore windfarm has been developed. The effort in Wigtown Bay increased from 1.9% to 6.6% of the overall fishing effort in FU14.

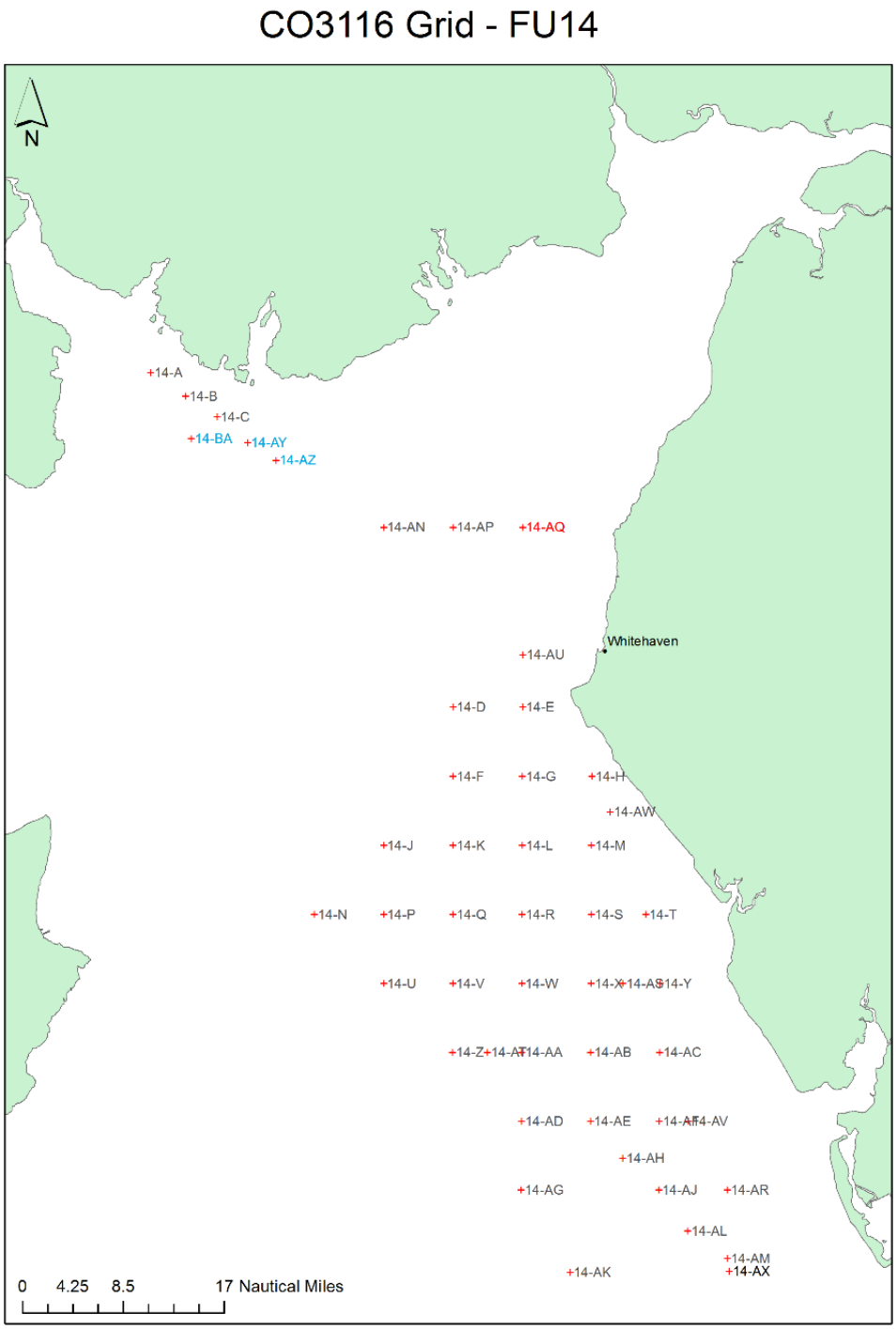


Figure 5.1.4.2 Sampling locations on August 2016 for the FU14 survey, the new stations added in Wigtown Bay are included (blue).

All 49 stations were surveyed, of which 60% were survey in good clarity conditions and 40% in moderate to poor conditions. Deterioration of the water clarity was mainly related with strong tides as no fishing vessels were present at the time of this survey.

- 44% of stations fell under the CCC threshold of 0.5;
- Training section was done for the stations where agreement could not be made to identify issues on burrow identification;

- Main factors identified in no agreement were due to: existence of multi-species burrows in the ground - high burrow density but not necessary for *Nephrops*, small burrows, visibility, overall not clear *Nephrops* signatures;
- To avoid discarding stations an average count was used per station to get final densities per station;
- All 49 stations were used in the assessment.

Conclusion/Recommendation:

As in other *Nephrops* stock there are a number of generic research questions related to occupancy and edge effect bias that needs still to be investigated.

- For FU14 and FU6 more accurate mapping of the spatial extent of the grounds and fisheries, this includes having positional data for <12 metre vessels and more survey data in the boundary areas to better define these grounds.
- For FU14 there is a need to improve the spatial coverage and sampling of landings and discards, this includes increasing the sampling levels to covers Northern Irish vessels, as the current sampling is mainly focused on local vessels form Whitehaven port.
- For FU14 there is a need to get area specific length-weight and maturity data to validate the parameters used for this FU.
- For FU14 better knowledge is required of the difference in growth and population structure across the area.

5.1.5 Denmark/Sweden

The 2015 survey was carried by Denmark mainly during the second half of August in subareas 1, 2, 5, and 7 and by Sweden during June in subareas 3, 4, and 6 (Figure 5.1.5.1). The late timing of the Danish survey period was due to engine problems with the vessel. Denmark completed 98 stations but a few of them were not suitable for analysis due to poor visibility. Similarly, Sweden encountered difficulties with water clarity and rocky bottom, and the overall achieved coverage for both countries together with stations suitable for analysis was 75% of the planned stations. Area coverage was in relative poor in Subarea 6 but this did not seriously affect the CV. For all subareas, the CV was below 25%. With the inclusion of Subarea 7, which was sampled the first time in 2014, the total survey area amounted to 9535 km^2 and the average bias corrected *Nephrops* burrow density was 0.45 burrows/m^2 with an overall relative standard error (OECV) of 5.7%. These values were quite similar than those for the previous year.

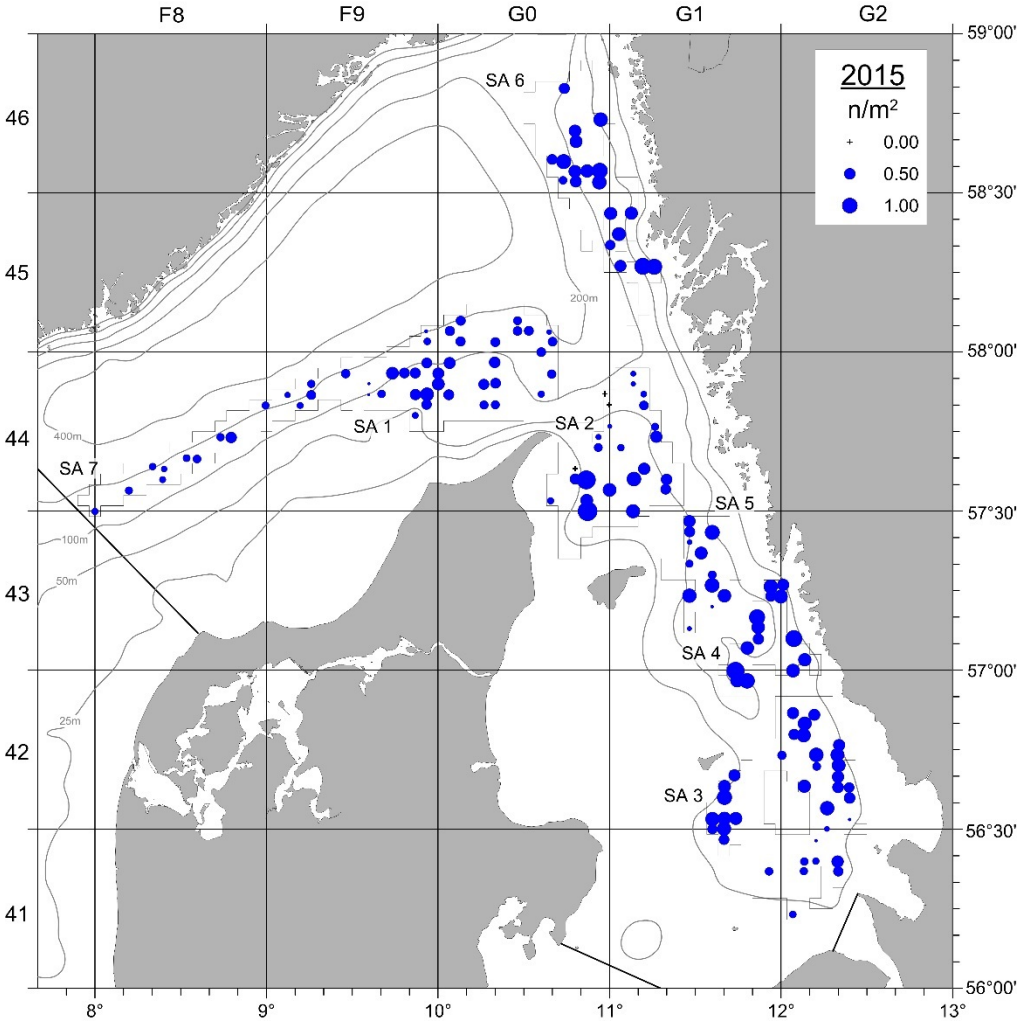


Figure 5.1.5.1. Sampling locations and *Nephrops* burrow density in UWTV survey in the Skagerrak and Kattegat in 2015 (SA: subarea).

A set of reference footage has been established for the Danish/Swedish UWTV survey in the Skagerrak and Kattegat using Danish recordings from 2015. These footages were analysed during a workshop in September 2016 and after some calibration satisfactory agreements between Danish and Swedish readers has been achieved (Table 5.1.5.1. and Figure 5.1.5.2.) for all except one footage which is characterized by low burrow density and poor water clarity.

Table 5.1.5.1. Average counts (number of burrows per minute) by station (10 x 5 minute run per footage) and counter.

Functional Unit 3 and 4						
Station	**Counter 1**	**Counter 2**	**Counter 3**	**Counter 4**	**Consensus count**	**Difference (%)**
1	2	2	1.8	1.8	1.9	11
2	4.8	4.8	4.6	4.6	4.7	4
3	1	0.8	0.8	0.8	0.9	24
4	1.8	0.6	1.2	1	1.2	104
5	3.8	3.4	2.8	3.4	3.4	30
6	13	12.8	12.8	13	12.9	2
7	11.8	11.6	11.4	11	11.5	7
8	4.4	4.2	4.2	4.2	4.3	5
9	32	31.8	32	31.4	31.8	2
10	10.8	10	10	9.8	10.2	10

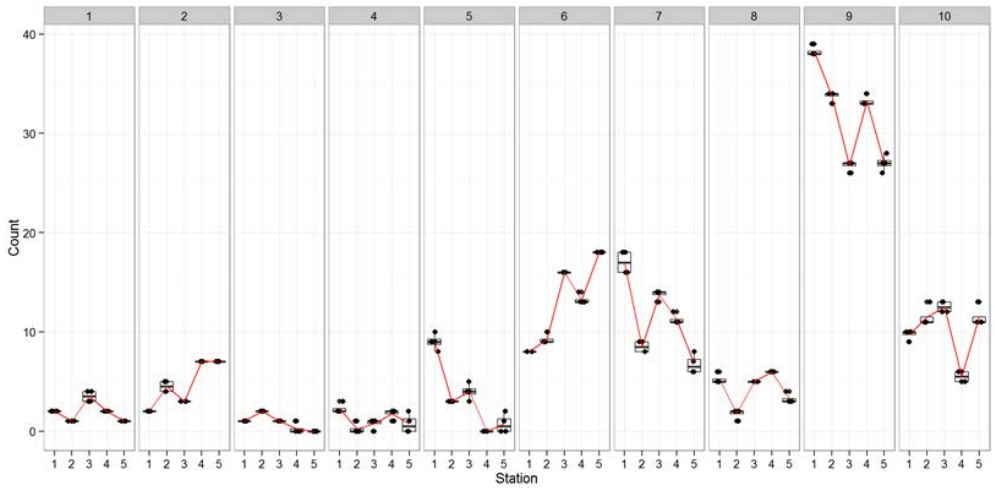


Figure 5.1.5.2. Boxplots of individual burrow counts and mean count (red line) by minute and station for FU 3 and FU4.

In 2016, on average 90 % of the planned stations in Subareas 1 to 7 were covered but the analysis of the survey data are yet not completed.

Conclusion/Recommendation:

- Refinement of subarea boundaries and stratification based on updated VMS, logbook data and sediment maps has been carried out together with the identification of creel fishing grounds in Swedish coastal areas. The results were presented at the benchmark meeting in October 2016.
- Rocky bottoms, in particular, in Subarea 6 should be redefined and corrected for estimation of the total *Nephrops* grounds Areas in 3a. Other refinements of the survey area, i.e. changes in the current boundaries of the subareas and adding strata covering low density and creel areas shall be implemented prior to the survey in 2017.

- The collaboration between the readers of the two countries should continue whereby the stations read by the two countries may be randomized. This could be organized by workshops held alternating between two institutes.

Note: Benchmarks outcomes were presented for the Kattegat/Skagerrak.

5.1.6 Spain

An exploratory *Nephrops* UWTV survey on the Gulf of Cadiz fishing ground was carried out in 2014 within the framework of a project supported by Biodiversity Foundation (Spanish Ministry of Agriculture, Food and Environmental) and European Fisheries Fund (EFF) (Vila *et al*., 2014). Since 2015, IEO carries out yearly ISUNEP-CA-UWTV survey in June (11 days).

The boundary to delineate the limits of the *Nephrops* ground estimated in 2014 was based mainly on the VMS data of fishing activity in the years 2012 and 2013. In 2016, other sources of information have helped to know the *Nephrops* distribution area in the Gulf of Cadiz with more accuracy such as, bottom-trawl surveys (1993–2015 time-series) and bathymetric and sedimentary information obtained from the LIFE-INDEMARES/CHICA project (www.indemares.es) and from the first ISUNEPCA UWTV survey carried out in 2014, respectively.

The *Nephrops* distribution observed from the bottom-trawl surveys is in concordance with the spatial distribution of the fishing activity on the ground in the Gulf of Cadiz (200–600 m depth) (Figure 5.1.6.1.). Nevertheless, small quantities of *Nephrops* occur below 200 m isobaths and on the deepest area (about 600–700 m) although none bottom-trawl fleet activity targeting to *Nephrops* is observed in the VMS. The particular bathymetry on this area shows deep channels with strong currents in the deepest border that prevent the fishing activity (Figure 5.1.6.2a.). However, beyond this channel the composition of the substratum could be suitable for *Nephrops* constructs their burrows although it is a faraway zone for the fleet and it might not be profitable regarding to benefits since the *Nephrops* abundance seem low, according to trawl surveys information.

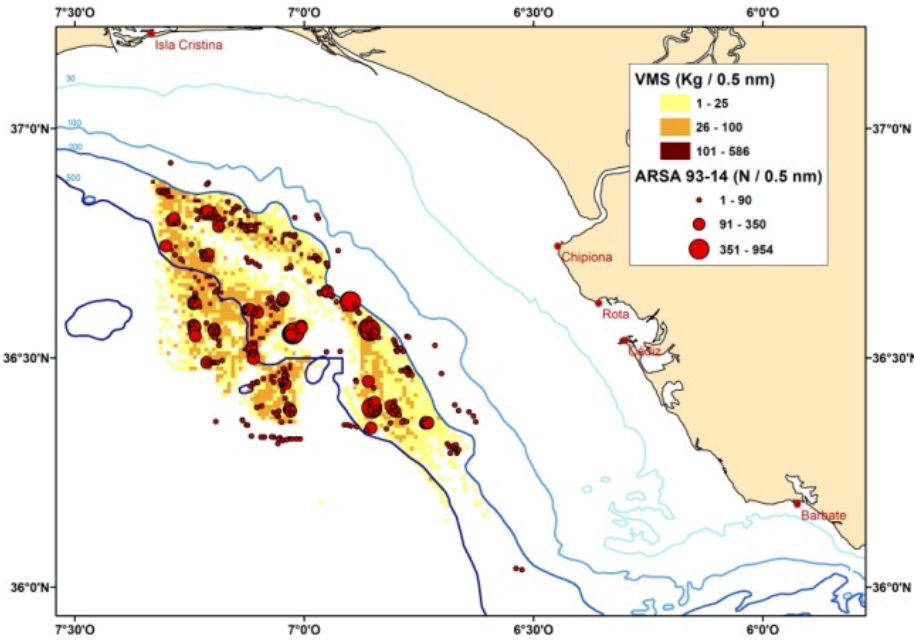


Figure 5.1.6.1. Results of the VMS analysis (2012–2013) and the *Nephrops* abundance obtained from the bottom-trawl surveys (IBTS) series (1993–2014) carried in the Gulf of Cadiz.

In the Gulf of Cadiz there are some mud volcanoes which could have a negative influence on *Nephrops* distribution and the fishing activity (Figure 5.1.6.2a.). The spatial distribution of the size grain in the sediment obtained in the 2014 ISUNEPCA UWTV survey shows sediments more classified near of these volcanoes (Figure 5.1.6.2a.). For example, near to Gazul volcano hard substratum with sponges and corals can be observed. Other zones where *Nephrops* fishing activity is absent correspond to bottoms containing a high percentage of sand (Figure 5.1.6.2b.). These types of seabed are not appropriated for *Nephrops* since this species needs bottoms of muddy nature to be able to construct their burrows.

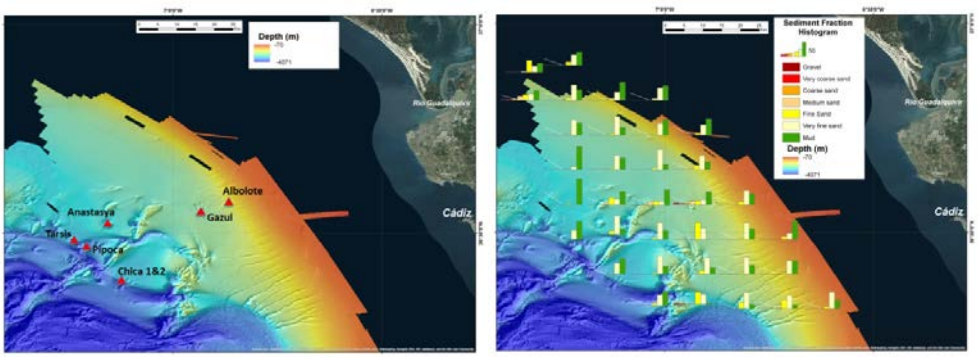


Figure 5.1.6.2. Bathymetry of the Gulf of Cadiz. a) Mud volcanoes and b) spatial distribution of the grain size obtained from samples taken during the ISUNEPCA UWTV survey in 2014. (Source: bathymetry from INDEMARES_Chica project).

The *Nephrops* distribution area was estimated around 321 km² less than in 2015. Thus, the area used in 2016 to raise the burrow density and estimate the *Nephrops* population abundance was 3000 km², which was also used to raise again the *Nephrops* abundance in 2015.

ISUNEPCA-UWTV surveys follow a randomized isometric grid design with stations spaces 4 nm since 2015. The number of valid stations considered for the *Nephrops* density estimation was 58 in 2015 and 2016 (Figure 5.1.6.3.). Some additional stations were planned in the shallower work area to confirm the *Nephrops* distribution area limits. Unfortunately, few these stations could be completed due to a lack of survey time and all of them were considered null because the water visibility was very poor. In general, water visibility in the Gulf of Cadiz since 250 m of depth is good, increasing with the depth up to excellent clarity.

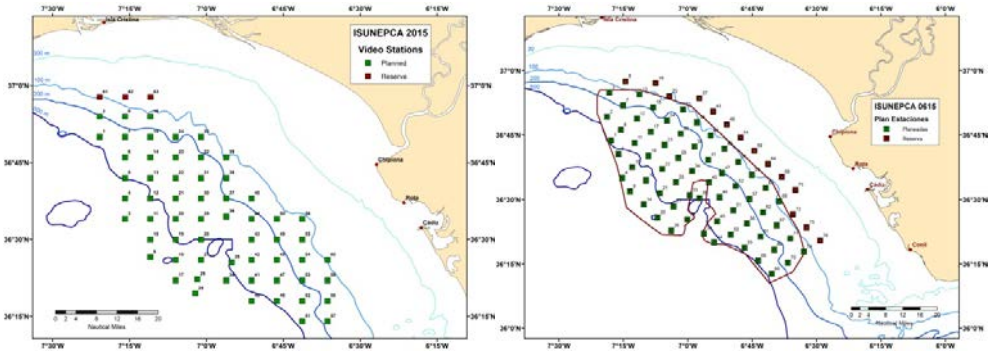


Figure 5.1.6.3. Stations grid planned in ISUNEPCA UWTV survey in 2015 and 2016.

There were no significant changes to the equipment and counting protocol in 2016. Footages of 10 good minutes are recorded and burrow counts for FU30 are individually timestamped and any discrepancies are consensus agreed. All recounts are conducted by at least two trained "burrow identifying" scientists independent of each other. In 2015 and 2016, a high percentage of the recounts were conducted on board the research vessel during the survey.

The factors that contribute to bias in UWTV surveys were calculated in 2016 and applied to the *Nephrops* abundance estimate in 2015 and 2016. The field of view of the camera is 0.75 cm and the expert judgment of the mean burrow diameter is 27 cm. The estimated edge effect bias using the simulation approach suggested by Campbell *et al*. (2009) is established in 1.24. Other bias identifies are the "burrow detection" and "burrow identification regarding to visibility quality and the presence of other burrowing macro benthic species. The burrow detection rates were thought to be relatively high due to good water clarity. Burrow identification could be overestimated since some squat lobsters were observed at burrow entrances. Regarding to the "occupancy", is assumed that 100% of burrows are occupied for an individual *Nephrops*. The proposed cumulative correction factor for the Gulf of Cadiz was 1.28 (text table below):

	Edge effect	Detection rate	Species identification	Occupancy	Cumulative bias
FU30: Gulf of Cadiz	1.24	0.90	1.15	1	1.28

The mean burrow density observed in 2015, adjusted to the cumulative bias, was 0.097 burrows/m^2 while a lower mean burrow density was observed in 2016 (0.075 burrows/m^2). In general, the range of the observations was relatively high in both years (0.00–0.345 burrows/m^2 in 2015 and 0.00–0.328 burrows/m^2).

The final modelled density surfaces in 2015 and 2016 are shown as a heat maps and bubble plots in Figure 5.1.6.4. The abundance estimate derived from the krigged burrow surface (and adjusted for the cumulative bias) was 298 million burrows (CV = 7.6%) in 2015 and 232 million burrow (CV = 7.3%) in 2016. The spatial pattern of burrow density is not consistent in the years but some reasons could explain it.

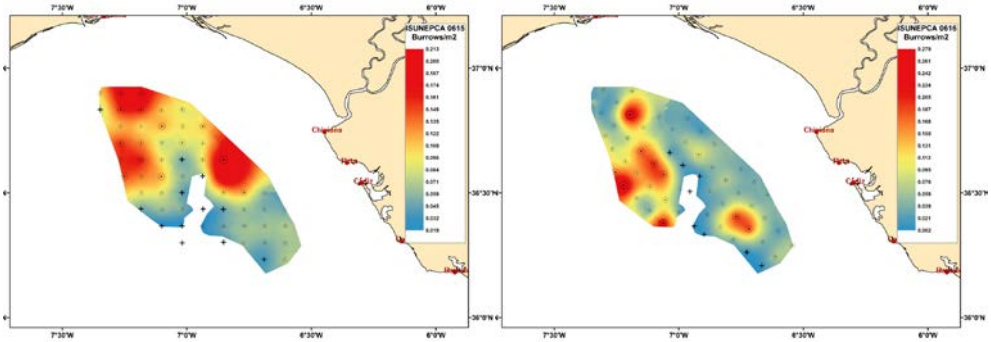


Figure 5.1.6.4. ISUNEPCA UWTV bubble plot of the burrow density observations overlaid on a head map of the krigged burrow density surface for 2015 and 2016. Station positions with zero density are indicated using a +.

In ISUNEPCA UWTV survey carried out in 2015, the number of stations and the space between them was increased in relation to 2014. However, the border was under sampled mainly in the shallower limit. In addition, an overestimation of the number of burrows may have happened. Many participants in the survey were not experienced in the quantification of *Nephrops* burrows. In 2016, the area was better covered, with more stations in the border. Moreover, the identification of the *Nephrops* burrows was carried out for three scientists who participated in the two previously surveys and therefore with more experience. A more realistic result was obtained in ISUNEPCA 2016 according to the VMS information.

The *Nephrops* abundance estimate obtained from the bottom-trawl survey (IBTS-surveys) carried out in the Gulf of Cadiz in March 2016 increased in relation to the previous year (ICES, 2016). So, we can think that the reduction of the *Nephrops* abundance estimated from UWTV survey in 2016 could be caused by an under sampling of the border area together with an overestimation of the number of burrows, not by a decrease in *Nephrops* abundance in FU30.

Nephrops abundance in FU30 was benchmarked in October 2016 (ICES, 2016). The approach based on UWTV survey to generate catch options was proposed for this FU. WKNEP 2016 mainly considered in detail: the technology of the survey, including correction for edge effects, discovery rate, species identification, etc., the distribution area and coverage and the derivation of a recommended harvest rate.

Regarding to first two points, WKNEP concluded that the UWTV survey based assessment as described could be standard for the future. However, some difficulties were found for the derivation of the reference points.

The runs of the cohort based models resulted in poor fits and in radically different population estimates compared to the TV abundance (differences of ~10 fold), coupled to high estimates of fishing mortality even at times where the fisheries were very small. So, harvest rates derived from the SCA lead to much larger recommended catches than experienced historically. The group felt that these discrepancies were so great that there was a significant risk of the LCA derived estimates of fishery parameters and their associated MSY proxy points being biased. The problems could be

solved in several ways, but in particular by increasing the natural mortality in the SCA model, which again would have an impact on the reference points and subsequently on the harvest rate to be recommended. On the other hand, some problems of quality in the length distributions were observed and the growth parameters are not robust.

Therefore, reference points were derived from the perception of the stock and historical experience from similar previously assessed stocks as an interim solution. Considering the fishery history, the HR ranging between 1.5% in recent years (2010–2012) and 4.0% when landings achieved the highest value (2003). The last period 2013–2015 is not considered because the situation of this fishery was abnormal due the very low TAC was limiting the fishery in this period. So, the WKNEP recommended setting an initial F_{MSY} ($F_{0.1}$) proxy to 4% and moving gradually towards this level although with no current definition of the transition scheme. As the UWTV approach is recently initiated for the FU30, this should be examined with caution for the definition of the transition scheme towards F_{MSY} proxy.

Conclusion/Recommendation:

- *Nephrops* FU30 will be assessed and provided catch options based UWTV survey approach from 2017. Therefore, the UWTV survey must be conducted annually.
- Continue carrying out several stations on the shallower *Nephrops* distribution area to confirm the *Nephrops* limits
- Produce our own reference footage for FU30 before survey in 2017
- Use additional beam trawl in areas with other burrower megafauna, mainly with *Munida* abundance, to validate video observations.
- Review the *Nephrops* counting from 2015 UWTV survey.

Note: Benchmarks outcomes were presented for the Gulf of Cadiz, Bay of Biscay (link for Benchmark report).

5.1.7 Italy – GSA-17 Adriatic Sea – Pomo/Jabuka Pits

The Adriatic Sea (GFCM Geographical Subareas 17 and 18) is one of the most important and most productive areas for the fishery of *Nephrops norvegicus* in Italian waters and in the whole Mediterranean basin (Morello *et al*., 2009; FAO FISHSTAT data). An important fishing ground occurs in the Central Adriatic depressions (the Pomo - or Jabuka in Croatian - Pits, part of GSA 17), which represent also a nursery for European hake (*Merluccius merluccius*) (Angelini *et al*., in press). The Norway lobster stock located in this area is distinct from other Adriatic populations and is characterized by small-sized, slow-growing individuals (Froglia and Gramitto, 1982; Vrgoć *et al*., 2004). Furthermore, this area represents a fishing ground shared by two fleets from different countries (Italy and Croatia), which fish there regularly (Martinelli *et al*., 2013). Therefore, the Pomo/Jabuka pits have been the subject of many discussions aimed at establishing there an area closed to fishery (e.g. ADRIAMED, 2008; De Juan and Lleonart, 2010). Finally, from August 2015 for 1 year, the Pomo area has been partially closed to trawling activities carried out by both fleets (D.M. 03/07/2015). Prorogation of the closure has been extended until mid-October 2016 (D.M. 20/07/2016). New Italian regulations limit fishing days in previously closed area until September 2017 (D.M. 19/10/2016). Therefore, it is important to continue discussions and research on this delicate area.

After some trials carried out in 1994 and 2004 by CNR-ISMAR (Froglia *et al*., 1997; Morello *et al*., 2007), in 2009, under the auspices of the FAO – ADRIAMED project, ISMAR-CNR of Ancona (Italy) and IOF of Split (Croatia) started a series of UWTV surveys in the Pomo Pits area. The footage collected during the surveys is analysed later in the institute lab by a team composed by Italian and Croatian scientists, applying consistently the criteria developed by ICES WGNEPS (Martinelli *et al*., 2013). During the Adriatic surveys, trawl hauls are usually carried out by means of an experimental net (sunrise and sunset) to obtain additional demographic and biological data relating to the stock. However, the UWTV surveys are not part of the DCF for Italy and Croatia.

Thanks to the Italian National Flagship Program RITMARE, in 2012 CNR-ISMAR received funding for the enhancement of scientific surveys for the acquisition of independent information on fisheries resources, thus a new UWTV system (partially funded by RITMARE) was designed and acquired (ICES, 2014). After the first trials in 2013, new modifications were carried out leading to satisfying results about image quality, collection of environmental parameters and operability. In 2013, the new system was trialled and only half of the usual monitoring program was completed during the survey, while in 2014 the scheduled program was covered in the entire study area. In April 2015, with the UWTV system reaching the final setup, the survey was again carried out with a reduced program due to delays in the arrival of permits by the authorities and due to bad weather conditions. In 2016, the survey has been carried out in April, also with reduced program (42 of 60 stations), due to unfavourable weather conditions.

All the collected footage has already been analysed and the obtained results have been calculated following the original stratified random sampling design (Martinelli *et al*., 2013). Furthermore, post-stratification experiments based on the bathymetry of the area, demographic information, commercial catches, VMS data and on the new definition of the fishing ground given by D.M. 03/07/2015 are currently in progress (Figure 5.1.7.1).

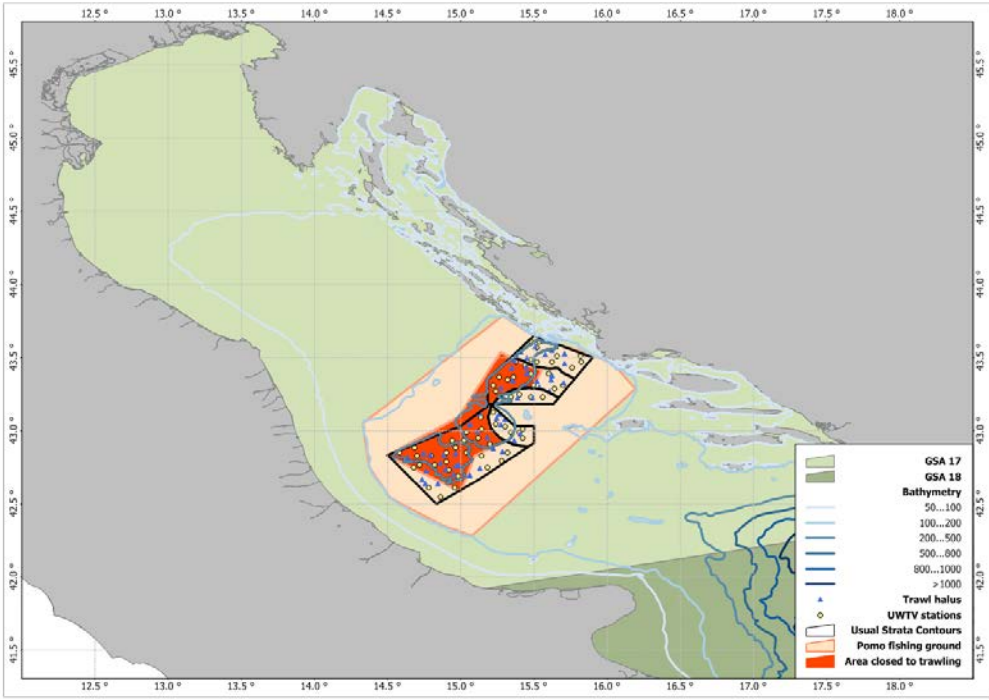


Figure 5.1.7.1. Location of the trawl hauls and of the UWTV stations performed during the surveys in the central Adriatic Sea (Pomo/Jabuka Pits) with indication of the areas usually applied for the stratification and the new contours of the fishing ground defined in D.M. 03/07/2015.

In 2016, the Italian Ministry of agriculture and forestry asked to CNR-ISMAR to perform a monitoring activity in the area by means of trawling and to compare the obtained results with those of the previous surveys for the evaluation of effects of Pomo management measures. Thus, an additional trawl survey (targeting also other species of major interest in the area, such as *Merluccius merluccius* etc.) was carried out in the Italian side in October 2015, after the Pomo closure, to evaluate short-term effects. The same trawl hauls of the UWTV Survey, plus additional hauls outside the UWTV strata were conducted (at sunrise and sunset). A second trawl survey is ongoing in the present days (November 2016).

Conclusion/Recommendation:

- A new UWTV survey in spring 2017 is strongly recommended to evaluate the effect of the reopening of the area and the fishing effort restrictions in the Pomo Pits area. Moreover, this would be a great opportunity to assess effects such as modification in density or population structure both for Norway lobster and other important benthic and demersal species associated and to evaluate the impact of new regulations.
- Due to their promising results, post-stratification experiments will be further enhanced to take advantage of the obtained datasets in the most suitable way to assess eventual effects of the fishery closure and to feed with the new UWTV time-series available for the study area both ecosystem models and stock assessment methodologies applied in the Adriatic.
- In addition, the use of uncertainty parameters specifics for this study area needs further refinements.
- Furthermore, the results of the trawling activity are under evaluation.

5.1.8 France

The third UWTV survey (Langolf TV2016) of the *Nephrops* ground in FU23-24 was carried out from 4 to 16 may 2016 on board RV Celtic Voyager. This survey was funded by the French fishing industry as part of a science-industry partnership. A student was on board during the second part of the survey in relation to the TETRIS project (Testing the Effect of Trawl using Recorded Images at Sea).

The main objectives of this survey were:

- to confirm the usefulness of this survey method to assess the stock
- to map the full extent of this *Nephrops* ground in FU23-24
- to estimate a mean burrow density

A randomized fixed square grid with station spacing of 4.7 nautical miles resulted in 204 planned TV stations for this ground. The initial ground perimeter has been established based on sediment data (Dubrulle C., *et al*. 2007) and professional surveys. This year, we have added the white area (Figure 5.1.8.1), known as area with non-attendance by *Nephrops* trawlers. The corresponding area is estimated at 16 164 km², while 11 660 km² (corresponding to actual *Nephrops* grounds) is used to derive the total number of burrows.

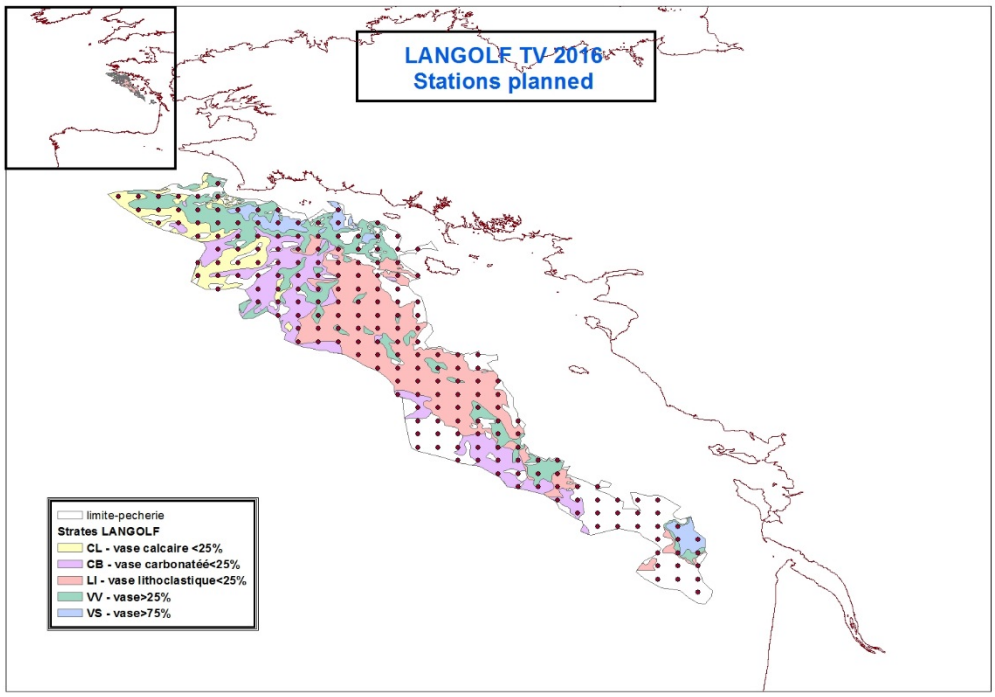


Figure 5.1.8.1. LANGOLF TV 2016 station plan overlaid on sediment data. Black outlines denotes the limit of *Nephrops* fisheries (fishers surveys).

This survey used the Marine Institute of Ireland UWTV equipment and processing methods. The UWTV system is a load bearing optic fiber armored cable with a multiplexer. The sledge based on Scottish design had 2 cameras mounted at fixed angles, 4 light units, 6-point laser system, sled transponder (USBL) and also CTD.

Similar to UWTV method in other labs, the sledge was towed at approx. 0.8 to 1.3 knot for 10 minutes (up to 12 minutes in case of problem), maintaining good ground contact and speed using the winch. The field of view of 0.75 metre was confirmed by lasers for the majority of stations where sometimes, in very soft muds, the sledge

tends to sink. The footage was recorded at high quality onto DVD. The vessel position (DGPS) and the position of the sledge using a transponder were recorded. The sled sensor used to calculate the DOG (Distance Over Ground) for 99% stations.

As for the previous surveys, it was decided to use the FU22 reference footage (Marine Institute) to train the staff in *Nephrops* burrow identification.

Figure 5.1.8.2 shows individual's counting performance against the reference counts as measured by Linn's concordance correlation coefficient (CCC). A threshold of 0.5 was used to identify counters who needed further training. Once this training and testing process had been undertaken, two scientists conducted independently all recounts, on board the research vessel during the survey.

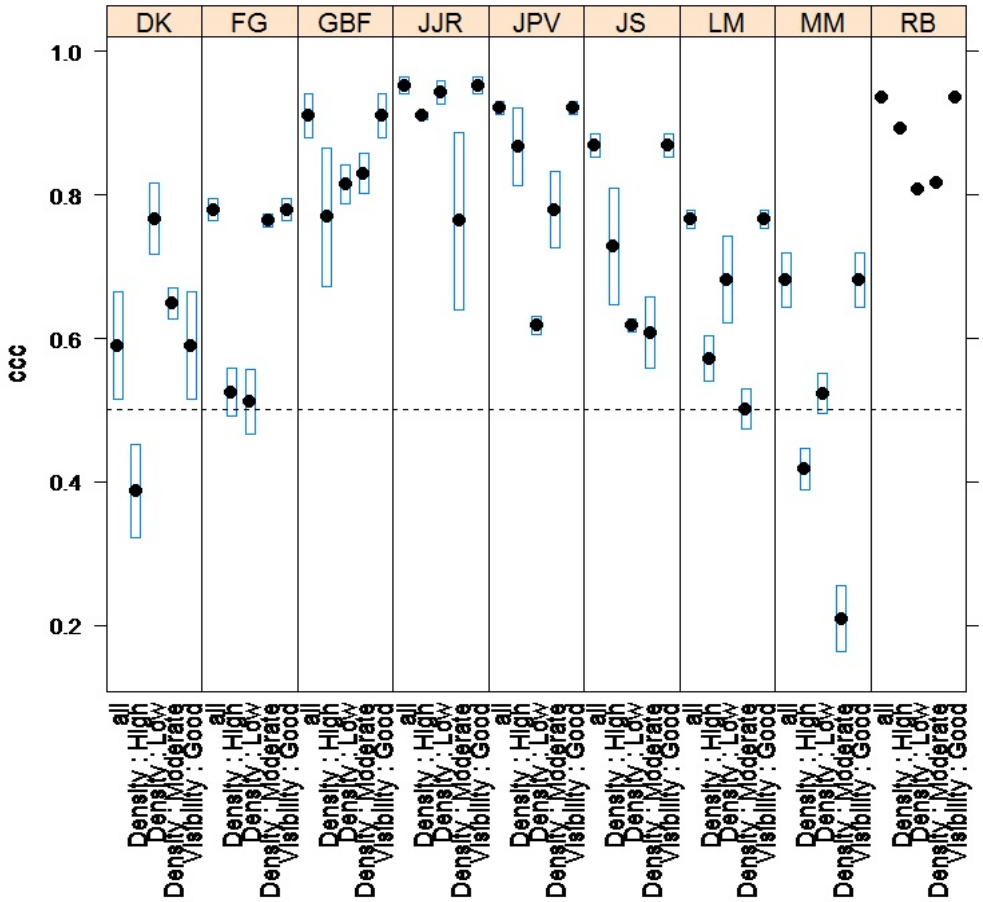


Figure 5.1.8.2. 2016 Counting performance against the reference counts as measured by Linn's CCC for FU 22 "Smalls".

Preliminary Results

The survey plan (204 stations) has been fully completed; however:

- 7 stations were abandoned due to hard ground or rocks present indicated by the camera on the sledge (multibeam in use, but we did them carefully to confirm).
- 1 station, visited twice, has been abandoned for a very bad visibility due to trawlers on area.

Stations abandoned in 2016 due to hard ground/rocks or bad visibility								
FU	Survey	Year	Station	Lat	Long	Absolute density	Count	
23-24	CV16045	2016	55	46.322059	-2.826515	0	0	very bad visibility visited twice
23-24	CV16045	2016	91	46.798529	-3.065909	0	0	rock
23-24	CV16045	2016	92	46.798529	-2.946212	0	0	rock
23-24	CV16045	2016	165	47.433824	-3.425	0	0	rock
23-24	CV16045	2016	166	47.433824	-3.305303	0	0	rock
23-24	CV16045	2016	174	47.513235	-3.784091	0	0	rock
23-24	CV16045	2016	200	47.751471	-4.861364	0	0	rock
23-24	CV16045	2016	202	47.751471	-4.62197	0	0	rock

These stations were used in analysis as zero density stations (Figure 5.1.8.3).

The navigational data quality was controlled using an "R" script developed by the Marine Institute (ICES, 2009b) and examples are shown in Figure 5.1.8.4a/b. The USBL sledge navigational data were used to calculate distance over ground for 99% of stations. Good visual clarity has been got for overall footage.

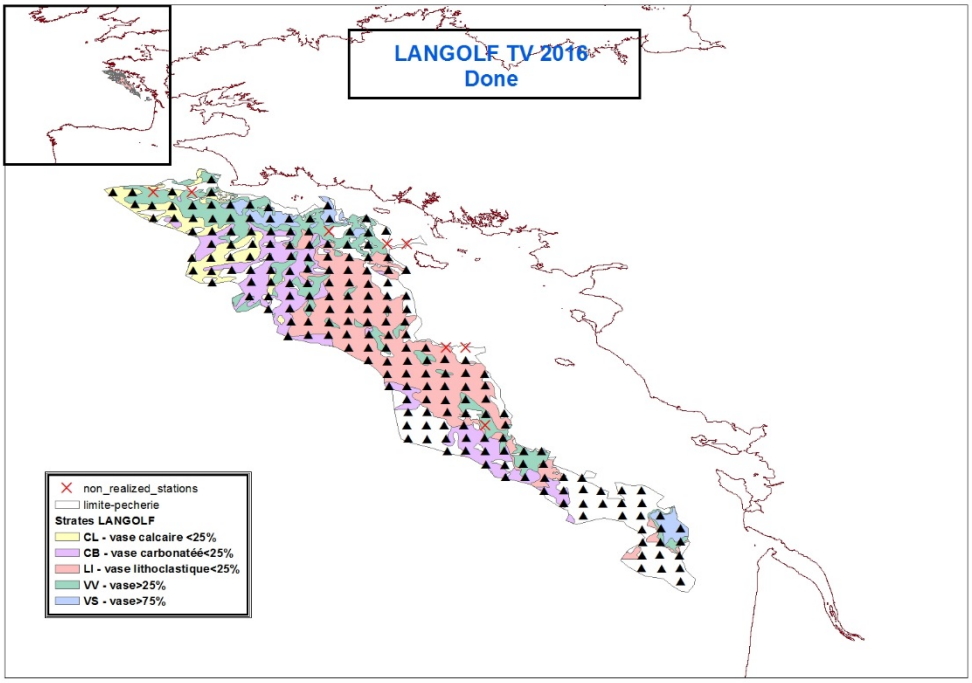


Figure 5.1.8.3. Stations realized or abandoned.

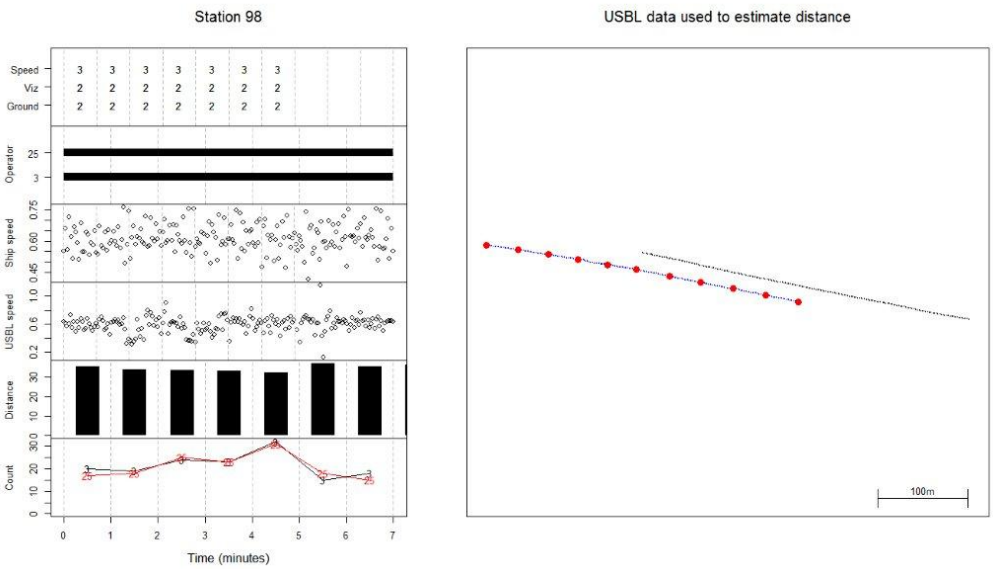


Figure 5.1.8.4a. Quality control plot of "perfect" station 98.

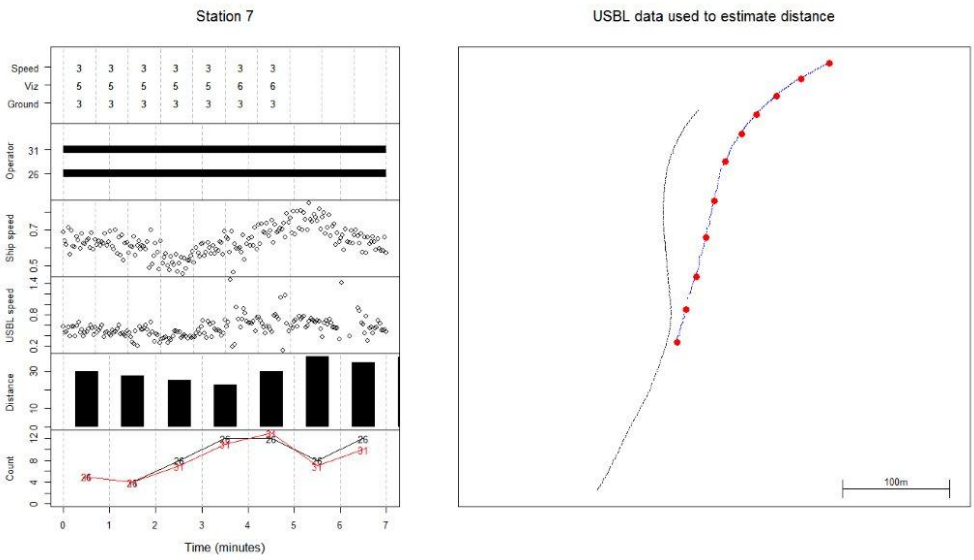


Figure 5.1.8.4b. Quality control plot of station 7. Footage probably indicate current effects.

Overall consistency and bias between individual counters was examined as shown in Figure 5.1.8.5. There is some variability between counters but no obvious bias or excessive deviations.

Figures 5.1.8.6a/b. shows the variability of density between minutes and operators (counters) for each station. These shows that the burrow estimates are fairly consistent between minutes and counters. High densities were observed in the northern sector of the grid with lower densities observed over all (Figure 5.1.8.7.).

The mean density for this survey based on the 204 stations is 0.39 burrow/m², almost similar to previous two years. This is considered as a moderate density *Nephrops* ground.

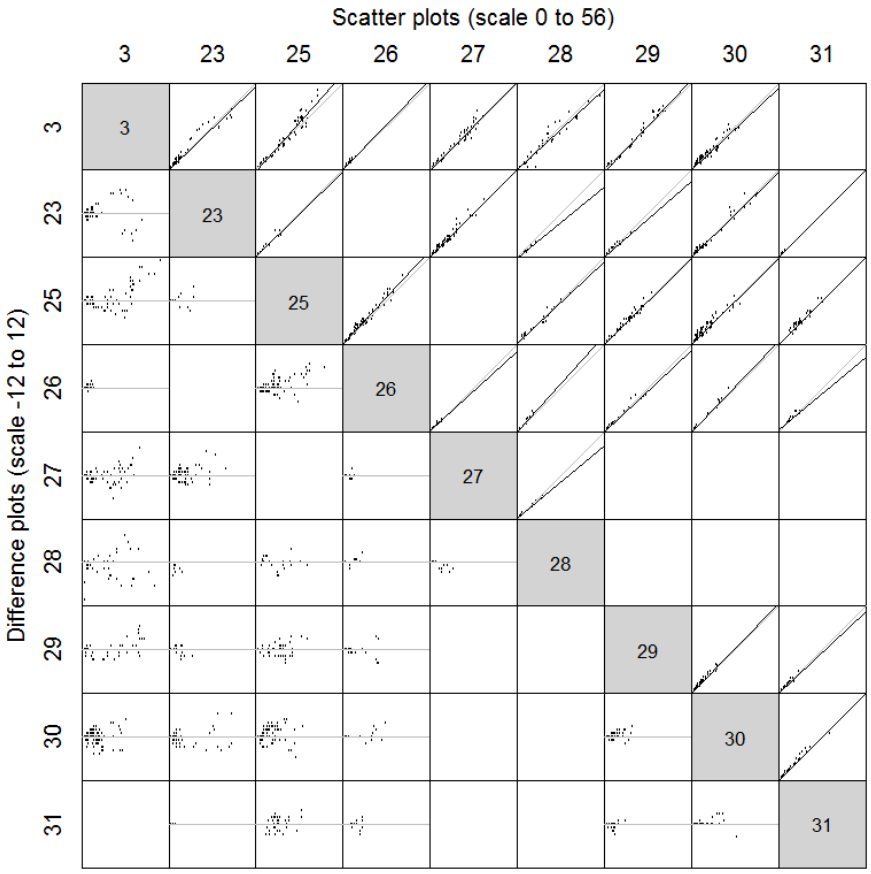


Figure 5.1.8.5. Scatterplot analysis of counter correlations for the 2016 survey.

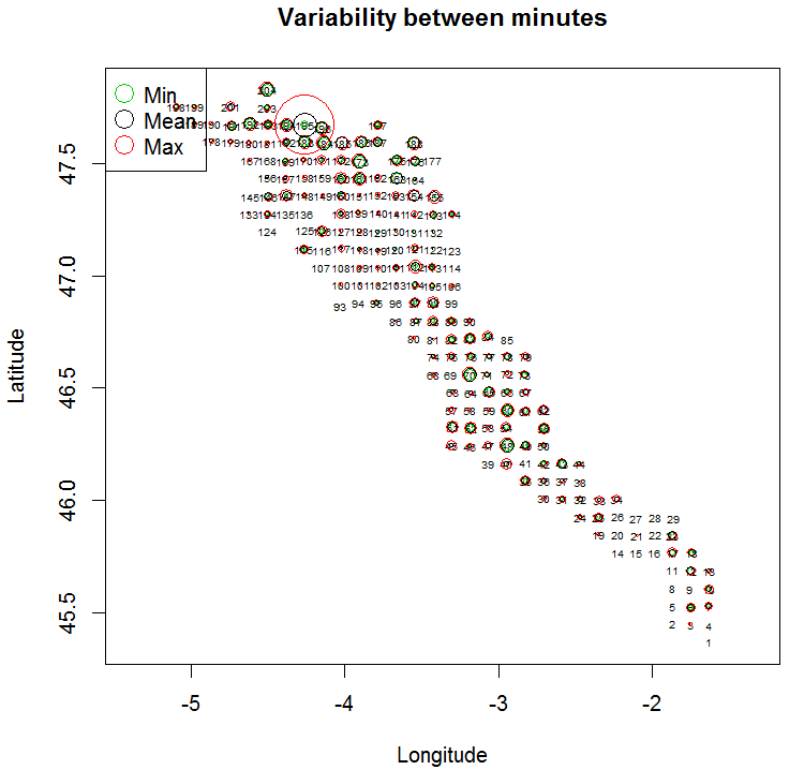


Figure 5.1.8.6a. Plot of variability of density between minutes for each station.

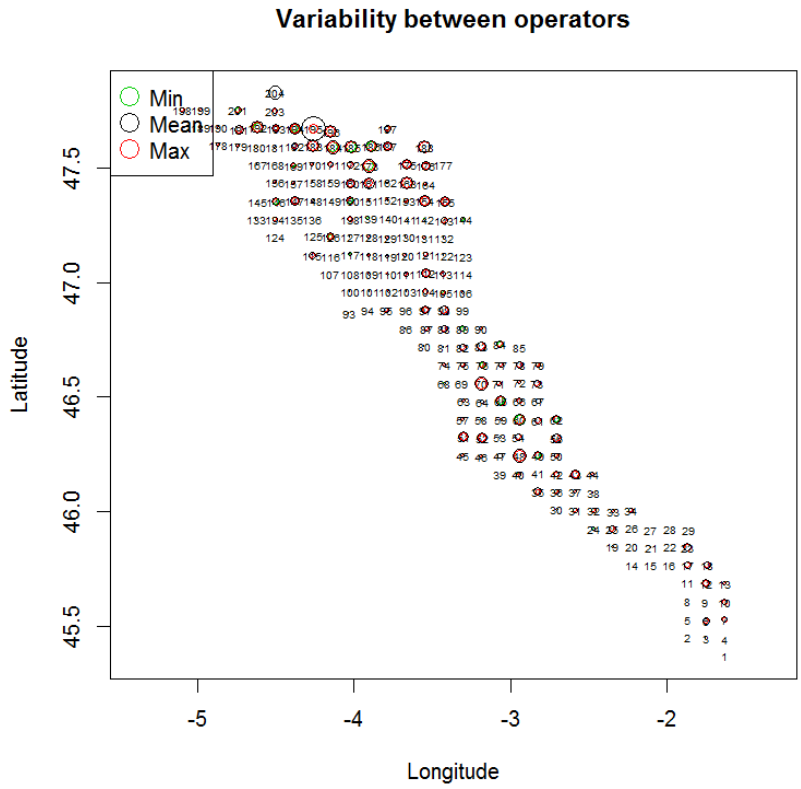


Figure 5.1.8.6b. Plot of variability of density between counters for each station.

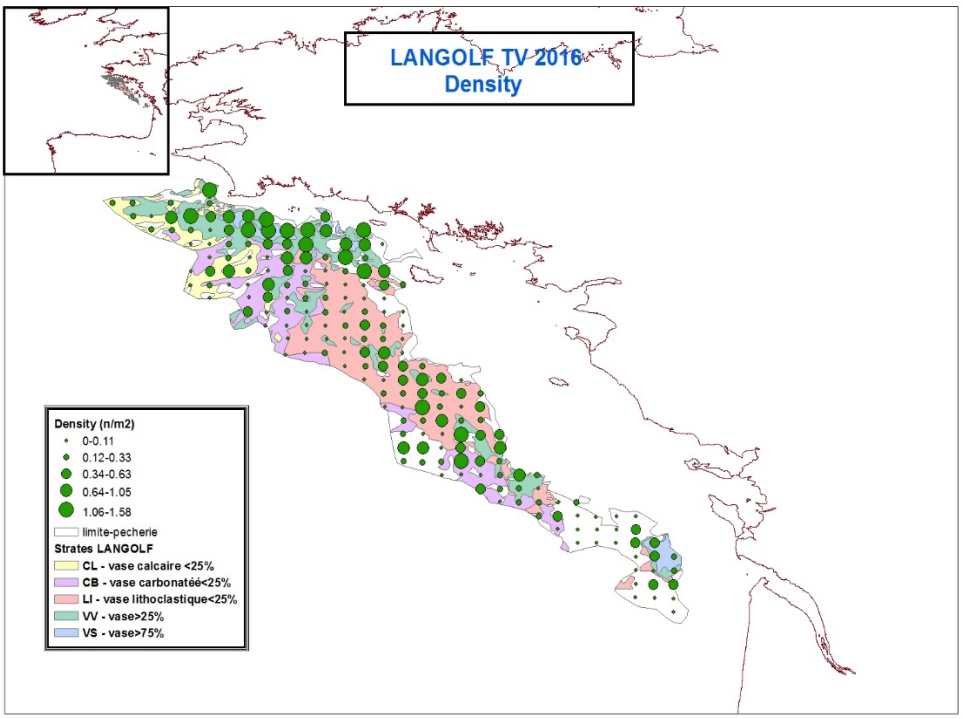


Figure 5.1.8.7. 2016 *Nephrops* burrow density (burrows/m²) observed on the grounds.

Conclusion/Recommendations:

- This third survey on the FU23-24 area using the MI equipment has proved that video counting is a suitable technique to assess the Bay of Biscay *Nephrops* stock.
- All 204 stations have been completed, thanks to team, crew and good weather.
- Only 8 stations have been abandoned: 1 station without any visibility due to trawlers on area (despite re-done) and 7 stations due to rock ground.
- Good visual clarity has been got for overall footage, and identification of *Nephrops* burrows was relatively straightforward despite the presence of other confusion species (*Munida* sp, *Goneplax*…).
- Benchmark 2016 has just end and make us confident in using UWTV method for the next years.
- Until now, the survey took place in 2 legs with team change (implying a re-test of reading), resulting in a waste of time and efficiency.
- The group recommends that only one team will be involved for the whole survey.
- As it was recommended by the 2015 WGNEPS, we have increased the 2016 survey duration to 14 days to protect us from possible bad weather. However, only 13 days were used. The group recommends using this time off for beam trawling on areas with *Munida* to validate video observations.
- Effective Staff exchange between Marine Institute and Ifremer have been successfully led; the group recommends that this collaboration will continue over the next years.

The only use of sediment data to define the ground boundaries may not be complete; for example, in the southern boundary, the sediment data indicates no suitable grounds for *Nephrops* (white zone on map Figure 1), but video demonstrates the opposite. Furthermore, the actual grid of stations should be extended until we aim 0 *Nephrops.* So, the group recommends using a distance of 5 nm between each station to achieve a bigger area with more or less the same number of stations.

- WGNEPS 2016 recommends us to produce our own reference footage for FU23-24 during 2017 survey, using Marine Institute new high resolution camera.

5.1.9 Iceland

The first trial UWTV survey in FU1 was carried out on Jökuldjúp ground on 18–22 April on board RV Bjarni Sæmundsson, during nights in regional shrimp trawl survey. On 7–15 June there was a full UWTV survey on remaining grounds, where the first two days, a regional shrimp survey was conducted during the day. The stations were laid out on randomized fixed square grid with around 4.5 nautical miles between points. The stations were selected based on data from electronic logbooks (Figure 5.1.9.1.). Out of 82 planned stations 77 were completed (one stations was aborted due to rough ground). The depth of station ranged from 87 to 289 m. The sledge was equipped with an HD camera, mounting at 45° and lasers 95 cm apart. The tow speed ranged between 0.5–1.5 knots and cable was played in or out to obtain the best possible footage but 10 minutes were recorded on each station. Vessel position (DGPS) and odometer on the sledge was used to estimate the distance over ground (DOG).

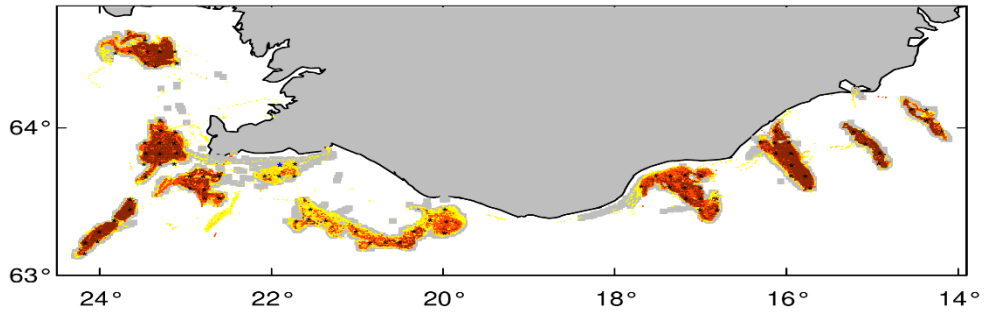


Figure 5.1.9.1. UWTV stations (Black stars) conducted in FU1 during 2016. Electronic logbook data are also plotted, ranging from yellow to red with increased cumulative catch (Data from 2012–2016).

All burrow system are timestamped by two readers, following recommendation from WKNEPH (November 2016) where reference footage of the FU1 ground was established. The mean burrow density has not yet been calculated but initial counts suggest that it could be in the range from 0.1 to 0.2 burrows/m^2.

Conclusion/Recommendation:

- The survey is still developing. The boundaries of the *Nephrops* ground have not yet been classified. VMS and electronic logbook data in conjunction with multibeam echosounder data will be used to define the area boundaries, but it could take several years until the boundaries are well established.

5.2 ToR b. To review the design, coverage, results and uses of *Nephrops* trawl surveys in consultation with WGISDAA.

5.2.1 Portugal

The trawl survey was conducted in June with RV NORUEGA covering Functional Units 28 and 29 (Southwest and South Portugal) with 73 valid hauls (22 in FU28 and 51 in FU29). As in previous years, the sampling grid was composed by 80 rectangles, with 33 squared nautical miles each (Figure 5.2.1.1).

The grid was designed to cover the main crustacean fishing grounds within the range of 200–750 m. The substratum in these grounds is characterized by muddy sediments composed by different percentages of silt and clay.

One station is carried out within each rectangle. The hauls are carried out during daytime with a speed of 3 knots and have duration of 30 minutes. Although directed at the crustacean species (Norway lobster, rose shrimp, and red and blue shrimp), data from all other taxa and species are also collected, as well as marine litter.

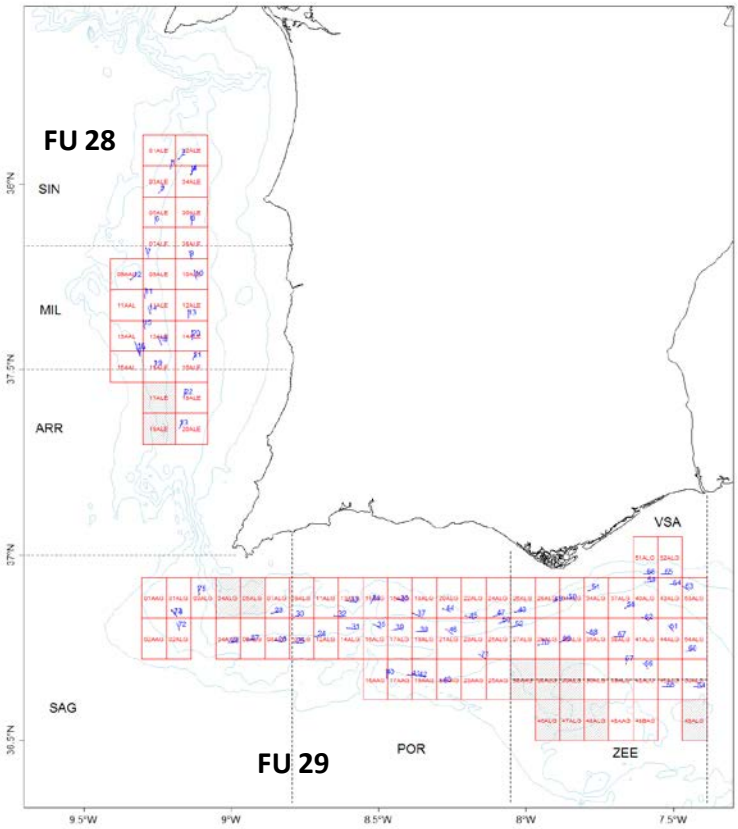


Figure 5.2.1.1. FU 28 (SW Portugal) and FU 29 (S Portugal) sampling grid and 2016 survey hauls. Shadowed rectangles were removed from the grid.

The survey is carried out in June, in the peak of the fishing season, where *Nephrops* males and females are equally available to the gear and most of females are in pre-spawning state, with ripe ovaries. The trawl survey provides an index of relative abundance and biomass of *Nephrops* stocks, which has been used in stock assessment.

Figure 5.2.1.2. shows the spatial distribution of the biomass index in the most recent years.

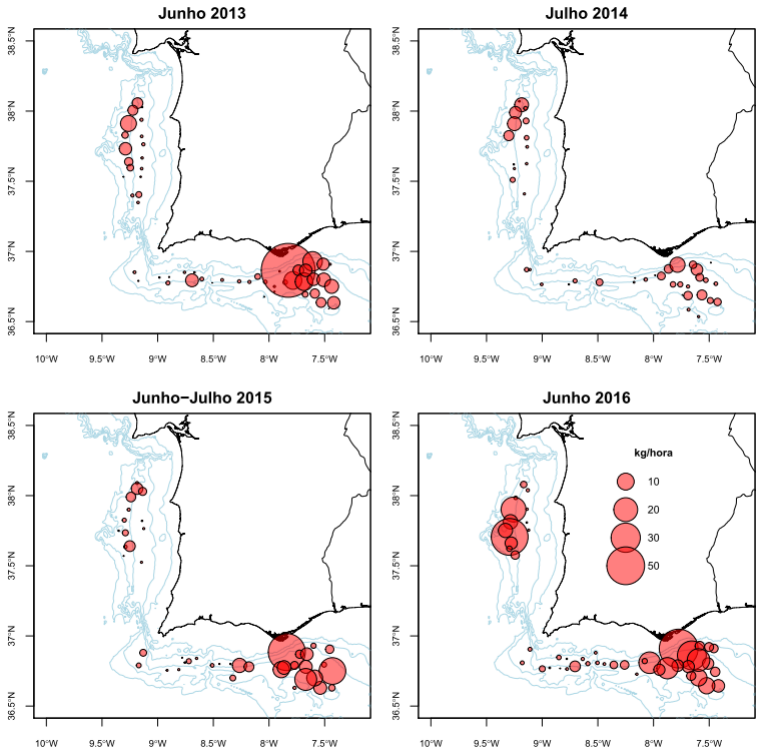


Figure 5.2.1.2. Spatial distribution of Norway lobster biomass index in the most recent years 2013-2015

At present, the abundance index is estimated based on a post-stratification of the area by zones (also indicated in Figure 5.2.1.1.) and depth strata, to compare with previous surveys indices. Geo-statistical methods are being explored to characterize the spatial distribution of *Nephrops*.

Figure 5.2.1.3. shows the biomass index time-series for Norway lobster in the period 2005–2016. In 2016, the CV was 19%.

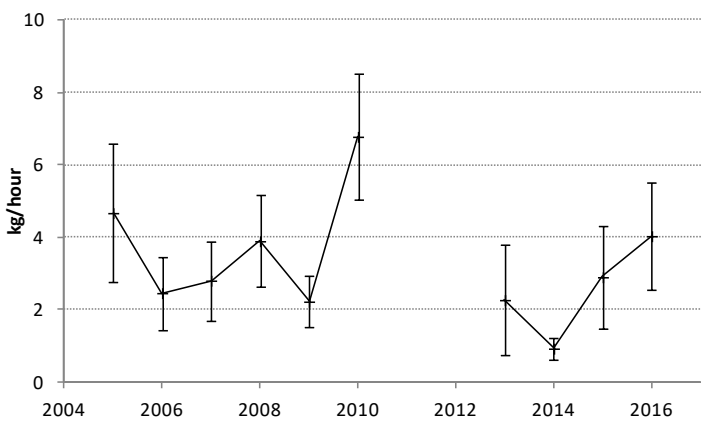


Figure 5.2.1.3. Biomass index with 95% CI in the period 2005–2016.

No estimates are presented for 2011 and 2012. In 2011, the survey did not cover the whole area due to engine failure and the biomass estimate was not considered. In 2012, the vessel was under repair and no survey was conducted.

Conclusion / Recommendations:

- New definition of fishing grounds.
- VMS data from the period 1999–2015 were used to define the crustacean fishing grounds (Figure 5.2.1.4.).
- Although, Norway lobster and Rose Shrimp distribution overlap in some areas and depths, the main fishing grounds for Norway lobster are Sines in FU28 and Olhão, Beirinha and ZEE in FU29, while for Rose Shrimp the most important are Arrifana in FU28 and Sagres-Portimão (sagpor) and Olhão-Portimão (olhpor) in FU29. Sediment samples collected in all area indicate that Norway lobster has preference for substratum composed by more than 80% of silt and clay.
- The delimitation of the fishing grounds may be used in a better definition of the survey strata and design.

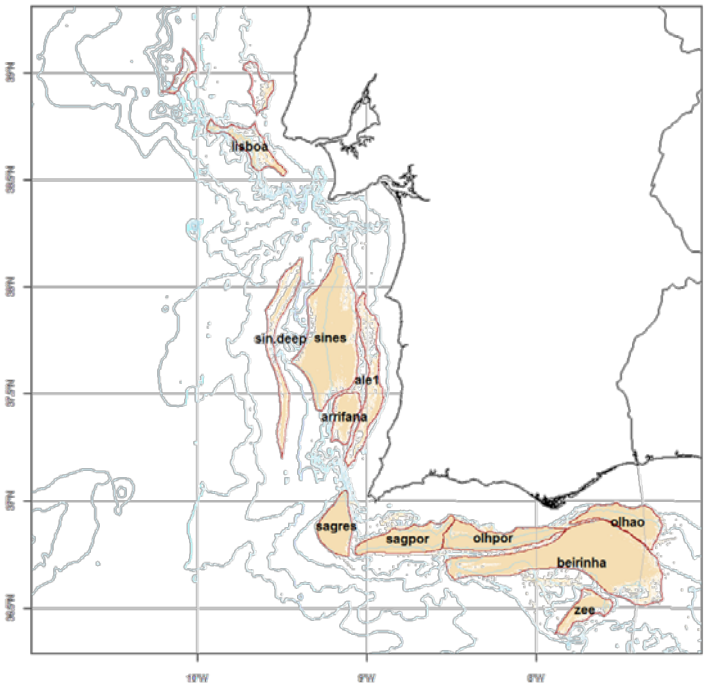


Figure 5.2.1.4. Crustacean fishing grounds based on VMS trawl data.

5.3 ToR c. To review video enhancement, video mosaicking, automatic burrow detection and other new technological developments.

5.3.1 Mosaicking and annotated footage

Kai Wieland (Denmark) gave a presentation to give an update of the mosaicking work currently being undertaken by DTU Aqua to create video mosaics from UWTV survey footage.

An update of a program developed by Bo Lundgren (DTU Aqua, Denmark) for creating video mosaics from UWTV survey footages. The program creates 1 minute strips which are built up while viewing the footage and allows annotating them, e.g. marking *Nephrops* burrows (Figure 5.3.1.1). The program can read video file in which date and time is overlaid in different version but also requires a concurrent GPS logging file with a specific format (text Tabel below). So far, the program has only been tested with files from the Danish and the Swedish part of the survey in FU3 and FU4 (Skagerrak and Kattegat). The output from the program includes a .csv file with e.g. the

annotated burrows counts by 1 min stripe with the concurrent frame number and position and as well the total sum of burrow counts of the station in addition to the stripes with its annotations (Table 5.3.1.1). WGNEPS felt that these features are helpful for training purposes but also for routine analysis.

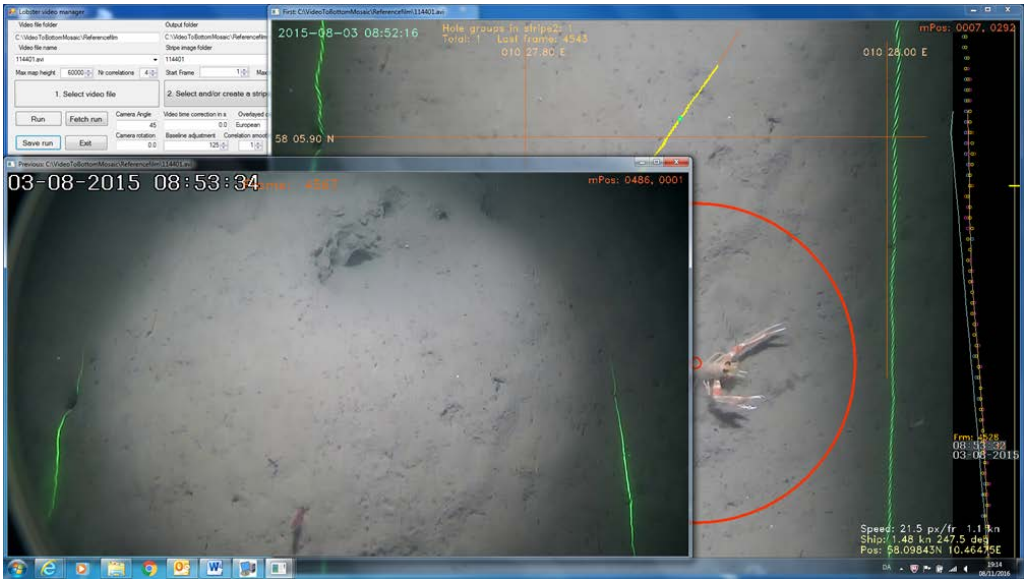


Figure 5.3.1.1. Video mosaic and annotating software, developed by DTU Aqua (example of software front-end).

Table 5.3.1.1. Example of a output .csv file.

File name: 114401.avi
File folder: C:\VideoToBottomMosaic\Referencefilm
Film size: 36027 frames File size 376.200 MB
Inimage size: 1280 pixels wide x 720 lines high

Save time: 2015-08-03 09:01:01

Strip image size: 1406 pixels wide x max 60000 lines long

StripNr	FrameNr	Time(s)	OutRow	Screen Time	Frame Time Date	GPS-Latitude	NS	GPS-Longitude	EW	GPS-Speed	GPS-Course	GPS-Height	Total hole group count	Strip group count
0	520	8.666667	50840	2015-08-03 08:51:19	2015-08-03 08:51:09.216	58.0986534	N	10.4650529	E	1.383333	215.928482	0	1	1
0	749	12.483333	46365	2015-08-03 08:51:26	2015-08-03 08:51:13.033	58.0986409	N	10.4650377	E	1.206667	191.785202	0	2	2
0	1501	25.016667	32327	2015-08-03 08:51:51	2015-08-03 08:51:25.566	58.0985988	N	10.4649759	E	0.943333	252.494263	0	3	3
0	1544	25.733333	31375	2015-08-03 08:51:53	2015-08-03 08:51:26.283	58.0985969	N	10.4649725	E	0.928333	232.574951	0	4	4
0	1806	30.1	26356	2015-08-03 08:52:02	2015-08-03 08:51:30.649	58.0985818	N	10.4649523	E	0.865	244.223541	0	5	5
0	2177	36.283333	19389	2015-08-03 08:52:14	2015-08-03 08:51:36.833	58.0985604	N	10.4649231	E	0.683333	244.400116	0	6	6
2	3669	61.15	54561	2015-08-03 08:53:04	2015-08-03 08:52:01.700	58.0984795	N	10.4648107	E	0.53	282.580353	0	7	1
2	3881	64.683333	50905	2015-08-03 08:53:11	2015-08-03 08:52:05.233	58.0984624	N	10.4647987	E	0.57	232.190002	0	8	2
2	4147	69.116667	46285	2015-08-03 08:53:20	2015-08-03 08:52:09.666	58.0984475	N	10.4647819	E	1.466666	198.241623	0	9	3
2	4286	71.433333	44583	2015-08-03 08:53:24	2015-08-03 08:52:11.983	58.0984435	N	10.4647703	E	0.985	251.414017	0	10	4
2	4546	75.766667	40847	2015-08-03 08:53:33	2015-08-03 08:52:16.316	58.0984298	N	10.4647541	E	0.643333	268.864563	0	11	5
2	4631	77.183333	39217	2015-08-03 08:53:36	2015-08-03 08:52:17.733	58.0984284	N	10.4647454	E	0.646667	322.574463	0	12	6
2	4753	79.216667	37648	2015-08-03 08:53:40	2015-08-03 08:52:19.766	58.0984177	N	10.464741	E	1.346667	189.698959	0	13	7
2	6223	103.716667	14746	2015-08-03 08:54:29	2015-08-03 08:52:44.266	58.098345	N	10.4646455	E	0.94	182.829361	0	14	8
2	6289	104.816667	13535	2015-08-03 08:54:31	2015-08-03 08:52:45.366	58.0983425	N	10.4646412	E	0.756667	208.017365	0	15	9
2	6959	115.983333	3177	2015-08-03 08:54:53	2015-08-03 08:52:56.533	58.098314	N	10.4646002	E	1.68	252.129242	0	16	10
3	7616	126.933333	45157	2015-08-03 08:55:15	2015-08-03 08:53:07.483	58.0982844	N	10.464567	E	0.89	204.536819	0	17	1

An English manual is under preparation but has yet not been completed. However, WGNEPS members are encouraged to provide examples of their video and GPS data files so that it can be checked whether the program is running with other video prior to the next meeting or whether minor adaptions of the program are necessary.

GPS data format:

$GPRMC,045000.00,A,5748.05192,N,00952.13582,E,001.6,286.1,060815,01.9,E,N*01

$GPRMC,045001.00,A,5748.05191,N,00952.13454,E,002.5,268.2,060815,01.9,E,N*0A

$GPRMC,045002.00,A,5748.05171,N,00952.13399,E,001.3,239.4,060815,01.9,E,N*06

$GPRMC,045003.00,A,5748.05135,N,00952.13340,E,001.7,219.9,060815,01.9,E,N*08

Recommendations/Conclusions:

- WGNEPS recommends that the mosaicking and automatic counting algorithm research needs to be continued and developed. Work should focus on automating the clip segmentation, reducing computation time and improving usability of the software. This will require implementation of existing technologies on a more efficient platform. Significant consultation with marine scientists will help specify requirements for the user-interface and presentation of mosaics. It is expected that this work will require external funding to finance it.

5.3.2 Other technologies: An advanced opto-electronic and fishery-independent monitoring of Sablefish. By Jacopo Aguzzi (ICM-CSIC), Emanuela Fanelli (ENEA, La Spezia), Simone Marini (CNR-ISMAR), Corrado Costa (CREA.GOV)

Scientific monitoring of demersal resources by trawling is progressively getting less feasible as depth increases, and given the technical difficulties in obtaining sufficient quality data and insufficient sampling frequencies. Furthermore, this approach does not take into consideration any aspects of the behaviour of the target species, nor issues of environmental fluctuations in the management model. In contrast, optoelectronic tools show promising monitoring potential for population sampling. This approach is more ecologically sensitive, and causes less physical damage than trawling. But considerable work remains in order to develop this approach into an efficient practice that can replace the trawling strategy. No previous alternative multiparametric environmental and video-monitoring sampling, by cabled observatory networks, has been conducted on fishery resources of strategic relevance. Here, we propose for the first time, to undertake such a systematic monitoring at the seabed for the sablefish population within the Barkley canyon (Figure 5.3.2.1 and 5.3.2.2). The species is a partial migrant where a population consists of both migratory and resident individuals (Chapman *et al.,* 2012). Complex geographic movements occur at short (i.e. North America based) and longer basin oriented (i.e. between North America and North Asia) ranges (reviewed by Orlov, 2003). Individuals also present complex horizontal nektobenthic and vertical bentho-pelagic movements, which vary upon gender and ontogeny (Beamish and Mcfarlane, 1988; Sogard and Olla, 1998; Ryer and Olla, 1999; Maloney and Sigler, 2008; Morita *et al.,* 2012; Hanselma *et al.,* 2015). The temporal patterning of those movements seems to be ruled upon internal tidal cycles (Doya *et al.,* 2014; Matabos *et al.,* 2014; Chatzievangelou *et al.,* 2016) with an unclear relationship upon the day-night alternation (Orsi *et al.,* 2006). Accordingly, we aim to use high-frequency, time-lapse video imaging, as well as environmental monitoring at Barkley canyon nodes, to study Sablefish behavioural rhythm and its effects on estimated demographic indices (i.e. abundance and class size frequencies). With this applicative monitoring study, we would contribute in the debate promoting new lines of thinking in fishery management and practices shifting the focus from single-species to integrated ecosystem-based fishery management (Pikitch *et al.,* 2004), by potentiating the assessment with the use of optoelectronic remote sampling methodologies at cabled observatory networks. The local Sablefish population will be surveyed at hourly frequency, in continuous fashion during 12 months by all nodes working on a synchronous schedule. Data will be analysed focusing on: i. characterization of animal movements/displacements rates on tidal, day-night, and seasonal time-scales, in order to show how populational rhythms can bias stock assessment, when sampling is not replicated at suitable temporal frequencies; ii. the characterization of corridors of animal movement within the canyon, in order to evaluate role of these geomorphological structures for the management and protection of this and

other demersal species worldwide; iii. the identification of recurrent associations of species (e.g. as marker of predator–prey interactions) as well as of key meteorological and oceanographic parameters, in order to increase the knowledge about the effects that the environment exert on deep-water and deep-sea communities via the behavioural response of individuals. Finally, the video population densities and size classes extrapolated for the whole canyon area (by combining all network nodes data) will be compared at different time of the day and season with concomitant trawl data by vessels operating in the upper nearby slope as a "proof of concept" for, in order to provide an evaluation of our fishery-independent monitoring capability.

ICES Advantages:

1. Get acquainted with the last technological advancements for the highly-integrated, continuous, real-time, and remote monitoring of marine ecosystems at any depth of the continental margin, form coastal areas to the deep sea.
2. Joining a context to explore Artificial intelligence routines in animal counting form HD and acoustic imaging outputs, as well as new multivariate statistic approaches to be used on complexly interrelated bio- and environmental datasets.
3. Develop an EU-Canada institutional dialogue for the implementation of common technological actions dedicated to the fishery assessment of *Nephrops*.

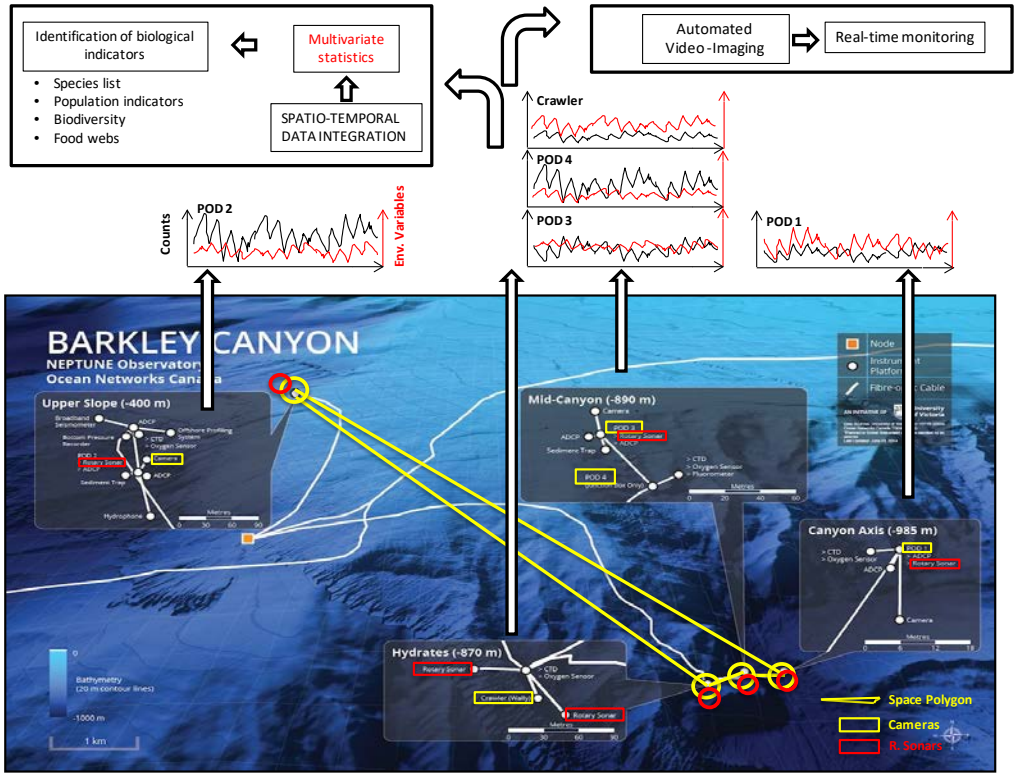


Figure 5.3.2.1. Diagram depicting the fishery-independent and environmental monitoring for *Anoplopoma fimbria* populations (sablefish), whose visual counts by cameras and rotary sonars at each video station are integrated over the whole canyon area (i.e. the yellow polygon). The marine spatio-temporal data gathered from this network of monitoring stations end up in providing valuable biological indicators on both demography (i.e. local abundance and size classes) and ecosystem (i.e. richness, biodiversity, species interactions and their spatio-temporal changes), as required by integrated ecosystem-based fishery management approaches.

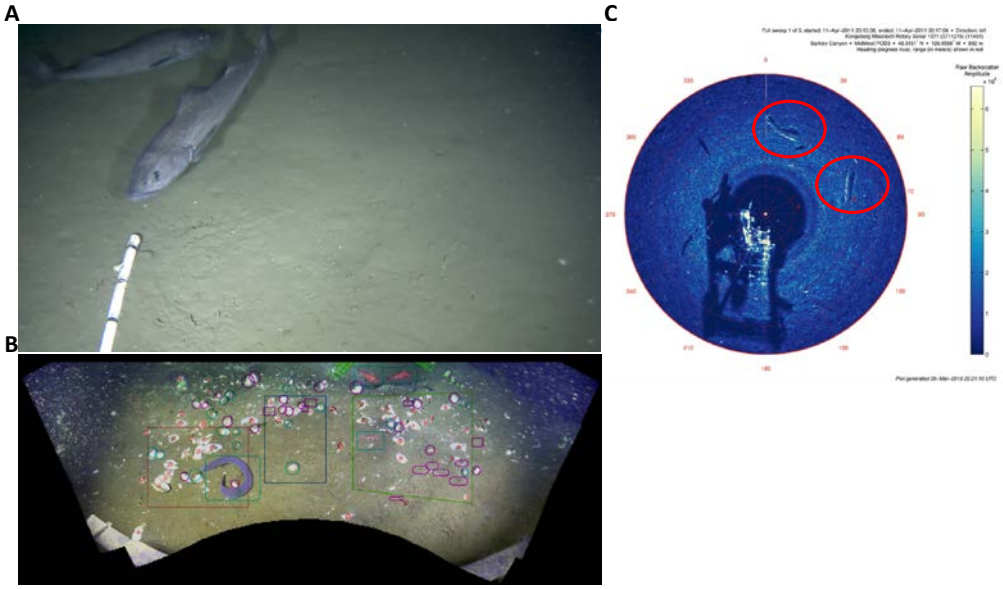


Figure 5.3.2.2. Different imaging outputs within the Barkley canyon nodes network, as recorded at one of the still cameras (POD 1; with metric bar), by a nearby rotary sonar (sablefish are likely those within red circles), and finally at the crawler (where few common faunistic items are present; a hagfish and two rockfish).

5.3.3 Other collaborations. Biodiversity patterns on the "Grande Vasière" area with emphasis on the potential impacts of fishing activities, by Dorothee Kopp.

The fishing area the "Grande Vasière", in the Bay of Biscay, is of great economic, social, and ecological interest. The fisheries of hake (*Merluccius merluccius*), crayfish (*Nephrops norvegicus*) and sole (*Solea solea*) are very developed in this area characterized by fine sediments. Using a new methodology to acquire data (underwater video), this study aims to investigate biodiversity patterns to evaluate the impact of fisheries.

To examine the link between fishing pressure and taxon's sensibility to bottom trawling, we used the method described in De Juan *et al.* (2007), based on the use of functional traits. In this way, we brought to light a negative relationship between trawling pressure and biodiversity (i.e. density and species richness). Two broad communities can be identified. The first one is located on the external border of the "Grande Vasière". Subjected to a low fishing pressure, this community is composed of suspensivore species, among which some require a coarse substratum (crinoid) and others a finer one (sea-pen, anemone). These species show morpho-anatomical and behavioural characteristics that make them sensitive to trawling. The second community is located on the rest of the area and is composed of opportunistic and motile predators, less vulnerable to trawling pressure. Fishing pressure is stronger over this community than over the former one and is composed of very few suspensivore species. At last, the comparison of these results with the ones of previous studies revealed that sea-pens, identified as a rare species, occurred in a great number of sites. The knowledge brought by the use of underwater video is thus of interest.

Recommendations:

UK guidelines on deriving epibiota data from UWTV footage. These guidelines have recently been published online via the National Marine Biological Analytical Quality Control Scheme (NMBAQC)'s website at:

Interpretation guidelines:

http://www.nmbaqcs.org/media/1643/nmbaqc_epibiota_interpretation_guidelines_final.pdf

Operational guidelines:

http://www.nmbaqcs.org/media/1591/epibiota_operational_guidelines_final.pdf

Queries regarding these guidelines can be addressed to Henk van Rein at JNCC:

Dr Henk van Rein, Marine Habitats Monitoring Officer, Joint Nature Conservation Committee UK. E-mail: henk.vanrein@jncc.gov.uk

5.4 ToR f. Develop an international database which will hold burrow counts, ground shape files and other data associated with UWTV surveys.

The working group had a first meeting with ICES to discuss the development (data requirements/structure) of an ICES-UWTV database for *Nephrops*.

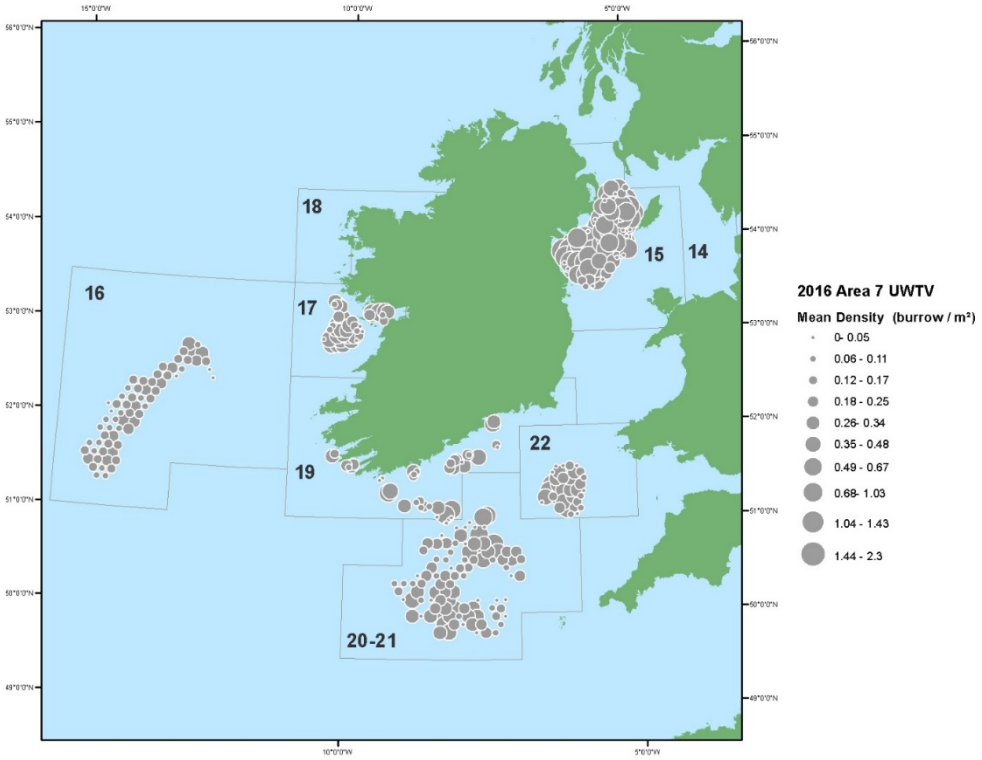
The discussion covered: Database outputs (summary tables, Figures, maps); time-lines; data submission; development; live version; database update; point of contact; data users (WGs, ADG), open access; historical data time-series.

The working group identified the minimum data requirements that should be included in the future ICES UWTV database. This work will be further developed in the coming years.

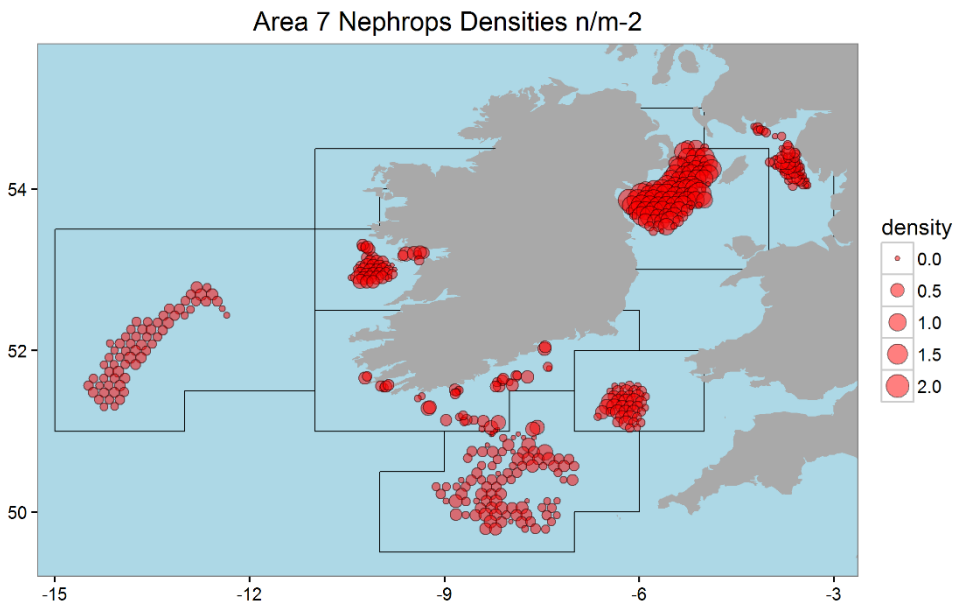
Some examples of outputs that as a minimum would be useful from ICES–UWTV database that can be agreed later.

- Summary Table.
  Fields to be consistent with Metadata table in ICES-UWTV database.
  - Survey/Survey Code
  - Year
  - FU
  - FU Name
  - FU ground
  - Country(ies)
  - Number of Stations
  - Mean Density n-2

- *Nephrops* Burrow Density Map.
  These are useful to provide overview of densities in areas. See examples below of density maps:

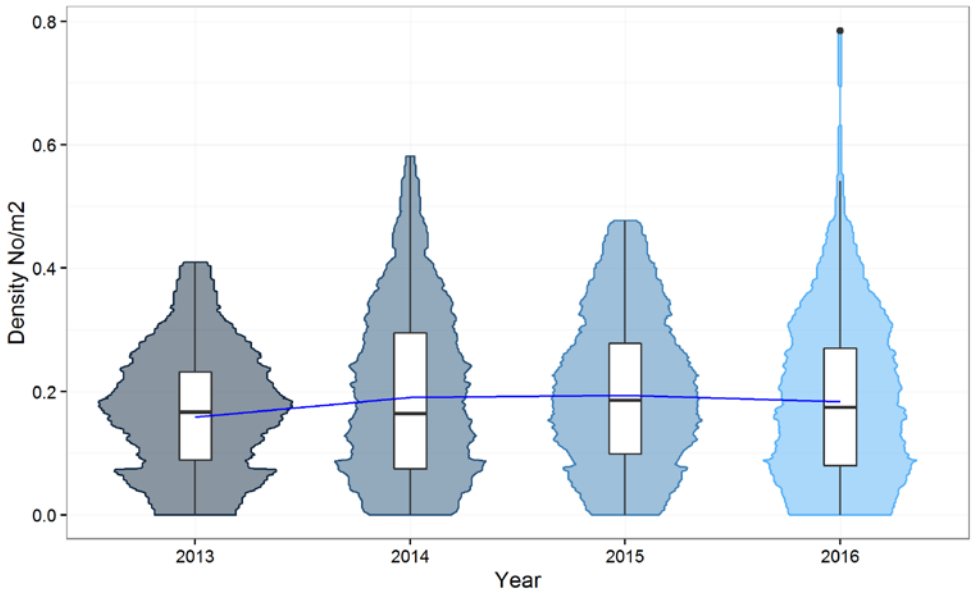


Exemple 1. 2016 density map of Area 7 *Nephrops*. ArcGIS 10 output.

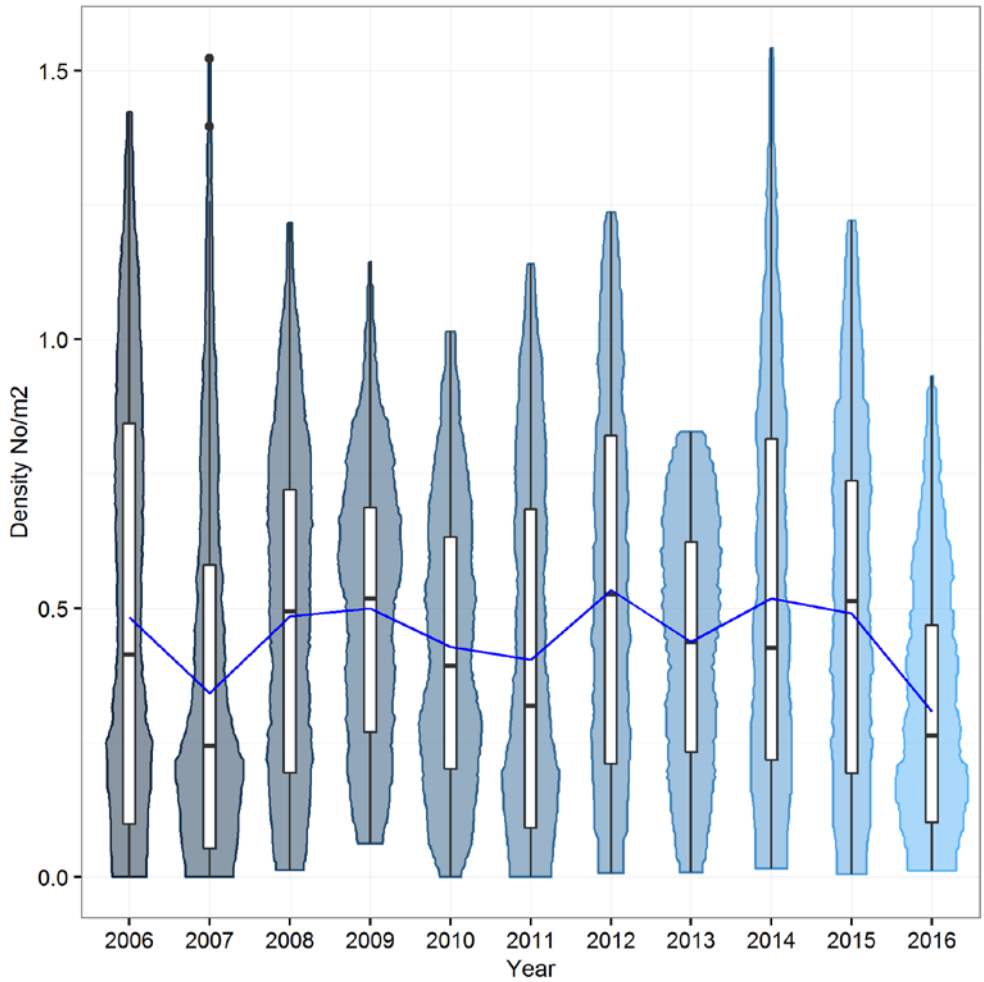


Exemple 2. 2016 Density map of Area 7 *Nephrops*. R script map ggplot2 output.

- Violin Plots of Density by FU.
  Violin plots are informative to show adjusted burrow density distributions by year as these data are not so obvious from area density maps. Refer to Marine Institute UWTV survey reports here. Example r-script is on the WGNEPS 2016 data folder here.



Exemple 3. FU20-21 grounds: Violin and box plot a of adjusted burrow density distributions by year from 2013–2016. 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.



Exemple 4. FU22 Smalls grounds: Violin and box plot of adjusted burrow density distributions by year from 2006–2016. 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.

- UWTV survey area polygons.
  For some stocks these are available and they should be housed in ICES UWTV database also. These are updated at Benchmark meetings. It was recommended by IBPNeph 2015 that any revisions to survey area should be considered by WGNEPS.
  The shapefiles of the *Nephrops* ground are available at: http://www.isde.ie and also http://data.marine.ie/downloads/fisheries/*Nephrops*Grounds.zip
- Data coordinators.
  It was agreed that each institute would have a national coordinator that would be responsible to upload the date and be the first point of contact to any matters related with the ICES UWTV database for *Nephrops*.

6 Revisions to the work plan and justification

No revisions made to the current work plan.

7 Next meetings

To be confirmed - 28 November – 1 December 2017, HCMR – Hellenic Centre for Marine Research, Heraklion, Crete, Greece.

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Annex 1: List of participants

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Annex 2: Recommendations

Recommendation	Adressed to
1. A dedicated research project on *Nephrops* UWTV surveys has been proposed by WGNEPS; "Further developing UWTV *Nephrops* survey methodologies (DevNepS)". WGNEPS recommends that this project be funded in the near future through funding mechanisms such as EMFF.	SCICOM, RCMs
2. WGNEPS recommends that survey coverage be expanded to other important fisheries not currently assessed e.g. Horns Reef FU33, Botney Gut FU5. This should be discussed with the stock coordinators.	WGNSSK, RCMs

Annex 3: Agenda

Day 1 Monday – 7/11/16

9:00 – 09:30 Welcome and Morning coffee

9:30 – 10:00 Introductions

- adoption of agenda
- report structure and allocate tasks
- TORs 2016-2018

10:00 – 10:45

Update on the ICES UWTV database, ICES requirements (TOR f)

- ICES Presentation (Skype with Neil Holdsworth, Head of Data and Information for the *Nephrops* Survey database.)
- Draft table with data requirements, update 2015 version.

10:45-11:00 Coffee Break

11:00 – 12:45

Review of survey activity for existing series – Part 1

- Updated on the Skagerrak and Kattegat UWTV survey.
- Review video enhancement, video mosaicking, automatic burrow detection and other new technological developments.

Kai Wieland and Mats Ulmestrand (45 min)

- Developments in Scottish UWTV surveys.

Adrian Weetman (30 min)

- Developments on Marine Institute Surveys

Jennifer Doyle (30 min)

12:45-14:00 Lunch

14:00 – 16:00

Review of survey activity for existing series – Part 2

- Developments on AFBI trawl and UWTV surveys

Annika Clements (30 min)

- Developments on Cefas surveys

Rob Masefield (30 min)

- Developments on the UWTV survey in the Gulf of Cádiz

Yolanda Vila (30 min)

- *Nephrops* in Icelandic waters

Jónas P. Jónasson (30 min)

16:00 – 16:15 Coffee Break

16:15 – 16:45

Review progress on the SISP documents (Publication deadline December 2016)

- Trawl SISP progress /set roles and responsibilities – Jonas/Ana
- UWTV SISP progress /set roles and responsibilities –Jennifer/Ana

16:45 – 18:30

Drafting Subgroups on SIPS

Day 2 Tuesday – 8/11/16

Review of survey activity for existing series – Part 3

9:00-10:30

- *Nephrops* in the Adriatic Sea

Damir Medvešek / Michela Martinelli (30 min)

- Developments on the trawl/UWTV surveys in Portugal

Cristina Silva (30 min), via Skype

- Developments on the UWTV and trawl surveys in the Bay of Biscay

Michèle Salaun (30 min)

10:30-11:00 Coffee Break

- Biodiversity patterns on the "Grande Vasière" area with emphasis on the potential impacts of fishing activities

Dorothee Kopp (30 min)

11:30 – 12:45

Nephrops Benchmarks outcomes and preparation (Gulf of Cadiz, Bay of Biscay and Kattegat/Skagerrak).

12:45-14:00 Lunch

Looking forward, next steps

14:00 – 14:30

- Next meeting (set dates)
- Actions/deadlines
- AOB

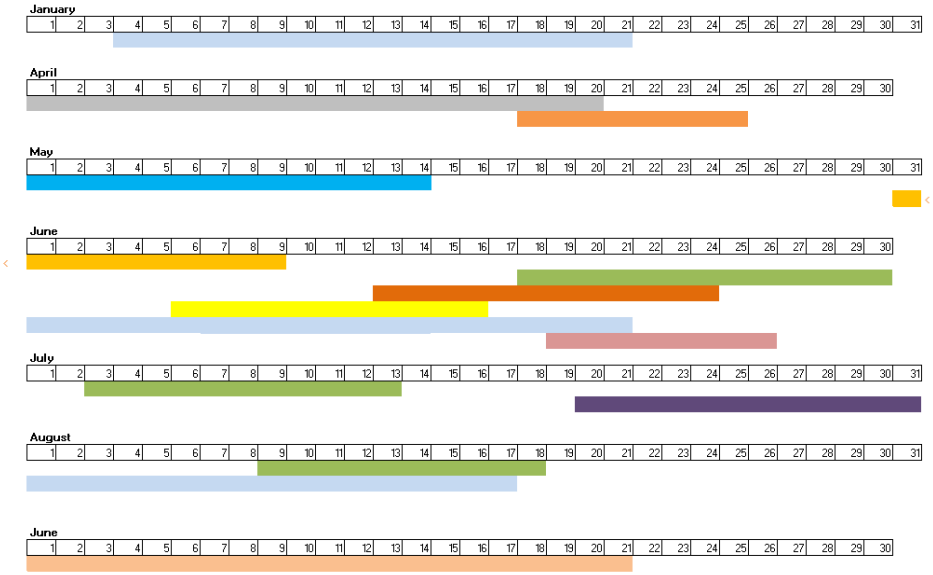
Report drafting

14:30 – 18:30

- Drafting WGNEPS report
- Review WGNEPS report and draft recommendations.
- Submission deadline Dec 2016
- Workshop – Notes for the next day

Annex 4: Overview of the *Nephrops* surveys (UWTV and Trawl) scheduled for 2017

Institute	Survey Type	Survey Area	Ship
MSS-Scotland	UWTV	West Coast Sealochs	Alba na Mara
Italy/Croatia	UWTV	Pomo Pit -GSA17	G. Dallaporta
DTUAqua-Denmark	UWTV	FU3&4	Havfisken
Ifremer-Lorient	UWTV	FU23-24	TBC
SLU-Sweden	UWTV	FU3&4	
MI-Ireland	UWTV	FU16&17	Celtic Voyager
IEO-Cadiz	UWTV	FU30	Ramon Margalef
MFRI-Iceland	UWTV	FU1	Bjarni Sómundsson
MSS-Scotland	UWTV	FU7,11,-13,34,10	Scotia
CEFAS-UKE&W	UWTV	FU6	Endeavour
MI-Ireland	UWTV	FU 19,22, 20-21	Celtic Voyager
AFBI-Belfast	UWTV	FU14,15	Corystes
MI-Ireland	UWTV	FU 19,22, 20-21	Celtic Voyager
MSS Scotland	UWTV	FU 8-9	Alba na Mara
Institute	**Survey Type**	**Survey Area**	**Ship**
IPMA-Portugal	Trawl	FU28-29	Noruega



Annex 5: Equipment specification UWTV surveys

	Institute	Institute	Institute					
	AFBI, UK-NI	DTU Aqua, DK	Marine and Freshwater Research Institue (Iceland)	CEFAS, UK-E&W	CNR-ISMAR (Italy/Croatia)	MSS (Scotland)	Spain	MI (Ireland)
Primary Video Gathering Method								
Method	Sledge	Sledge	Sledge	Sledge	Drop frame	Sledge	Sledge	Sledge
Other Video Gathering Methods Available								
Method	Drop frame	NA	NA	Drop frame	NA	Drop Frame/Creel frame	NA	NA
Primary Video Camera								
Make/model	Kongsberg OE 14-364/5 (https://www.km.kongsberg.com/ks/web/nokbg0397.nsf/AllWeb/59D9FBC855B24AECC1256E8C002C88BD/$file/oe14364_Datasheet_A4.pdf?OpenElement)	Samsung SNB-6004 PoE	Kongsberg OE14-502F	STR SeaSpectrum IP	Kongsberg oe14-372/373	Konesberg OE-14366	Thalasssatech/TST HORUS	Kongsberg OE-14366
HD/Analogue	Analogue	Full HD 1980x1080P, 60 FPS	HD	HD	Analogue	Analogue	Full HD	Analogue
Lens	6.0mm f/1.4	Samsung SLA-M3180		Wide angle, Acrylic Viewport	Standard Lens 2.3mm	4.1mm to 73.8mm, F1.4 to F3		4.1mm to 73.8mm, F1.4 to F3
Sensor specs	½" Hyper HAD CCD		1/4" Interline Transfer CCD	1/2.5" Aptina 5 Mega Pixel CMOS		Super HAD CCD		Super HAD CCD
Picture Resolution (HD - pixels; Analogue - TV lines)	470 TV Lines	2MP				750 TV lines	1080x1920 pixels	460 TV lines
Focus (fixed/zoom)	50mm - Infinity (remotely controlled)	Manuel Zoom	fixed	Fixed Focus	fixed	18 x Optical Zoom	Fixed	18 x Optical Zoom
Focus range	NA	3.1-8mm	Front port to infinity (wide angle)/700mm to infinity (narrow angle)		250 mm / 90° in water	70mm - infinity		70mm - infinity
Field of View Reference (lasers, bottom of monitor screen, etc)	Lasers (external from camera): 4 - 2 either side positioned horizontally near bottom of field of view, distance between measured daily during operations.	Line laser		Lasers	lasers	Bottom of monitor screen	2 Line Lasers	2 sets of Point lasers set at 65, 70, 75 cm at bottom edge of screen
Dimensions of Field of View	56° diagonal in water (Optional 97°)	2x 20mW line laser	95cm	81.5cm	80 cm	sledge: 90cm but variable	75 cm	sledge: 75cm

Secondary Video Camera								
Purpose	Spare in case of breakdown	NA	NA	NA	NA	Rear facing, monitoring odometer	Live imagen	Forward facing - set at alteranative FOV or angle if required
Make/model	Kongsberg OE 1364 (https://www.km.kongsberg.com/ks/web/nokbg0397.nsf/AllWeb/CF3F0DB13F23AE23C12576770047844 5/$file/oe1364.pdf?OpenElement)					Deepsea Power and Light, MSC2065	Thalasssatech/TST HORUS_LIVE	Kongsberg OE-14366
HD/Analogue	Analogue					Analogue	Ful HD	
Lens	6.0mm f/1.4					3mm, f2.0	(0.67x) 63º	
Sensor specs	1/2" Hyper HAD CCD					1/3" CCD	5M Pixel	
Effective pixel	460 TV Lines					460 TV Lines	1080x1920 pixels	
Focus (fixed/zoom)	70mm - Infinity (remotely controlled)					Fixed wide angle	Fixed	
Focus range						NA		
Still Camera								
Purpose	Not routinely used yet in Nephrops UWTV surveys, but under consideration for inclusion	NA	Navigation assist	NA	NA	NA	NA	NA
Make	Sub C Imaging 1Cam Alpha+ Mk5 (http://subcimaging.com/product/1cam-mk5/)		Kongsberg OE 14-208					
Image recording (35mm, digital SD card, flashback,etc)	HD recording		SD card					
Digital image format (RAW, JPEG, PNG, etc)	Variable		JPEG					
Lens	Carl Zeiss Vario Sonnar T 10X Optical Zoom							
Resolution	24.1 MegaPixel							
Image area estimation								
Surface controlled shutter (Y/N)	Yes		Y					
Power supply (batteries/surface feed)	Batteries and/ or surface feed		Surface feed					
Type of deployment								
Flash lighting	Sub C Imaging Aquorea LED Strobe		OE11-242					

Lighting								
Type (LED, halogen, etc)	Halogen - two lights mounted on sled	LED	LED	LED	LED	LED	LED	LED
Make/model	Kongsberg OE11-135	Made in house, based on Cree CXA2530	6x Deepsea Sealite sphere	STR SeaLine	Kongsberg OE11-150	Seatronics Sea LED; High intesity underwater lamp	Thalassatech/TST-OFL 7000	ROS - BrightLIGHT - Ultra High Power LED Light
Typical light power (watts)	300W	2*5500 lumen	6x 90w	20	54 watts	40W (max)	7160 lumenx max (70W)	>1070 lumens
Dynamic light control	Yes - Surface controlled dimming		Yes	Non dimmable	No	Yes - Surface controlled dimming	Yes - Surface controlled dimming	Yes - Surface controlled dimming
Video recording unit								
Video recording method (DVD, HD, mini HD tape, etc)	DVD	Full HD	DVR	MP4 to harddrive	HD/SD recorder	DVD recorder	Full HD	DVD recorder
Video recording device details (make, model)	Panasonic DMR - EX83EB-K	Dell Laptop with external harddisk	SubC DVR	STR interface application	Data video HD/SD recorder HDR-60	Panasonic DMR EX-86EBK	Laptop with external harddisk	Sony DVD Recorder/Pioneer Hard-drive recorder
Recording device capacity	N/A	2GB	2 Tb	2TB	2 tera byte	320GB HD/4.7GB DVD disk	1.0 T	160GB HD/4.7GB DVD disk
HD recording Software	N/A	Samsung Smartviewer	SubC			NA	VLC	NA
Storage format	DVD	H.264	mpg	MP4	AVI	DVD	.MOV	DVDS and iso files created form ImgBurn software
Number of BackUps	1		2	2	2	0		3 (DVD, cloud storage, external hard-drive)
Annual Survey footage file size (GB, No. DVDs, etc)	20-25 DVDs (94GB - 117GB)		250 GB	100GB		Approx 75 DVDs per year (approx. 352GB)		Approx.60 per year (282 GB approx_
Battery pack								NA
Purpose	For stills camera - optional extra	NA	NA	Power delivery via coax umbilical	NA	Typically supplies rear camera; backup for all other components	Energy for the system	
Type	Sub C Imaging					2 x Yuasa lead acid	Li-Po	
Voltage/Amps	24Volts/ 16A					24V DC 12Ah	44V / 7.2 Ah	
Autonomy	Dependent on camera setting					Manually operated	10 h	
Charge time	4 Hours					12 hours	2 h	
Interchangebility	Interchangable with other Sub C Imaging systems					Yes	Yes	

Cable								
Cable performance (load bearing, fishing warp required, etc)	Fishing warp required	working load 10.7kN	Load bearing	Load bearing	load bearing	Load bearing	Electromechanical, stainless steel, type Rochester	Load bearing
Type (copper core analogue, fibre HD, other)	Copper core	Copper core 18AWG, 39Ohm impedance	Copper and fibre	Copper core coax	coaxial	Copper core coax	Ø 14.1 mm, breaking load 22kN	1500 m Rochester Fibre Optic
Cable construction description	MacArtney Type 6013/B Special TV Cable	Double steel reinforced coaxial			Inner Conductor: Stranded bare copper 7x0.20 mm nom. Insulation: Polyolefin Outer conductor: bare copper braid, optical coverage _ 85% Separator: Double reverse polyester foil-3.70 Conductor: Stranded tinned copper 0.75 mm2 Insulation: Polyolefin colour black + red numbered 1-2 Shield: Aluminium/Polyester tape + drain wire 0.75 mm2 Separator: Polyester foil Conductor: Stranded tinned copper 0.75 mm2 Insulation: Polyolefin colour white numbered 1-5 Separator: Double reverse polyester foil Inner Conductor: Stranded bare copper 7x0.20 mm nom. Insulation: Polyolefin Outer conductor: bare copper braid, optical coverage _ 85% Separator: Double reverse polyester foil-3.70 Conductor: Stranded tinned copper 0.75 mm2 Insulation: Polyolefin colour black + red numbered 1-2 Shield: Aluminium/Polyester tape + drain wire 0.75 mm2 Separator: Polyester foil Conductor: Stranded tinned copper 0.75 mm2 Insulation: Polyolefin colour white numbered 1-5 Separator: Double reverse polyester foil	Double sheathed polypropylene, kevlar braid	coaxial cooper core 3.08/7.05 mm^2	
Core design						21 conductors plus 2 coaxials		
Additional equipment fitted								
Altimeter				Altimeter	GPS	Altimeter		
USBL	TrackLink USBL	GPS	Altimeter	USBL	Laser scalers	Sediment Grab		IXSEA GAPS system
GPS	Ship's dGPS	CTD	USBL	GPS	Recovery assistance device	Odometer	SHIP dGPS	SHIP dGPS
Sediment grab	4 point lasers manufactured by Cefas		Odometer	Odometer	Turbidity meter	Laser scalers (drop framr only)		6 point lasers set built by CEFAS
Odometer	Optional and not currently used for Nephrops UWTV surveys (only in habitat mapping surveys)		Video overlay	HIPAP Beacon	CTD	Video Overlay		
Laser scalers	Seabird Electronics CTD		Recovery location device	Video overlay		Recovery Location Device	2 point lasers	
HIPAP Beacon				Recovery location device		Recovery Assistance Device	HiPAP (Simrad)	
Video overlay				Recovery assistance device		Track Point Acoustic Location Beacon		No Video Overlay
Recovery location device				Turbidity meter				Recovery buoy attached to sledge for stations < 160 m
Recovery assistance device				CTD				
Turbidity meter								
CTD							AML Oceanographic MINOS X	Seabird 37

Overall system:								
Dimensions	Max. Height: 157cm (180cm inc. Floats). Max. Length: 235cm. Max. Width: 168cm.		200x140x180 L/W/H	1.7m X 2.5m X 2m	220x125x150 cm	2.1m x 1.4m x 1.6m - sledge	180 x 150 x 130 (cm)	
Weight	Approx. 150kg		NA	NA	180kg	Approx. 180kg	80 Kg	
Operational depth	Max. cable deployment 300m		750m	NA	max 500 m.	1000m	1000 m Max	Max depth 700 m
Reviewing Equipment								
CRT Monitors								
- make/model	1. TVS CH-15DXA CRT Colour Video Monitor 2. ABUS LED Monitor with BNC port	NA	NA	NA	JVC TM-10E-K	JVC TM-H150CG		JVC TM-H150CG/Sony
- screen size (diagonal)	1. 15 inch 2. 13 inch				10"	15"		15"
- specification	1. >600 TV lines (Centre) 2. 1280 x 1024 pixels				Colour	Colour		Colour
HD Monitors								
- make/model	NA		NEC Multisync UHD	Sony PVM A250	NA	NA		NA
- screen size (diagonal)			27"	25"				
- specification				Full HD				
Laptops (Size and Specification)						Dell 630	HP 15", 3.8 GiB, intel®Core™i5-4210U CPU@1.70GHzx4	
Supplier homepage								
Camera	www.km.kongsberg.com	samsungsecurity.com	Kongsberg	http://www.str-subsea.com/home	https://www.km.kongsberg.com/ks/web/nokbg0397.nsf/AllWeb/1122AA02D643BA0BC12577DF0051EA0E/$file/oe14_372_Datasheet_US.pdf?OpenElement	main camera: www.kongsberg.com/rear camera: www.deepsea.com		Kongsberg
Lighting	www.km.kongsberg.com	Cree.com	DeepSea	http://www.str-subsea.com/home	https://www.km.kongsberg.com/ks/web/nokbg0397.nsf/AllWeb/6D56A29E8457D03AC125756E004A1105/$file/oe11150_Datasheet_A4.pdf?OpenElement	www.seatronics-group.com		
Video recorder	www.panasonic.com		SubC		http://www.datavideo.com/product/HDR-60	www.amazon.co.uk		
Video player	www.panasonic.com		SubC	amazon. LG BP250 bluray player. Don't recommend it, rewind skips back 20 seconds, very frustrating for reviewing footage		www.amazon.co.uk		
Cable	www.macartney.com	MacArtney.com		http://www.str-subsea.com/home	http://www.nexansintercond.it/eservice/Italy-it_IT/navigate_321815/Intercond.html	www.macartney.com/www.hydrogroupplc.com		www.macartney.com/www.hydrogroupplc.com
CRT monitor	http://www.ess-split.hr/pdf/ch15.PDF					no longer available		no longer available
HD monitor	N/A			http://www.visuals.co.uk/		NA		
Laptop - live data capture		Dell.com				www.dell.co.uk		
Laptop - footage reviewing		Dell.com				NA		
Other						Altimiter: www.remontec.co.uk (no longer available)		
						Recovery device: built in-house at MSS		
						Odometer: built in-house at MSS		
						Video overlay: www.ashtead-technology.com		
						mini van Veen sediment sampler: www.eijkelkamp.com		
						Laser scalers (drop frame only): built in-house at MSS		