

## 13 Norway lobster in Atlantic Iberian waters East, western Galicia, northern, southwestern and southern Portugal, and Gulf of Cádiz

nep.fu.2627 , nep.fu.2829 , and nep.fu.30 – *Nephrops norvegicus* in Division 9.a, Functional Units 26–30

The ICES Division 9.a has five *Nephrops* Functional Units (FUs): FU 26, West Galicia; FU 27 North Portugal; FU 28, Alentejo, Southwest Portugal; FU 29, Algarve, South Portugal; and FU 30, Gulf of Cádiz.

### 13.1 *Nephrops* in western Galicia and northern Portugal (FUs 26–27)

*Nephrops* in FUs 26–27 was recently benchmarked during the WKMSYSPiCT in 2021 (ICES, 2021a). The Surplus Production in Continuous Time (SPiCT) model (Pedersen and Berg, 2017) was implemented and accepted to produce MSY advice, thus upgrading the stock to a category 2.

#### 13.1.1 General

##### 13.1.1.1 Ecosystem aspects

See the Stock Annex.

##### 13.1.1.2 Fishery description

See the Stock Annex.

#### 13.1.2 ICES advice for 2023, 2024 and 2025 and management applicable to 2022 and 2023

##### 13.1.2.1 ICES advice for 2023, 2024 and 2025

For *Nephrops* in FUs 26–27, ICES advises that when the MSY approach and precautionary considerations are applied, there should be zero catch for each of the years 2023, 2024 and 2025.

##### 13.1.2.2 Management applicable to 2022 and 2023

A recovery plan for the southern hake and Iberian *Nephrops* stocks has been implemented since the end of January 2006. The aim of the recovery plan was to rebuild the stocks within 10 years, with a reduction of 10% in *F* relative to the previous year and the TAC set accordingly (EU, 2005). This plan was based on the precautionary reference points for the southern hake stock. In March 2019, the European Parliament and the Council have published a multiannual management plan (MAP) for the Western Waters (EU, 2019a) and repealed the previous recovery plan. This plan applies to demersal stocks including *Nephrops* in ICES Division 9.a, which cover the *Nephrops* in FUs 26–27.

In order to further reduce *F* on *Nephrops* stocks in this division, seasonal fishing restrictions were imposed on the trawl and creel fisheries during the peak of the *Nephrops* fishing season in two

boxes located in FUs 26 and 28. These boxes are closed for *Nephrops* direct fishing from June to August and from May to August, respectively (EU, 1998 amended by EU, 2005). A new regulation on technical measures was implemented in 2019 (EU, 2019b) which repealed the CR(EC) No 850/98 (EU, 1998) but kept the fishing restrictions in the two boxes, thus, the *Nephrops* is only fished as bycatch.

The TAC set for the whole Division 9.a was 355 t for 2022 and 298 t for 2023, respectively. However, no catch is allowed in 2022 and 2023 in FUs 26 and 27. In FU 30, *Nephrops* fishing is allowed but not more than 50 t in 2022 and 32 t in 2023. In the current Management Plan for Western Waters that was applied from 2020 onwards, no effort limitations were established.

A Fishing Plan for the Northwest Cantabrian ground was established in 2013 (BOE, 2013) and modified in 2014 (BOE, 2014). These regulations establish a quota assignment system for several stocks (including *Nephrops*) by vessel.

### 13.1.3 Data

#### 13.1.3.1 Commercial catches and discards

Spanish landings are based on sales notes which are compiled and standardized by IEO-CSIC. Since 2013, trips from sales notes were combined with their respective logbooks which allowed the georeferencing of catches. During the same year, the Spanish concurrent sampling is used to raise the FUs 26–27 observed landings to total effort by *métier*. When the estimated landings exceed the official landings, the difference is provided to InterCatch as non-reported landings.

Landings in these FUs are reported by Spain and, in minor quantities, by Portugal. The catches are taken by the Spanish fleets fishing along the coast of western Galicia (FU 26) and northern Portugal (FU 27) fishing grounds, and by the artisanal Portuguese fleet fishing on FU 27. *Nephrops* represents a minor percentage in the composition of total trawl landings and can be considered as bycatch despite being considered a very valuable species.

Considering the whole 1975–2022 landings time-series for both FUs and countries combined, two periods can be distinguished (Figure 13.1.1). During 1975–1989, the mean landing was 680 t fluctuating approximately between 575 and 800 t. From 1990 onwards, there has been a marked downwards trend in landings, being above 50 t from 2005 to 2011 and below 10 t since 2012. Landings remained minimal and not even reaching 10 t since that year. The lowest value (2 t) of the whole series was recorded in 2015 and 2018. Landings in 2022 were 4 t.

Table 13.1.1 shows the total landings time-series in FUs 26 and 27 by FU and country. Information about discards sampling was sent to WGBIE through InterCatch although no discards are recorded in these FUs. Differences between landings in both FUs diminished with FU 27 recording higher landings despite remaining stable at low levels. Landings in FU 27 represent in the last three years 74%, 81% and 98% in 2020, 2021 and 2022, respectively.

The landings time series consists mainly from removals by mostly the Spanish fleets in FU 26, coupled with smaller quantities taken from FU 27. However, no distinction was made between these two FUs before 1996 and, therefore, these FUs were combined together. Overall, Spanish landings recorded in both FUs has been continuously decreasing in the time-series. From 2005 onwards, Spanish landings from both FUs were of the same order of magnitude. In 2022, Spanish landings were less than 1 t in each of the FU.

Total Portuguese landings from FU 27 increased in the 1984–1988 period. Afterwards, landings have decreased from almost 100 t in 1988 to 17 t in 1996. During the 1997–2004 period, landings decreased to a mean value of 7 t but a slight increase was observed from 2005 to 2009 (mean value of 11 t). From 2010 onwards, landings decreased to the lowest values in 2018 (ranging from 0 to 3 t). Portuguese landings in 2019 increased to 4 t which then decreased to 2 t for each of the

years 2020 and 2021. In 2022, Portuguese landings in FU 27 increased to about 50% in relation to previous years (4 t).

### 13.1.3.2 Biological sampling

The sampling levels for 2022 are shown in section 1 of this report.

Mean size (carapace length, CL) for both sexes showed an increasing trend from 2001 to 2010 with the highest value recorded in 2010 for both males (52.0 mm CL) and females (43.7 mm CL) (Figure 13.1.1). In contrast, mean CL declined in both sexes in the period 2011–2013 (40.1 mm CL and 31.6 mm CL in 2013 for males and females, respectively). However, mean sizes show an oscillating trend again since 2014. No length frequencies distributions (LFDs) for both sexes were available in 2017 and 2018. Sampling was only partially conducted in 2020 because of the COVID-19 disruptions and administrative issues (ICES, 2021b). Only two of *Nephrops* samplings were carried out during the third quarter of 2020. Information obtained from these samples were deemed not representative of the stock size composition and, therefore, were not considered (ICES, 2021b). In 2022, the mean size for males was 54.0 mm CL and for females 45.2 mm CL, the highest value recorded in the time-series. The continuous increase of the mean sizes in both sexes indicates a possible failure in the recruitment. Annual length compositions for males and females combined, mean size and mean weight in landings for the period 1988–2022 are given in Tables 13.1.2a and 13.1.2b and Figures 13.1.2a and 13.1.2b, respectively.

### 13.1.3.3 Commercial catch-effort data

Fishing effort and LPUE estimates are available for the Marine trawl fleet (SP-MATR) for the period 1990–2022 (Table 13.1.3; Figure 13.1.1). It was not possible to estimate the LPUE in 2020 because of the COVID-19 pandemic disruptions and administrative problems which affected the sampling programs (ICES, 2021b). However, it should be noted that the overall trends for the SP-MATR effort and LPUE time-series are decreasing. Fishing effort has remained at very low levels since 2010 and values below 400 trips since 2015. LPUE indices are also very low since 2012, with values lower than 1 kg.trip<sup>-1</sup> since 2014, indicating that the biomass of the stock in these FUs is very low. The fishing effort for 2022 was 352 trips, the lowest value recorded in the time series and LPUE was about 1 kg.trip<sup>-1</sup> for each of the years 2021 and 2022.

Time-series of fishing effort and LPUE of the bottom trawl fleets landing their catches in the Spanish local ports of Muros (1984–2003), Riveira (1984–2004) and Vigo (1995–2008 and 2010) are also available. These data are plotted in Figure 13.1.1 for complementary information.

## 13.1.4 Biomass index from surveys

### 13.1.4.1 International bottom trawl surveys

The Spanish International Bottom Trawl Survey-Q4 (SpGFS-WIBTS-Q4, G2784) covers the northern Spanish shelf in ICES Division 8.c and the northern part of 9.a, including the Cantabrian Sea and off Galicia waters from 70 m to 500 m of depth (Figure 13.1.3). This survey usually starts at the end of the third quarter (September) and finishes in the fourth quarter of the year. Time-series is available for the period 1984–2022. No survey was carried out in 1987. This survey is designed to estimate demersal species abundance but it could be used for the analysis of the *Nephrops* abundance trends. In the past, the abundance index survey was estimated for the whole surveyed area and not by FU. Data from this survey was used to estimate a *Nephrops* index for all ICES statistical rectangles (14E0, 13E0, 13E1) in FU 26 (West Galicia). This survey index time-series was presented for the first time in WGBIE 2020 (ICES, 2020) and it was expressed as the mean biomass or abundance per haul (mean kg per haul and mean number of individuals per haul). During the WKMSYSPiCT workshop (ICES, 2021a) in 2021, this index was not considered appropriate as depth was not considered in the estimation which raised an uncertainty issue as

to the quality of the index. Based on the depth stratification and the total area in FU 26, a new survey index was estimated and standardized to one hour based on the SpGFS-WIBTS-Q4 (G2784) data during the WKMSYSPICT benchmark (ICES, 2021a) in 2021.

This survey index shows an increasing trend from 1986 to 1991 (Figure 13.1.4) and was the period when the highest value was recorded (3.5 kg/h). The *Nephrops* index decreased in 1994 (0.1 kg/h) and fluctuated up to 2001 (0.6 kg/h). In 2002, the biomass index decreased and remained at very low levels onwards. The mean value in the 2001–2022 period was 0.05 kg/haul. In 2022, no *Nephrops* was caught in any of the hauls conducted during the SpGFS-WIBTS-Q4 (G2784) survey, so the biomass index was zero (Table 13.1.4 and Figure 13.1.4).

The Portuguese International Bottom Trawl Survey Q4 (PtGFS-WIBTS-Q4, G8899) is carried out in Division 9.a during autumn (October), covering the Portuguese continental waters from 20 to 500 m of depth (Figure 13.1.3). The abundance index is available from 1989 to 2022. The survey was not carried out in 2019 as a consequence of external administrative issues then again in 2020 as a result of the COVID-19 disruptions (ICES, 2021b). The main objective of the PtGFS-WIBTS-Q4 (G8899) survey is to estimate the abundance of the most important commercial fish species in the Portuguese trawl fishery. *Nephrops* biomass index in FU 27 from the depth-stratified PtGFS-WIBTS-Q4 (G8899) survey, was estimated using hauls included in the ICES statistical rectangles corresponding to FU 27 (6E0–12E0) during the WKMSYSPICT benchmark (ICES, 2021a).

The biomass index was almost zero g/h at the beginning of the time-series (1985–1988 period). After that, the *Nephrops* biomass index increased but has greatly fluctuated up to 2000. In 2001, the PtGFS-WIBTS-Q4 (G8899) survey index decreased and it has remained at about zero g/h until the only peak in the time series, although not very high, was observed in 2015 (Table 13.1.4 and Figure 13.1.4). In 2022, the biomass index had increased slightly. It should be noted that a few amounts of *Nephrops* was caught in a unique haul during the survey in the Berlengas (BER) strata.

Figure 13.1.5 shows the sector areas from Spanish (SpGFS-WIBTS-Q4, G2784) and Portuguese (PtGFS-WIBTS-Q4, G8899) IBTS-Q4 surveys occur, covering FUs 26 and 27, respectively. *Nephrops* is mainly distributed in the Miño-Fisnisterre sector (GAL) in FU 26 from about 100 to 700 m depth and the Caminha sector (CAM) in the northern part of FU 27 from 100 to 500 m depth (Table 13.1.4). In the rest of the FU 27, *Nephrops* patches occur particularly in the deepest stratum of the Figueira da Foz sector (FIG) and in a higher bathymetric range of the Berlengas sector (BER). In the Lisbon sector (LIS), *Nephrops* is present in a small patch in front of Cascais where water depth is about 350 m.

The annual spatial distribution of *Nephrops* biomass index in FUs 26–27 for the entire time-series is shown in Figure 13.1.6a and Figure 13.1.6b where a declining trend of the biomass index since 1983 as well as of the *Nephrops* patches in FUs 26–27 are clearly apparent.

A new depth-stratified biomass index was estimated from the combined Spanish (SpGFS-WIBTS-Q4, G2784) and Portuguese (PtGFS-WIBTS-Q4, G8899) IBTS-Q4 surveys. This combined IBTS-Q4 index survey, referred to by the ICES code G2784\_G8899, was estimated based on the area and depth strata for the total area covering FUs 26–27 during the WKMSYSPICT benchmark (ICES, 2021a) and considers the following area/sectors: Miño-Finisterre (GAL), Caminha (CAM), Matosinhos (MAT), Aveiro (AVE), Figueira da Foz (FIG), Berlengas (BER) and Lisbon (LIS) (Figure 13.1.4; Table 13.1.4) as parts of a unique survey and taking into account the area corresponding to each stratum of depth. *Nephrops* weight by haul was standardized to one hour.

It should be noted that the Spanish (SpGFS-WIBTS-Q4, G2784) and Portuguese (PtGFS-WIBTS-Q4, G8899) IBTS-Q4 surveys each use different vessels and gears so catchability could also be different for some species. The Portuguese (PtGFS-WIBTS-Q4, G8899) survey is not suitable for flatfish, anglerfish and probably *Nephrops*. However, no weight has been applied to each of these surveys in order to standardize the *Nephrops* biomass index. Fishery knowledge suggests that

the main *Nephrops* fishing grounds are in FU 26 and a small part in north Portugal near the Spanish border, in FU 27, which are exploited by the Spanish trawl fleet. Therefore, the combined biomass index trend should not be very different.

The combined G2784\_ G8899 IBTS-Q4 survey index increased from 1983 to 1991, when the highest value of the time-series (0.17 g/h) was recorded. Then a decreasing trend was observed from 1992 to 1994 (0.01 g/h). In 1995, *Nephrops* biomass index increased again and after that, it has fluctuated at low levels up to 2001 (0.03 g/h). The combined G2784\_ G8899 IBTS-Q4 survey biomass index value has been at a minimal level since 2002.

#### 13.1.4.2 Trawl surveys with the fishing industry

Marine Fishing Industry (Productores de Pesca Fresca del Puerto y la Ría de Marín; OPROMAR) did a survey using a commercial vessel with an observer onboard under the IEO supervision in order to estimate *Nephrops* abundance index in FU 26. The survey is hereinafter referred to as GALNEP-26. From 2019 to 2021, this survey was conducted in summer (July–August) since this is the peak of the *Nephrops* fishing season when both males and females are accessible to the gear as a result of their reproductive behaviour. No survey was conducted in 2022 when the zero-TAC advice for *Nephrops* was applied and fishery was closed. The survey design followed a systematic sampling over a 5x5 nm grid over the historical *Nephrops* distribution area estimated using VMS linked to logbooks and sediment information (Vila *et al.*, 2020). In 2019, the GALNEP-26 survey index was estimated at  $0.74 \pm 0.58$  kg/h with a 95% confidence interval. This index increased ( $1.82 \pm 1.86$  Kg/h) in 2020 then decreased ( $0.95 \pm 1.31$  Kg/h) again in 2021. Figure 13.1.7 shows the *Nephrops* biomass index spatial distribution in FU 26. *Nephrops* represented about 1% of the total retained catch while the discard rate was zero for each of the years 2019 and 2020 then was considered negligible in 2021. The spatial analysis of the survey index indicates that *Nephrops* is concentrated in a small area on the Northwestern half of the original distribution area of FU 26 (Figure 13.1.7). Despite the very low catches in 2021, the *Nephrops* spatial distribution has spread to the southern part of the survey area. The mean lengths were similar to values observed in 2019 and 2020 for both sexes (39.9 mm CL for females and 43.9 mm CL for males) (ICES, 2021b). However, a slight decline of the females mean size was observed in 2021 (Table 12.1.5). Figure 13.1.8 shows the LFDs by sex for the entire time-series.

### 13.1.5 Assessment

This stock was benchmarked during the WKMSYSPiCT workshop in February 2021 (ICES, 2021a). The Surplus Production in Continuous Time (SPiCT) model (Pedersen and Berg, 2017; Mildenerger *et al.*, 2020) was implemented and this assessment model was accepted to produce an advice based on the MSY approach, upgrading the stock to category 2. The latest advice for a category 2 stock was given in 2022 and is considered valid for each of the years 2023, 2024 and 2025 (ICES, 2023). The stock data were updated with the new information for 2022 and the assessment process was done following the new ICES guidelines for category 2 stocks (ICES, 2022a). The 2023 assessment indicates that *Nephrops* in FUs 26 and 27 is depleted, similar in 2022. Therefore, the perception of the stock did not change since the assessment in 2022 (ICES, 2022b).

### 13.1.6 Quality considerations

The combined G2784\_ G8899 IBTS-Q4 survey biomass index was estimated using a Bayesian hierarchical model that takes into account the spatial-temporal analysis. This work was presented during the WKMSYSPiCT benchmark in 2021 (ICES, 2021a). However, the model-based index used an autoregressive process to estimate the time-trend which implies that the resulting

indices by year are not independent of each other, thus, giving an appearance of a smoother time-series as opposed to when the year effects are treated independently. Using such index as data in an assessment model that assumes that each data point is independent of the others is undesirable. Therefore, it was recommended to use the independent year effects to estimate the index in a model-based approach. A simpler approach to estimating a new combined G2784\_G8899 IBTS-Q4 index survey based on area and depth was used during the 2023 WGBIE assessment.

### 13.1.7 Management Considerations

*Nephrops* is taken as bycatch in a mixed bottom-trawl fishery. Landings of *Nephrops* have substantially declined since 1995. Recent landings represent less than 1% of the average landings in the early period of the time-series (1975–1992). Fishing effort in FUs 26–27 has decreased throughout the time-series.

There is a seasonal fishing closure (June–August) for *Nephrops* in a *box* within West Galicia (FU 26) fishing grounds which was amended in the Council Regulation (EC) No 850/98 (EU, 1998). A regulation on technical measures issued in 2019, Regulation (EU) No 2019/1241 (EU, 2019b), replaced and repealed the CR (EC) No 850/98 but kept the *box* previously defined that allowed only the bycatch fishing of *Nephrops*.

A multiannual management plan (MAP) for the Western Waters has been published by the European Parliament and the Council (EU, 2019a). This plan applies to demersal stocks including *Nephrops* in FUs 26–27 in ICES Division 9.a.

A Fishing Plan for the Cantabrian and Northwest fishing grounds was established in 2013 (BOE, 2013) and modified in 2014 (BOE, 2014). These regulations establish a quota assignment system for several stocks (including *Nephrops*) by vessel.

Unwanted catches from *Nephrops* are regulated by the discard plan for demersal fisheries in southwestern waters for the period 2019–2023 (EU, 2018) which was replaced in 2019 (EU, 2019c) then in 2020 (EU, 2020). Here, an exemption from the landing obligation is applied based on this species' high survival rates. This exemption applies to all bycatches of Norway lobster from ICES subareas 8 and 9 by bottom trawls which are immediately retrieved and released from all discards in the area where they were caught.

### 13.1.8 References

- BOE. 2013. Orden AAA/1307/2013, de 1 de julio, por la que se establece un Plan de gestión para los buques de los censos del Caladero Nacional del Cantábrico y Noroeste. BOE no. 165, 11.07.2013, Sec. III, 51652–51673.
- BOE. 2014. Orden AAA/417/2014, de 17 de marzo, por la que se modifica la Orden AAA/1307/2013, de 1 de julio, por la que se establece un Plan de gestión para los buques de los censos del Caladero Nacional del Cantábrico y Noroeste. BOE no. 66, 18.03.2014, Sec. III, 23690–23698.
- EU. 1998. Council Regulation (EC) No 850/98 of 30 March 1998 for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms. Official Journal of the European Union, L125, 27/04/1998 p. 1–36. <http://data.europa.eu/eli/reg/1998/850/oj>
- EU. 2005. Council Regulation (EC) No 2166/2005 of 20 December 2005 establishing measures for the recovery of the Southern hake and Norway lobster stocks in the Cantabrian Sea and Western Iberian peninsula and amending Regulation (EC) No 850/98 for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms. Official Journal of the European Union, L 345, p. 5–10. <http://data.europa.eu/eli/reg/2005/2166/oj>

- EU. 2018. Commission Delegated Regulation (EU) 2018/2033 of 18 October 2018 establishing a discard plan for certain demersal fisheries in South-Western waters for the period 2019–2021. Official Journal of the European Union, L327, p.1 – 7. [http://data.europa.eu/eli/reg\\_del/2018/2033/oj](http://data.europa.eu/eli/reg_del/2018/2033/oj)
- EU. 2019a. Regulation (EU) 2019/472 of the European Parliament and of the Council of 19 March 2019 establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. Official Journal of the European Union, L83, p. 1–17. <http://data.europa.eu/eli/reg/2019/472/oj>
- EU. 2019b. Regulation (EU) 2019/1241 of the European Parliament and of the Council of 20 June 2019 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures, amending Council Regulations (EC) No 1967/2006, (EC) No 1224/2009 and Regulations (EU) No 1380/2013, (EU) 2016/1139, (EU) 2018/973, (EU) 2019/472 and (EU) 2019/1022 of the European Parliament and of the Council, and repealing Council Regulations (EC) No 894/97, (EC) No 850/98, (EC) No 2549/2000, (EC) No 254/2002, (EC) No 812/2004 and (EC) No 2187/2005. Official Journal of the European Union, L83: 1–17. <http://data.europa.eu/eli/reg/2019/472/oj>
- EU. 2019c. Commission Delegated Regulation (EU) 2019/2237 of 1 October 2019 specifying details of the landing obligation for certain demersal fisheries in south-western waters for the period 2020–2021. Official Journal of the European Union, L336, p. 26–33. [http://data.europa.eu/eli/reg\\_del/2019/2237/oj](http://data.europa.eu/eli/reg_del/2019/2237/oj)
- EU. 2020. Commission Delegated Regulation (EU) 2020/2015 of 21 August 2020 specifying details of the implementation of the landing obligation for certain fisheries in Western Waters for the period 2021–2023. Official Journal of the European Union, L415, p. 22 – 38. [http://data.europa.eu/eli/reg\\_del/2020/2015/oj](http://data.europa.eu/eli/reg_del/2020/2015/oj)
- ICES. 2020. Report of the Working Group for the Bay of Biscay and the Iberian waters Ecoregion (WGBIE). 6–13 May 2020. Web conference meeting. ICES Scientific Reports. 2:49. 865 pp. <http://doi.org/10.17895/ices.pub.6033>
- ICES. 2021a. Benchmark Workshop on the development of MSY advice for category 3 stocks using Surplus Production Model in Continuous Time; SPiCT (WKMSYSPiCT). ICES Scientific Reports. 3:20. 316 pp. <https://doi.org/10.17895/ices.pub.7919>
- ICES. 2021b. Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE). ICES Scientific Reports. 3:48. 1101 pp. <https://doi.org/10.17895/ices.pub.8212>
- ICES. 2022a ICES technical guidance for harvest control rules and stock assessments for stocks in categories 2 and 3. In Report of ICES Advisory Committee, 2022. ICES Advice 2022, Section 16.4.11. <https://doi.org/10.17895/ices.advice.19801564>
- ICES. 2022b. Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE). ICES Scientific Reports. 4:52. <http://doi.org/10.17895/ices.pub.20068988>
- ICES. 2023. Advice on fishing opportunities. In Report of the ICES Advisory Committee. ICES Advice 2023. Section 1.1.1. <https://doi.org/10.17895/ices.advice.22240624>.
- Mildenberger, T.K., Kokkalis, A., Berg, C.W. 2020. Guidelines for the stochastic production model in continuous time (SPiCT). [https://raw.githubusercontent.com/DTUAqua/spict/master/spict/inst/doc/spict\\_guidelines.pdf](https://raw.githubusercontent.com/DTUAqua/spict/master/spict/inst/doc/spict_guidelines.pdf)
- Mohn, R. 1999. The retrospective problem in sequential population analysis: An investigation using cod fishery and simulated data. ICES Journal of Marine Science, 56: 473–488.
- Pedersen, M.W. and Berg, C.W. 2017. A stochastic surplus production model in continuous time. Fish and Fisheries, 18: 226–243.
- Vila, Y., Salinas, I. 2022. *Nephrops* biomass index estimation from GALNEP26\_2021 Survey in FU26 (West Galicia, ICES Division 9a), WD 06. In ICES. 2022. WGBIE report. *In prep.*
- Vila, Y., Salinas, I. and Gomez, F.J. 2020. *Nephrops* abundance index estimation from GALNEP19 Survey in FU26 (West Galicia, ICES Division 9a). In ICES, 2020 (this report). Report of the Working Group for the Bay of Biscay and Iberian Waters Ecoregion (WGBIE), 6–13 May 2020. Working Document 09.

### 13.1.9 Tables and Figures

Table 13.1.1. *Nephrops* in FUs 26–27. Landings (in tonnes) by FU and country.

Year	Spain		Portugal	Total
	FU 26*	FU 27	FU 27	FU 26–27
1975				622
1976				603
1977				620
1978				575
1979				580
1980				599
1981				823
1982				736
1983				786
1984	603		14	617
1985	731		15	746
1986	655		37	692
1987	670		71	741
1988	631		96	727
1989	577		88	665
1990	402		48	450
1991	515		54	569
1992	584		52	636
1993	472		50	522
1994	428		22	450
1995	501		10	511
1996	264	50	17	331
1997	359	68	6	433
1998	294	42	8	344
1999	192	48	6	246
2000	102	21	9	132

Year	Spain		Portugal	Total
	FU 26*	FU 27	FU 27	FU 26–27
2001	105	21	6	132
2002	59	24	4	87
2003	39	26	8	73
2004	38	24	9	71
2005	16	16	11	43
2006	15	17	12	44
2007	20	17	10	47
2008	17	12	13	42
2009	10	17	10	37
2010	9	13	4	26
2011	7	8	4	19
2012	2	4	1	7
2013	1	<1	1	3
2014	<1	<1	1	3
2015	<1	<1	<1	2
2016	1	<1	3	5
2017	<1	<1	2	3
2018	<1	1	0	2
2019	3	1	4	7
2020	1	2	2	5
2021	<1	2	2	4
2022	<1	<1	4	4

Table 13.1.2a. *Nephrops* in FUs 26–27. Length compositions, mean weight (Kg) and mean size (mm CL) in landings for the period 1988–2022. Data were not available in 2017, 2018 and 2020.

Lenght (mm)	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
12	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	71	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	69	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	451	110	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	191	289	13	0	0	0	0	0	0	0	0	3	17	0	0	0	0	0	0	0	0	0	0	0
17	0	128	518	17	0	0	7	0	0	0	0	0	3	11	0	0	0	0	0	0	0	0	0	0	0
18	0	683	898	25	0	0	2	1	0	0	0	0	16	19	0	4	0	0	0	0	0	0	0	0	0
19	0	679	1502	38	0	0	0	0	0	0	0	0	38	52	0	4	0	0	0	0	0	0	0	0	0
20	27	1057	2044	97	6	5	10	7	25	3	0	0	86	151	3	29	0	0	0	0	0	0	0	0	0
21	27	1260	2489	199	12	24	19	8	78	0	0	0	119	236	3	27	0	0	1	0	0	0	0	0	0
22	39	1657	2642	398	48	99	84	47	202	12	1	0	129	348	11	11	1	0	1	0	0	0	0	0	0
23	109	1901	3063	568	103	99	77	151	373	26	6	0	127	518	16	31	0	0	0	0	1	0	0	0	0
24	198	1626	2736	1216	284	222	169	338	550	46	7	3	93	466	22	17	1	2	1	0	2	0	0	0	0
25	290	2212	1802	1477	541	381	199	672	906	113	45	15	134	441	35	28	1	2	1	0	3	1	0	0	0
26	574	1675	1451	1516	829	542	289	709	960	184	40	43	145	365	56	22	7	2	2	1	2	1	0	0	0
27	854	1878	1333	1351	926	904	409	933	746	306	80	68	129	419	106	40	18	8	5	2	3	1	0	0	0
28	1272	1560	1319	1940	1079	1017	524	1298	842	402	138	109	123	274	74	46	23	12	8	6	9	4	0	0	0
29	1487	1716	913	1797	1023	987	613	1223	706	489	191	134	143	266	86	60	20	15	13	7	7	9	0	0	0
30	1615	1510	845	1501	1069	1140	767	1371	792	681	295	195	172	252	118	90	31	25	20	12	13	11	0	2	1
31	1960	1106	632	1450	1180	890	802	1378	609	719	359	239	182	209	105	102	27	21	21	13	16	9	1	2	0
32	1951	1472	772	1484	1197	912	847	1491	601	888	411	292	285	220	160	95	49	29	35	23	27	11	2	5	2
33	2288	1313	601	1126	1378	878	898	1444	517	780	525	377	176	201	167	84	56	26	40	47	23	11	2	3	0
34	1581	1299	572	1160	1001	849	853	1255	542	745	551	376	192	156	131	83	56	31	51	43	37	22	5	3	2
35	1487	952	518	1044	915	855	745	963	506	637	569	432	200	148	96	91	53	26	48	25	18	4	5	2	0
36	1161	634	407	879	776	901	611	744	433	527	484	360	176	120	110	85	56	21	42	36	22	15	4	4	1
37	838	545	284	651	627	736	546	580	348	484	417	321	175	143	106	111	70	31	51	49	31	17	7	2	2
38	1196	608	294	616	545	682	621	542	346	534	425	308	128	110	76	72	86	35	61	38	28	20	6	2	2
39	837	451	226	600	505	510	475	425	285	406	292	240	128	85	95	79	65	27	43	36	21	14	6	8	3
40	501	325	199	450	666	573	412	455	284	466	393	218	115	65	76	60	90	24	55	39	32	21	7	7	4
41	428	288	165	375	431	385	321	321	213	399	312	182	112	58	88	48	60	21	40	32	23	16	8	6	4
42	367	287	144	220	362	375	314	214	182	360	249	210	66	57	81	54	101	22	47	43	26	14	6	7	6
43	433	296	156	203	425	307	293	188	165	325	292	219	64	36	76	47	73	25	38	49	25	13	9	7	4
44	164	277	87	136	301	251	200	152	127	290	207	193	61	44	52	33	62	20	32	38	36	13	10	7	3
45	165	286	58	110	303	219	178	125	118	218	196	162	58	42	44	34	56	17	18	29	17	12	8	10	5
46	96	135	23	90	350	153	129	116	94	191	178	152	40	28	49	26	29	20	18	24	18	8	10	11	3
47	94	117	45	82	228	104	92	84	56	123	120	84	38	47	42	31	38	26	18	28	17	8	8	9	4
48	71	100	25	49	222	58	96	55	70	117	147	96	23	18	22	13	28	18	12	15	16	7	7	7	3
49	73	76	29	42	148	84	71	46	23	60	105	64	21	16	15	16	18	13	11	14	9	5	7	7	3
50	83	127	14	46	63	81	69	29	31	81	95	54	17	12	12	15	16	15	13	14	9	9	10	14	3
51	15	48	9	14	71	27	59	13	21	43	59	21	17	6	7	15	7	15	7	9	6	4	5	3	3
52	20	75	14	33	71	21	59	18	22	43	55	30	18	6	7	10	12	10	8	10	9	6	5	5	3
53	23	34	13	26	34	20	28	6	13	30	37	33	5	5	6	10	5	7	6	8	4	6	5	6	2
54	14	10	11	23	23	14	12	6	15	42	28	27	8	3	2	8	4	11	10	6	7	4	5	4	3
55	6	27	1	6	13	17	12	1	9	25	26	12	6	7	3	4	5	8	3	6	6	5	7	5	1
56	6	9	1	5	5	10	5	1	9	14	14	14	7	4	3	5	3	4	2	3	6	6	4	5	1
57	10	5	1	2	6	5	10	0	4	8	12	6	5	3	3	2	2	3	2	4	5	5	3	2	0
58	11	5	1	4	6	5	14	0	3	6	11	5	4	5	4	3	3	4	4	4	5	5	4	2	0
59	7	0	4	0	7	2	7	0	0	2	1	5	3	3	0	1	4	3	1	3	2	2	1	3	1
60	2	0	2	0	4	3	3	0	0	1	2	3	2	2	2	2	7	4	2	1	3	3	4	3	1
61	4	0	1	0	3	2	12	0	0	0	2	0	3	2	0	2	1	14	1	2	1	1	3	2	1
62	2	0	1	0	1	0	7	0	0	0	0	0	1	5	0	2	2	4	2	1	3	2	1	1	1
63	1	0	1	0	3	0	5	0	0	1	0	0	3	3	0	2	1	2	1	1	1	1	2	2	0
64	2	0	1	0	3	1	4	0	0	0	1	0	2	2	0	2	1	1	1	1	2	3	2	2	0
65	2	0	1	0	1	0	2	0	0	0	0	0	1	1	1	1	2	2	1	1	1	2	2	2	0
66	3	0	1	0	1	0	2	0	0	0	1	0	2	2	0	1	0	1	1	1	1	1	1	1	1
67	2	4	1	0	1	1	1	1	0	0	1	0	3	1	0	2	1	2	1	1	1	1	1	1	0
68	2	11	1	0	2	2	6	0	0	0	0	0	2	1	0	2	1	1	2	2	2	1	2	2	0
69	1	4	1	0	1	1	0	0	0	0	0	0	2	1	0	1	1	1	2	1	1	1	1	1	1
70	12	25	1	2	12	6	8	0	1	0	3	0	11	1	1	5	4	8	1	1	4	1	1	1	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80	0	0	0	0	0	0	0	0	0	0	0														

(Continue in the next page)

**Table 13.1.2b. *Nephrops* in FUs 26–27. Length compositions, mean weight (Kg) and mean size (mm CL) in landings for the period 1988–2022. Data were not available in 2017, 2018 and 2020 (continued from the previous page).**

Lenght (mm)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
12	0									
13	0									
14	0									
15	0									
16	0									
17	0									
18	0									
19	0									
20	0									
21	0									
22	1								0	
23	0								0	
24	0	1							0	
25	0	2	0	1			0		0	
26	0	1	0	0			0		0	
27	0	1	0	0			0		0	
28	0	2	0	1			0		0	
29	0	2	0	2			0		0	
30	1	4	0	4			2		0	
31	1	1	0	0			1		0	
32	1	1	0	2			1		0	
33	1	0	1	2			1		0	
34	1	5	1	3			3		0	
35	1	5	2	5			2		1	1
36	1	2	1	2			3		0	0
37	1	3	1	2			3		0	0
38	1	1	1	3			2		0	2
39	1	2	1	2			3		0	1
40	1	4	3	5			4		1	2
41	1	1	1	1			3		1	2
42	1	1	1	2			2		1	2
43	1	1	2	1			6		1	1
44	0	3	1	3			3		0	3
45	0	3	1	6			5		3	1
46	0	1	0	1			2		1	2
47	0	1	0	3			3		1	1
48	1	1	0	2			3		1	0
49	0	1	0	2			3		1	0
50	0	2	0	3			3		4	1
51	0	0	0	1			1		1	2
52	0	0	0	1			1		1	1
53	0	0	0	1			2		1	1
54	0	1	0	1			1		1	2
55	0	1	0	2			1		2	1
56	0	0	0	0			1		1	0
57	0	0	0	0			0		2	1
58	0	1	0	0			1		0	1
59	0	0	0	0			1		1	0
60	0	1	0	1			1		1	0
61	0	0	0	1			0		1	1
62	0	0	0	0			1		0	1
63	0	0	0	0			1		0	1
64	0	0	0	0			0		0	1
65	0	0	0	0			0		0	1
66	0	0	0	0			0		0	0
67	0	0	0	0			0		0	0
68	0	0	0	0			0		0	1
69	0	0	0	0			0		0	0
70	0	0	0	1			0		0	1
71	0	0	0	0			0		0	1
72	0	0	0	0			0		0	1
73	0	0	0	0			0		1	1
74	0	0	0	0			0		0	1
75	0	0	0	0			0		0	0
76	0	0	0				0		0	0
77	0	0	0				0		0	0
78	0	0	0				0		0	1
79	0	0							0	1
80	0								0	
81	0								0	
82	0								0	
83	0								0	
84	0									
Total number (thousand)	20	60	23	69			72		37	33
Total weight (t)	3	4	2	5			5		4	4
Mean weight (kg)	0.081	0.059	0.087	0.077			0.065		0.118	0.133
CL Mean length (mm)	35.8	39.4	42.0	42.2			45.0		49.7	52

**Table 13.1.3. *Nephrops* in FUs 26–27. Landings and LPUE for the SP-MATR fleet.**

Year	Landings (t)	trips	LPUE (Kg/trip)
1994	234	2692	87.0
1995	267	2859	93.2
1996	158	3191	49.5
1997	246	3702	66.3
1998	189	2857	66.0
1999	134	2714	49.5
2000	72	2479	28.9
2001	80	2374	33.6
2002	52	1671	31.2
2003	38	1597	24.0
2004	38	1986	19.2
2005	17	1629	10.3
2006	18	1547	11.9
2007	22	1196	18.1
2008	17	980	17.2
2009	7	517	14.1
2010	5	676	7.7
2011	3	513	6.0
2012	1	483	2.1
2013	<1	418	1.0
2014	<1	491	0.8
2015	<1	384	0.8
2016	<1	396	0.8
2017	<1	386	0.3
2018	<1	369	1.1
2019	<1	383	0.3
2020*	na	na	na
2021	<1	381	1.1
2022	<1	352	1.4

\*No estimate can be made in 2020 as sampling was only partially conducted as a result of COVID-19 disruptions and administrative issues.

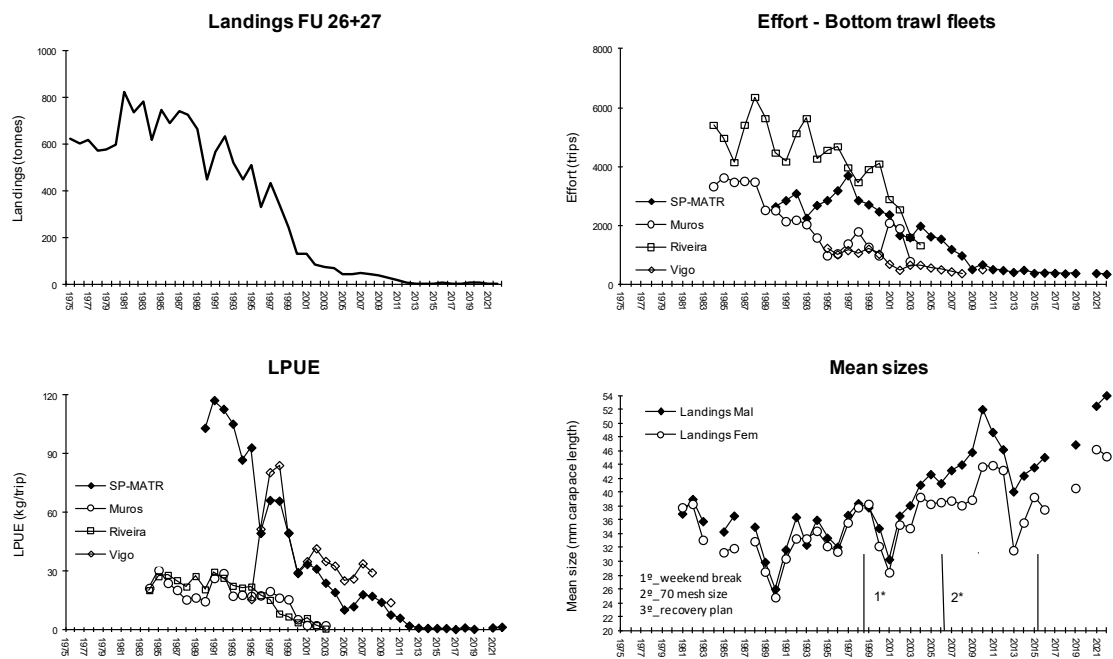
**Table 13.1.4. *Nephrops* in FUs 26–27. Biomass indices from the Spanish (SpGFS-WIBTS-Q4, G2784), the Portuguese (PtGFS-WIBTS-Q4, G8899) IBTS-Q4 surveys in FU26 and FU27, respectively, and the new estimated combined G2784\_G8899 IBTS-Q4 index (in g/h) for both FUs.**

Years	Spanish International Bottom Trawl Survey (G2784)	Portuguese International Bottom Trawl Survey (G8999)							Combined index (G2784-G8999)
	FU26	FU27							FU26-27
	GAL	CAM	MAT	AVE	FIG	BER	LIS	All sectors	
1983	711.11								0.0304
1984	382.53								0.0164
1985	261.67	12.93	4.08	0.00	0.00	12.05	0.00	0.0015	0.0124
1986	866.49	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0371
1987	na	9.20	0.00	0.00	0.00	0.00	0.00	0.0005	na
1988	1488.09	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0636
1989	643.79	53.35	0.00	19.09	0.00	202.68	0.00	0.0144	0.0393
1990	1495.42	293.99	53.66	164.78	5.45	18.31	76.92	0.0322	0.0902
1991	3460.29	377.36	0.00	8.47	0.15	22.69	7.46	0.0218	0.1658
1992	971.21	322.75	0.00	58.89	2.92	23.15	0.00	0.0214	0.0590
1993	239.85	172.87	5.23	10.89	11.36	41.64	0.00	0.0127	0.0206
1994	146.91	5.12	0.00	0.00	0.00	77.87	0.00	0.0044	0.0098
1995	748.55	17.34	0.00	26.54	112.50	592.77	0.00	0.0393	0.0641
1996	117.28	94.06	0.00	0.00	0.00	59.63	0.00	0.0081	0.0116
1997	163.11	187.49	0.00	158.77	1.70	164.28	48.13	0.0294	0.0309
1998	315.49	0.00	0.00	138.11	0.00	56.96	0.00	0.0102	0.0218
1999	359.80	28.00	0.00	0.00	0.00	0.00	0.00	0.0015	0.0166
2000	188.58	35.62	0.00	105.84	2.58	115.32	0.00	0.0136	0.0192
2001	610.60	4.77	0.00	0.00	0.00	63.91	0.00	0.0036	0.0291
2002	59.95	20.00	0.00	0.00	0.00	0.00	0.00	0.0010	0.0034
2003	88.02	35.99	0.00	0.00	9.11	0.00	0.00	0.0024	0.0057
2004	44.56	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0019
2005	15.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0007
2006	78.31	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0033
2007	28.34	0.00	0.00	0.00	4.79	0.00	0.00	0.0003	0.0014
2008	46.64	18.87	0.00	0.00	0.00	0.00	0.00	0.0010	0.0028
2009	30.41	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0013
2010	135.44	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0058
2011	20.04	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0009
2012	9.47	na	na	na	na	na	na	na	0.0004
2013	81.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0035
2014	21.39	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0009
2015	28.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0012
2016	62.34	0.00	0.00	0.00	0.00	27.32	347.44	0.0197	0.0187
2017	61.16	0.00	0.00	0.00	0.00	88.73	0.00	0.0047	0.0064
2018	54.76	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0.0023
2019	56.06	na	na	na	na	na	na	na	0.0024
2020	19.89	na	na	na	na	na	na	na	0.0009
2021	20.62	5.25	0.00	0.00	23.32	0.00	0.00	0.0015	0.0021
2022	0.00	0.00	0.00	0.00	0.00	50.06	0.00	0.0026	0.0021

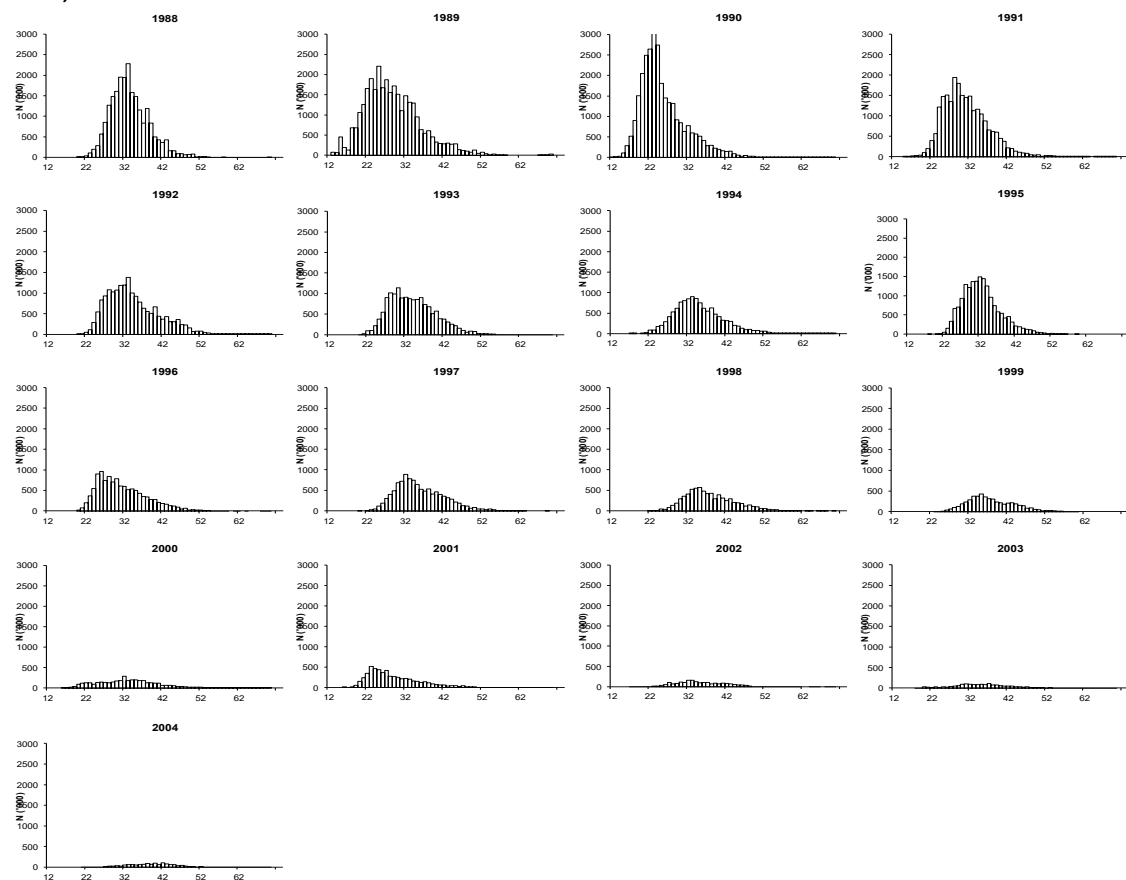
**Table 13.1.5. *Nephrops* in FUs 26–27. Biomass index and mean sizes by sex from the GALNEP-26 survey in FU 26.**

Year	Biomass survey index		Mean size		
	K/h	n° indiv/h	Males	Females	Combined
2019	0.74	11.4	43.98	39.95	42.00
2020	1.82	30.18	43.4	39.31	41.51
2021	0.95	15.07	41.90	35.00	37.5

\* No survey was conducted in 2022 because of this survey is carried out in a commercial vessel and zero catch in FU26-27 was set for each of the years 2023, 2024 and 2025.



**Figure 13.1.1. *Nephrops* in FUs 26–27. Long-term trends in landings (in tonnes), LPUE (Kg/trip) and mean sizes (mm CL). Effort, LPUE and mean sizes for 2020 are not available.**



**Figure 13.1.2a. *Nephrops* in FUs 26–27. Length–frequency distributions in landings (in tonnes) for the period 1988–2004.**

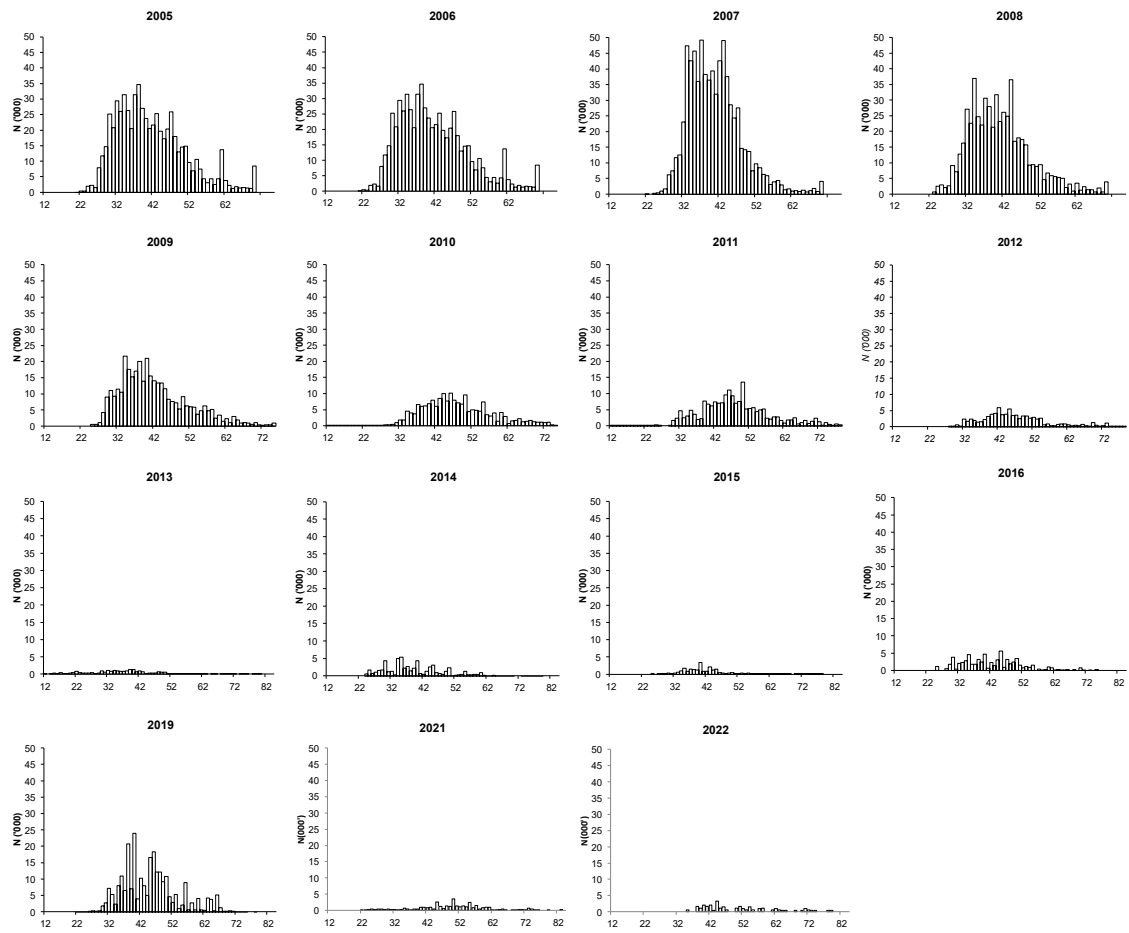


Figure 13.1.2b. *Nephrops* in FUs 26–27. Length–frequency distributions in landings (in tonnes) for the period 2005–2022. Data not available for 2017, 2018 and 2020.

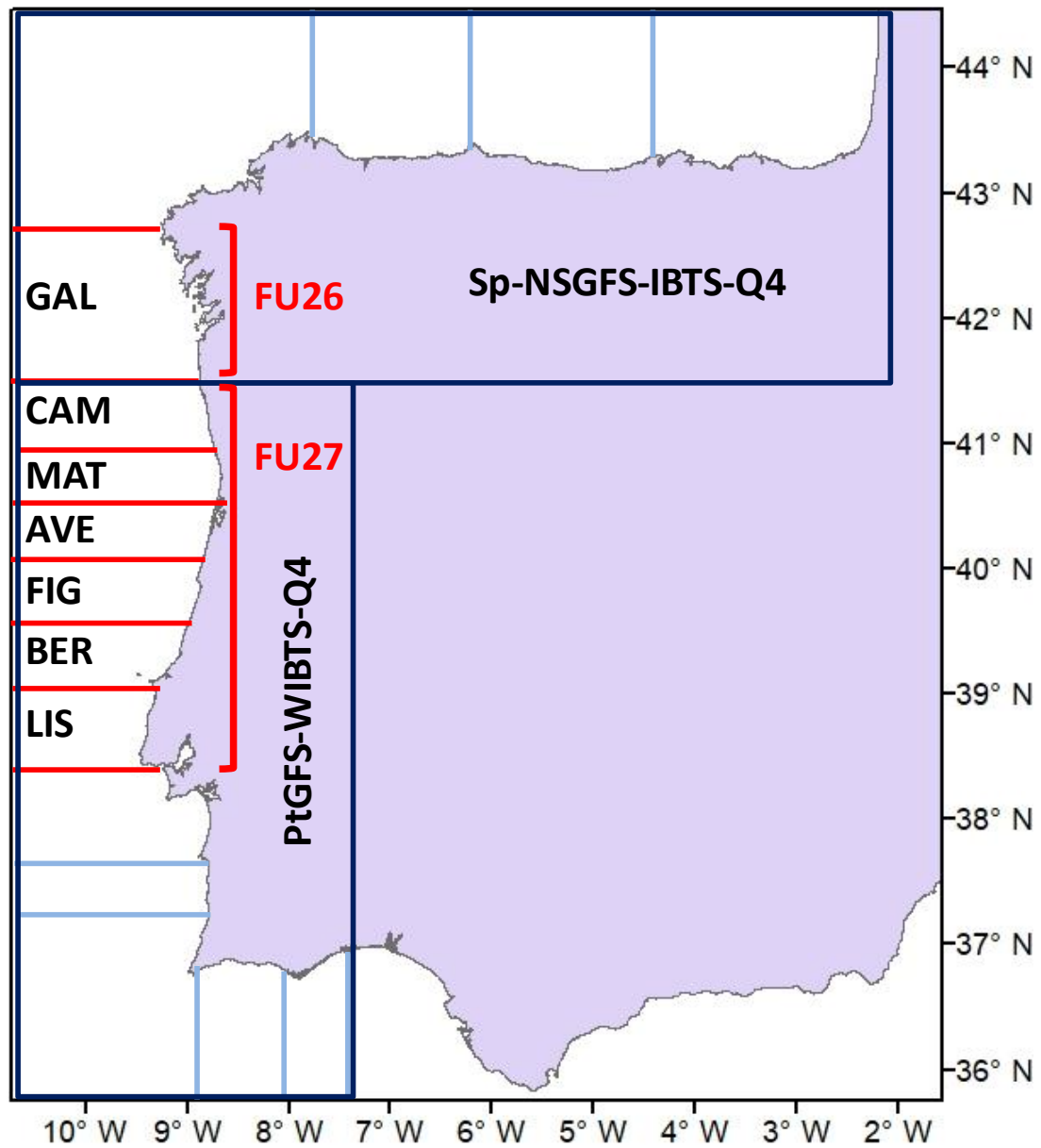


Figure 13.1.3. *Nephrops* in FUs 26–27. Area sectors covered by the Spanish (SpGFS-WIBTS-Q4, G2784) and Portuguese (PtGFS-WIBTS-Q4, G8899) IBTS-Q4 surveys in FU26 and FU27, respectively. (GAL: Miño-Finisterra; CAM: Caminha; MAT: Matosinhos; AVE: Aveiro; FIG: Figueira da Foz; BER: Berlengas; LIS: Lisbon).

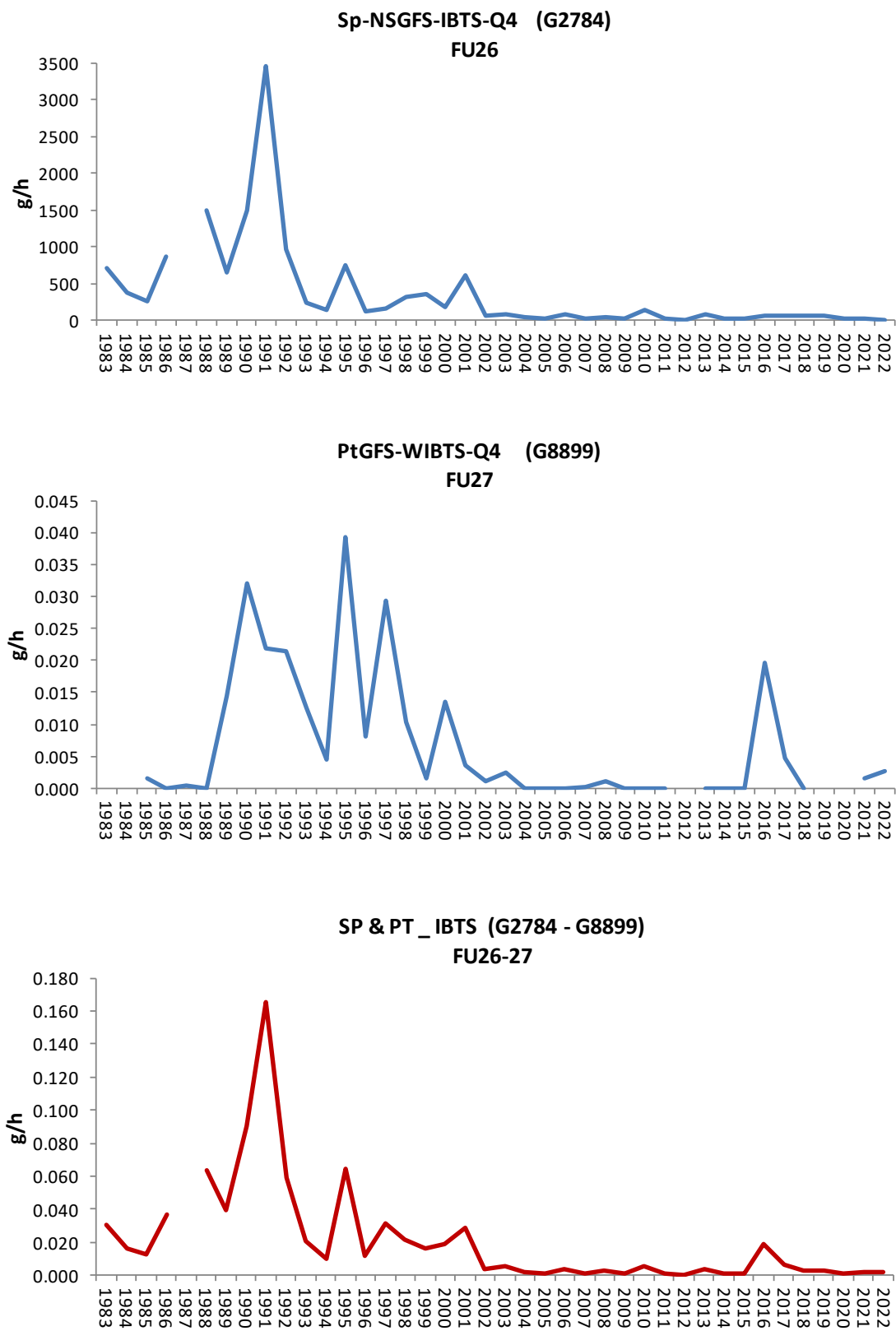


Figure 13.1.4. *Nephrops* in FUs 26–27. Biomass indices (g/h) from the Spanish IBTS-Q4 (SpGFS-WIBTS-Q4, G2784) in FU 26 (top panel), the Portuguese (PtGFS-WIBTS-Q4, G8899) in FU 27 (middle panel) IBTS-Q4 surveys and the new combined (G2784\_G8899) IBTS index in FUs 26–27 (bottom panel).

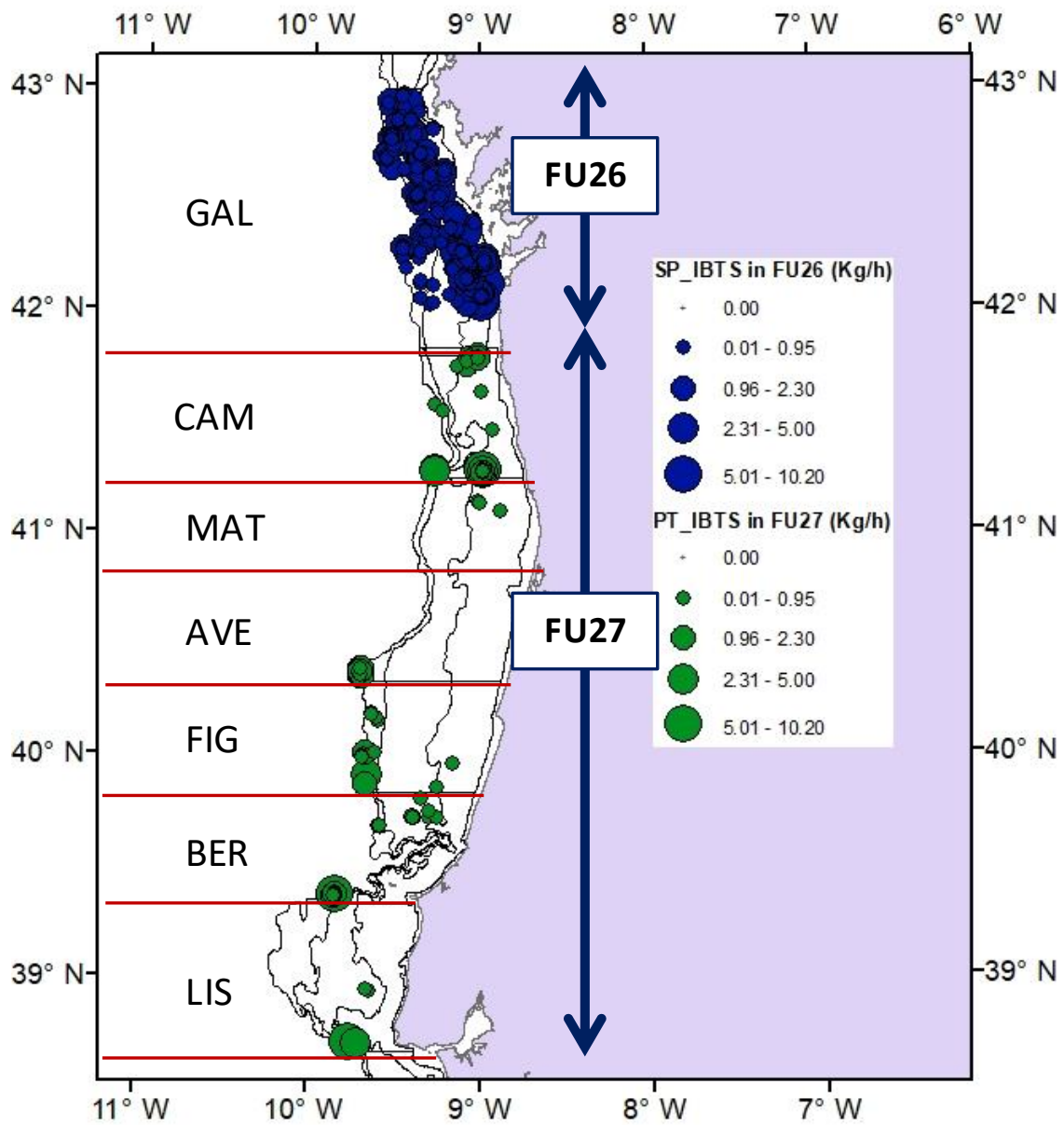


Figure 13.1.5. *Nephrops* in FU 26–27. *Nephrops* spatial distribution in FUs 26–27 from the Spanish (SpGFS-WIBTS-Q4, G2784) and the Portuguese (PtGFS-WIBTS-Q4, G8899) IBTS-Q4 surveys (blue and green, respectively) for the entire period 1983–2021. (GAL: Miño-Finisterra; CAM: Caminha; MAT: Matosinhos; AVE: Aveiro; FIG: Figueira da Foz; BER: Berlengas; LIS: Lisbon).

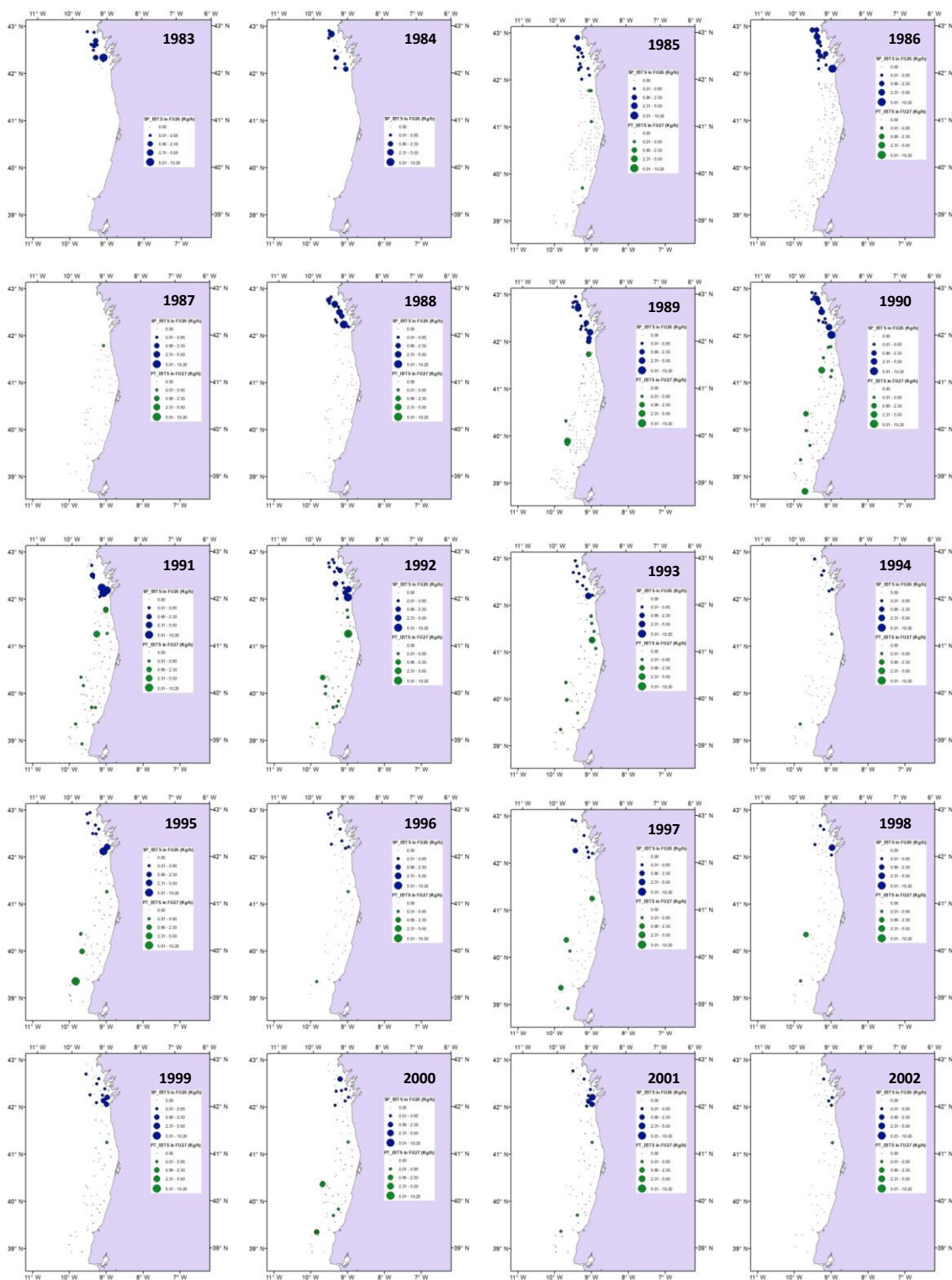


Figure 13.1.6a. *Nephrops* in FUs 26–27. Annual *Nephrops* spatial distribution from the Spanish (SpGFS-WIBTS-Q4, G2784) and Portuguese (PtGFS-WIBTS-Q4, G8899) IBTS-Q4 surveys (blue and green, respectively) for the period 1983–2002.

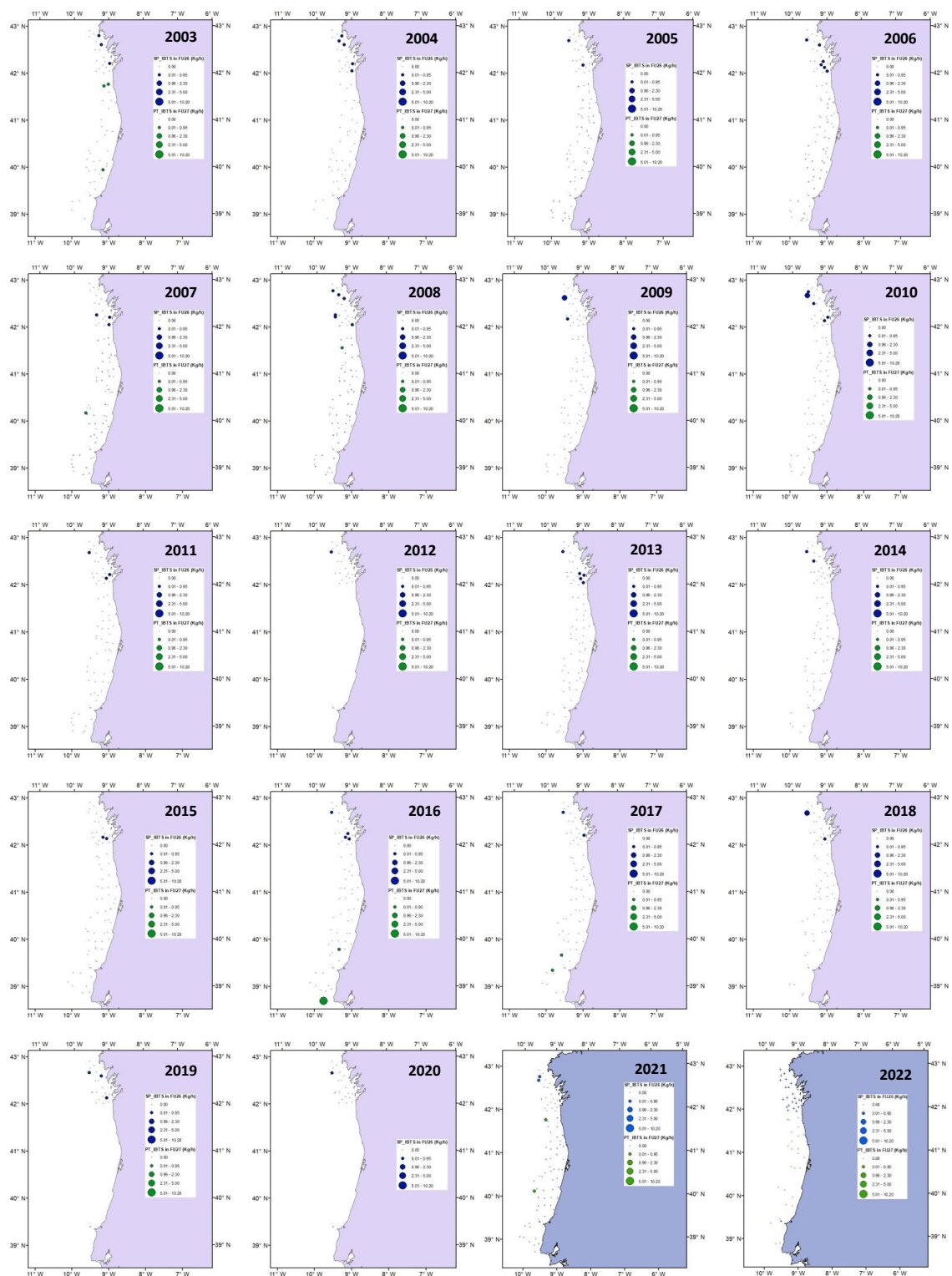


Figure 13.1.6b. *Nephrops* in FUs 26–27. Annual *Nephrops* spatial distribution from the Spanish (SpGFs-WIBTS-Q4, G2784) and Portuguese (PtGFs-WIBTS-Q4, G8899) IBTS-Q4 surveys (blue and green, respectively) for the 2003–2022 period.

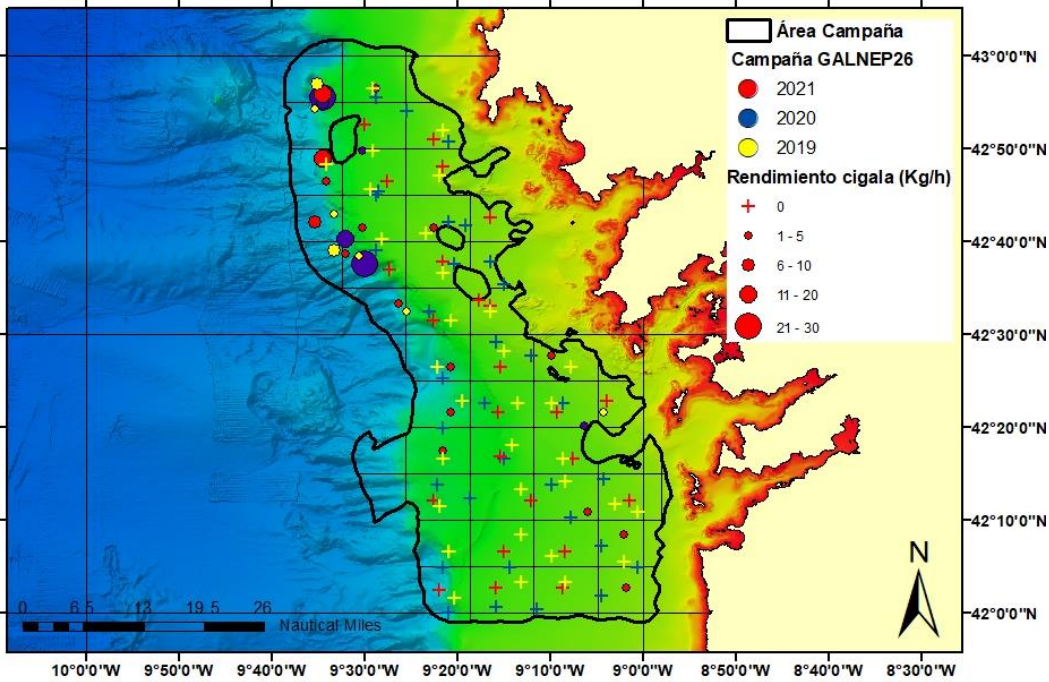


Figure 13.1.7. *Nephrops* in FUs 26–27. *Nephrops* biomass spatial distribution for the years 2019 (yellow bubble), 2020 (blue bubble) and 2021 (red bubble) from the GALNEP\_26 survey in FU 26.

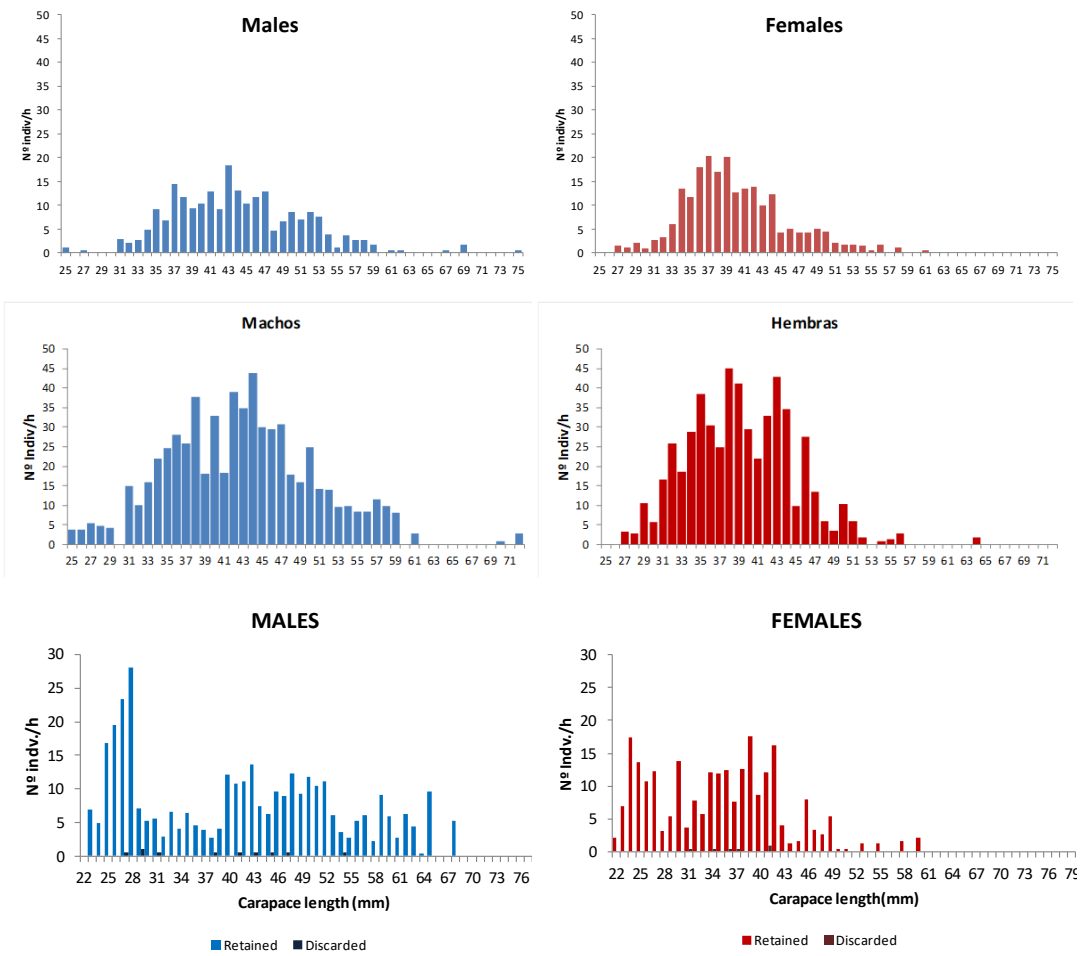


Figure 13.1.8. *Nephrops* in FUs 26–27. Length–frequency distribution by sex from GALNEP-26 survey for the years 2019 (top panel), 2020 (middle panel) and 2021 (bottom panel).

## 13.2 *Nephrops* in Functional Units (FUs) 28–29 (SW and S Portugal)

### 13.2.1 General

#### 13.2.1.1 Ecosystem aspects

See Stock Annex.

#### 13.2.1.2 Fishery description

See Stock Annex

#### 13.2.1.3 ICES Advice for 2023 and management applicable for 2022 and 2023

##### ICES Advice for 2022

The advice for this stock is biennial and valid for 2022 and 2023. Based on the ICES approach for data-limited stocks (DLSs), ICES advises that catches in FUs 28 and 29 should be no more than 266 t in each of the years 2022 and 2023.

To ensure that the stock in FUs 28 and 29 is exploited sustainably, ICES advises that management should be implemented at the FU level.

##### Management applicable for 2022 and 2023

A recovery plan for southern hake and Iberian *Nephrops* stocks was enforced since the end of January 2006. The recovery plan aimed to rebuild the stocks within ten years, with a reduction of 10% in F relative to the previous year and the TAC set accordingly (Council Regulation (EC) No 2166/2005, 2005). ICES did not evaluate the recovery plan for *Nephrops* in relation to the precautionary approach. This plan was based on precautionary reference points for southern hake. A new Management Plan for Western Waters (Regulation (EU) 2019/472, 2019a) was established in 2019 for demersal species including *Nephrops* in these FUs and the former recovery plan was repealed. In the current Management Plan for Western Waters, applied from 2020 onwards, no effort limitations were established.

To further reduce the fishing pressure on *Nephrops* stocks in Division 9.a, seasonal restrictions were introduced in the trawl and creel fishery in two boxes (geographic areas) located in FUs 26 and 28, during the peak of the *Nephrops* fishing season. These restrictions are applied to *Nephrops* fleets fishing in these boxes in June–August and May–August, respectively, and were amended to the existing regulation on technical measures (Council Regulation (EC) No 850/98, 1998) by the Council Regulation (EC) No 2166/2005 (2005). A more recent regulation on technical measures (Regulation (EU) 2019/1241, 2019b) replaced the previous CR (EC) No 850/98 and kept the two boxes allowing fishing *Nephrops* only as bycatch.

The TAC set for the whole Division 9.a was 355 t for 2022, of which no more than 50 t may be taken in FU 30 (Council Regulation (EU) 2021/92). For 2023, the TAC for the Division 9.a was set as 298 t, with a maximum of 32 t for FU 30 (Council Regulation (EU) 2022/109). No catches are allowed to be taken in FUs 26 and 27.

### 13.2.2 Data

#### 13.2.2.1 Commercial catches and discards

Table 13.2.1 and Figure 13.2.1-top left show the landings data series for these FUs. For the period 1984 to 1992, the recorded landings from FUs 28 and 29 have fluctuated between 420 and 530 t,

with a long-term average of about 480 t, falling drastically down to 132 t in the period 1990–1996. From 1997 to 2005, landings increased to similar levels observed during the early 1990s then decreased until 2009. The landings values were approximately at the same level ( $\approx 150$  t) for the years 2009–2011, presenting an increasing trend until 2018 and then a decreasing trend in the last period of the series. From 2013 onwards, the reduced TAC has limited the fishing activity, and the fishery has been closed for 1–2 months in the second semester, in some of the years.

Since 2011, landings include the Spanish official landings. Spanish vessels are licensed to fish for crustaceans in these FUs under a bilateral agreement since 2004. No data from these vessels' operations is available prior to 2011.

Spanish official landings are derived from logbooks. This source of information allows landings disaggregation by ICES statistical rectangles. In 2012 and 2013, *Nephrops* catches were recorded in statistical rectangles outside the FUs in Division 9.a and these were allocated to the closest rectangles in each FU. Since 2014, 100% of the catches were from FUs 28–29.

In terms of sex ratio, males are the dominant component in the catches of most of the years in the time-series. The years of 1991 and 1995 were the years when total female landings largely exceeded male landings (1:1.58 and 1:2.18 male:female ratio in numbers respectively for each year). In more recent years, from 2019 to 2021 females were also more abundant in landings (1:1.18, 1:1.05 and 1:1.33, respectively), while in 2022 males were slightly more dominant than females (1:0.95).

Information on discards and on the onboard sampling program was sent to WGBIE through the ICES Accessions. The frequency of *Nephrops* occurrence in discards samples is very low. Discards are negligible in this fishery mostly due to *Nephrops* quality and not related to the minimum landing size (MLS = 20 mm of carapace length). It was only in 2013 that the occurrence of *Nephrops* in discards samples was greater than 30% and a total amount of 3 t was estimated, with a high coefficient of variation (CV = 58%). In 2020 and 2021, the Portuguese on-board sampling programme was compromised by the COVID-19 pandemic situation and the sampling occurred only during the first quarter of the 2020, with no sampled trips in 2021. In 2022, there were limitations in the onboard sampling effort due to issues related with subcontracting services. Since discards were considered negligible for *Nephrops* during the whole sampling period 2004–2019, this was also assumed to be the case for the 2020 (ICES, 2021a), 2021 and 2022 assessments.

### 13.2.2.2 Biological sampling

Length distributions for both males and females for the Portuguese trawl landings are obtained from samples taken weekly at the main auction port, Vila Real de Santo António. Sampling frequency in 2022 was at the same level as in previous years and occurred in months when the Norway lobster fishing was open. The sampling data were raised to the total landings by market size category, vessel, and month.

The length compositions by sex of the landings are presented in Tables 13.2.2a-b and Figures 13.2.2a-b. The number of samples and measured individuals are presented in Table 1.4a.

In 2020, *Nephrops* sampling in Portuguese markets was affected by the COVID-19 pandemic and no sampling was conducted during the months of April, May, July, and August. Raising of the length compositions for the missing months was based on the mean length composition of the previous three years (2017–2019) in each of those months (ICES, 2021b). In 2021, the same procedure was used for August and September, due to deficient sampling. In 2022, no sampling was conducted in October and the raising of the length composition was based on the mean length of the two adjacent months (September and November) of the same year.

### 13.2.2.3 Biomass indices from surveys

#### Trawl surveys

Since 1997, groundfish (PtGFS-WIBTS-Q4; G8899) and crustacean trawl surveys (NepS (FU 28–29), G2913) were carried out every year, covering FUs 28 and 29. Table 13.2.3 and Figure 13.2.1-bottom-left show the average *Nephrops* CPUEs (kg/h trawling) from the crustacean trawl surveys, which can be used as an overall biomass index. As the surveys were performed with a smaller mesh size than the commercial fishery, this information provides a better estimation of the abundance for small-sized individuals. There was an increase in the overall biomass index in the period 2003–2005, as well as of small individuals at a particular juvenile concentration area in 2005, which could be an indicative of higher recruitment.

The R/V “Noruega” had some technical problems in 2010 and could not trawl in areas deeper than 600 m. The survey plan had to be adapted accordingly. The CPUE value estimated for 2010, the highest value for the whole series, was probably affected by this change. In 2011, due to an engine failure, the survey did not cover the whole area of *Nephrops* distribution. No CPUE index was presented for that year. The following year, budgetary constraints of national scope led to the unfeasibility of the R/V “Noruega” to be repaired as well as the chartering of a replacement research vessel and, therefore, no survey was conducted in 2012.

The biomass index estimated from the 2013 survey is only comparable to the value of 2009, which covered the same area. Comparing the fraction of the area covered in 2011 and the same area in 2013, the biomass of *Nephrops* increased in the area of Alentejo (FU 28). The survey in 2011 did not cover the main area of concentration in Algarve (FU 29).

Taking into account the information from the fishing grounds obtained from the VMS data, the survey area was adapted in 2014. Figure 13.2.3 shows the spatial distribution of the survey biomass index in the last five years.

In 2019, the survey was not conducted due to issues external to IPMA. In 2020, the survey was also not conducted due to legal constraints at the national level that made it unfeasible for hiring fishing and vessel crews on time to undertake the survey. This was not due to the COVID-19 pandemic disruptions (ICES, 2021b).

In 2021, the survey started to be conducted with a new vessel (R/V “Mário Ruivo”). Although the gear used is the same, the trawling speed and the doors characteristics may affect the net geometry and the performance of the fishing operation. This survey was considered a trial, with gear and equipment operational issues to be fixed. FU 28 was not completely covered (36% of the planned stations) due to engine problems during the third week of the survey. FU 29 was fully covered. In 2022, the survey was carried out with less operational issues than in 2021 and the whole stock area was covered.

#### UWTV experiments

In 2005 and 2007, some experiments to collect UWTV images from the *Nephrops* fishing grounds were made with a camera hanging from the trawl headline. In 2008, the images collected from nine stations in FU 28 with the same procedure showed very promising results. During the 2009 survey, a two-beam laser pointer was attached to the camera and UWTV images were recorded from 58 of the 65 sampled stations. The trawling speed and the water turbidity were the main problems affecting image clarity and the high variation of the camera height to the ground. Both factors contributed to significant variations in the field of view. It was not possible to guarantee that this method can be used for abundance estimation, mainly due to these uncertainties (information presented to SGNEPS 2012–Study Group of *Nephrops* Surveys (ICES, 2012a).

#### 13.2.2.4 Mean sizes

Mean carapace length (CL) data for males and females in the landings and surveys are presented for the period 1994–2022 (Table 13.2.4). Figure 13.2.1-bottom right shows the mean CL trends since 1984. The mean sizes of males and females have fluctuated along the period with no apparent trend. The mean length of males and females in landings in 2021 was reviewed and updated; the new values are within the range of the time series.

#### 13.2.2.5 Commercial catch-effort data

The effort in 2003–2004 corresponds to only eleven months of fleet operations for each year as the crustacean fishery was experimentally closed in January 2003 and 30 days for *Nephrops* fishery in September–October 2004.

A Portuguese national regulation (Portaria no. 1142/2004, 2004) closed the crustacean fishery in January–February 2005 and enforced a ban in *Nephrops* fishing for 30 days in September – October 2005. As a result, the effort in 2005 corresponds only to nine months.

The recovery plan for southern hake and Iberian *Nephrops* stocks was approved in December 2005 and entered into force at the end of January 2006. This recovery plan includes a reduction of 10% in F relative to the previous year (Council Regulation (EC) No 2166/2005, 2005). As a result, the number of fishing days per vessel was progressively reduced. Additional days were allocated in 2010 to Spanish and Portuguese vessels within divisions 8.c and 9.a excluding the Gulf of Cádiz, on the basis of the permanent cessation of vessels from each country (Commission Decision No 2010/370/EU, 2010a; Commission Decision No 2010/415/EU, 2010 b).

Besides this effort reduction, the Council Regulation (EC) No 850/98 (1998) was amended by the Council Regulation (EC) No 2166/2005 (2005), with the introduction of two boxes in Division 9.a, with one of them located in FU 28. In the period of higher catches (May–August), this box is closed for *Nephrops* fishing. By way of derogation, fishing with bottom-trawls in these areas and periods is authorized provided that the bycatch of Norway lobster does not exceed 2% of the total weight of the catch. The same applies to creels that do not catch *Nephrops*.

The effort reduction measures were combined with a national regulation closing the crustacean fishery every year in January (Portaria no. 43/2006, 2006). In 2016, this period was extended until February. Besides the closed season in 2013–2016, the Portuguese vessels had to stop fishing for 1.5 to 2 months, in October–November, due to quota limitations. With regards to the Spanish fleet, the number of fishing days was reduced due to sanctions imposed by EC related to the catches exceeding the quota in 2012. The operation of this fleet was also affected in the Portuguese fishing grounds for the period 2013–2015.

Crustacean vessels target two main species, rose shrimp and Norway lobster, which have different market values. Depending on their abundance and availability, the effort is mostly directed at one species or the other (Figure 13.2.4). A standardized CPUE series for *Nephrops* (Figure 13.2.5) based on Portuguese crustacean trawlers' logbooks and VMS records, is used to estimate the fishing effort in standard hours. The model used to standardize CPUE is described in the Stock Annex. In 2020, a new approach for the standardization of the CPUE series to incorporate both positive and null catches of *Nephrops* was presented and accepted during the WKMSYSPICT (ICES, 2021a). Other improvements made to the model, include i) the incorporation of a variable to account for the spatial dimension of the *Nephrops* distribution (fishing ground), ii) the replacement of the variables used to mimic the target fishing in the previous model, that was not truly independent from the response variable, by a cluster-based variable estimated from the catch composition of the main crustacean species caught by the fishery; iii) the inclusion of the 'vessel' variable as a random effect, and iv) the estimation of the mean standardized annual CPUE considering all the factor levels and not only for a reference set of levels like in the previous model. The variability explained by the model increased from 51% to 60%, although both the previous

and the new model produced similar trends. The model was updated with the 2022 data with a deviance explained of 61.9%. A decreasing trend is observed after 2018 (Figure 13.2.5).

Standardized effort in trawling hours is estimated based on the latest modelled series, dividing the total catch by the standardized CPUE. The series shows a consistent declining trend since 2005 reaching an historic low in 2009–2010. During the last decade the standardized fishing effort has fluctuated at a low level due to a quota reduction resulting from the application of the former recovery plan rules. It slightly increased up to almost 124 thousand hours in 2017 and has been decreasing since then ((Figure 13.2.1-top right and Table 13.2.5).

### 13.2.3 Assessment

The advice for this stock is biennial. The stock data were updated with the new information for 2022. The advice is based on the standardized commercial CPUE trend and the relative  $F$  obtained from Mean Length-Z (MLZ) model (ICES, 2015). According to the ICES data-limited approach, this stock is classified as category 3.2.0 (ICES, 2012b).

In February 2021, a Benchmark workshop (WKMSYSPiCT) on the application of SPiCT to produce MSY advice for selected stocks, including *Nephrops* in FUs 28–29, was conducted (ICES, 2021a). Given the input data available for the stock, different model configurations produced contradictory results and it was not possible to distinguish between two alternative stock statuses. For this reason, the SPiCT model was not accepted to provide assessment and advice for this stock. Thus, the stock remained as category 3.

In 2023, given the most recent ICES guidelines to provide advice for data limited stocks (ICES 2023), this stock should have been assessed using the ICES rfb rule (Method 2.1, ICES, 2021c). However, since the fishing pressure indicator from the MLZ, accepted in the last benchmark, is based on more complete information than the one in the Method 2.1, the new rule was not applied, following the ACOM recommendation.

WKLIFE XII, to occur in late 2023, has as one of its terms of reference to explore methods for *Nephrops* after which new guidelines will be available for the next advice in 2025.

#### 13.2.3.1 Length-based indicators (LBIs)

Length-based indicators (LBIs), defined at WKLIFE V (ICES, 2015), were used to assess the status of the stock conservation, considering males and females separately (Table 13.2.6 and Figure 13.2.6). The ratios  $L_c/L_{mat}$  and  $L_{25\%}/L_{mat}$  indicate that immature individuals are preserved. However,  $P_{mega} < 30\%$  indicates a truncated length distribution of the female catch which may be explained by their reproductive behaviour of not leaving the burrows during the egg-bearing period. The  $F_{MSY}$  proxy ( $L_{mean}/L_{F=M}$ ), suggests that the stock is exploited at sustainable levels, with values above or very close to 1 for both sexes.

#### 13.2.3.2 Mean length-based mortality estimators (MLZ)

Assuming a constant  $M$  of 0.3 for males and 0.2 for females,  $F$  was estimated using the mean length-based mortality estimators (MLZ) as defined in WKLIFE-V (ICES, 2015) and WKProxy (ICES, 2016). The input data and the output of Gedamke and Hoenig (G&H; Gedamke and Hoenig, 2006) and Then, Hoenig and Gedamke (THoG; Then, 2014) models are summarized in Table 13.2.7. Figures 13.2.7 and 13.2.8 show the model diagnostics for G&H model and the  $F$  series estimated by the THoG model.

G&H model with two periods gives a better fit and a lower AIC. For the last period, fishing mortality was estimated at 0.17 for males and 0.10 for females. The results indicate that the stock is exploited at a level below the  $F_{MSY}$  proxy, either with the Gedamke & Hoenig or the THoG model, although the latter gives much lower  $F$  values. The  $M$  value estimated by the THoG model is also greater than the fixed  $M$ , historically assumed for *Nephrops* stocks. The results of the models were accepted using fixed values for  $M$  (0.3 for males and 0.2 for females) which give higher  $F$  values, while still below  $F_{MSY}$ .

### 13.2.3.3 Summary

The standardized commercial CPUE (Figure 13.2.5), used as an index of biomass shows a decreasing trend since 2018 (Figure 13.2.3). The fishing pressure indicator, corresponding to the relative  $F$  obtained from the MLZ model, is well below the  $MSY$  reference point for over a decade and remains at a low level (Figure 13.2.8), suggesting that the stock is exploited at sustainable levels.

## 13.2.4 Biological reference points

Proxies of  $MSY$  reference points were reviewed in WGBIE 2017 (ICES, 2017) using the methods developed in WKLIFE V and WKProxy (ICES, 2015, 2016, respectively). From length-based analysis of the period 1984–2016, the values of  $F_{0.1}$  were updated at 0.23 for males and 0.24 for females, as proxies of  $F_{MSY}$ . No proxy for  $B_{MSY}$  was identified (ICES, 2017).

In November 2019, a workshop on methodologies for *Nephrops* reference points was held in Lisbon to evaluate reference point estimation methods for stocks with UWTV surveys, and to evaluate the utility of other modelling frameworks to assess and provide reference points for *Nephrops* stocks (ICES, 2020). Besides the LBIs and MLZ models (WKLIFE V, ICES, 2015) which are already used in the assessment of this stock, other approaches as Separable Cohort Analysis (SCA R package, version 1.2.0; Bell, 2019), Separable Length Cohort Analysis (SLCA – *nepref* R package, version 0.2.2; Dobby, 2019), Length-based Stock Potential Ratio (LBSPR, Hordyk *et al.*, 2015) and Surplus Production in Continuous Time (SPiCT, Pedersen and Berg, 2017) were tested.

## 13.2.5 Management considerations

*Nephrops* is caught by a multispecies and mixed bottom-trawl fishery.

A recovery plan for southern hake and Iberian *Nephrops* stocks was approved in December 2005 and in action since the end of January 2006 (Council Regulation (EC) No 2166/2005, 2005). This recovery plan includes a reduction of 10% in the hake  $F$  relative to the previous year and TAC set accordingly, within the limits of  $\pm 15\%$  of the previous year TAC. Although no clear targets were defined for Norway lobster stocks in the plan, the same 10% reduction has been applied to these stocks' TAC. The number of allowed fishing days is set in each year by EU regulation fixing the fishing opportunities for fish stocks, applicable in Union waters. The recovery plan target and rules have not been changed since it was implemented. In March 2019, a new multiannual plan (MAP) for stocks fished in the Western Waters (including the *Nephrops* stocks in these FUs) and adjacent waters was established, repealing the previous recovery plan (Regulation (EU) 2019/1241, 2019b).

Besides the recovery plan, the Council Regulation (EC) No 850/98 (1998) was amended with the introduction of two boxes in Division 9.a, one of them located in FU 28 (Council Regulation (EC) No 2166/2005, 2005). In the period of higher catches (May–August), this box is closed for *Nephrops* fishing. By derogation, fishing with bottom-trawls in these areas and periods are authorized

provided that the bycatch of Norway lobster does not exceed 2% of the total weight of the catch. The same applies to creels that do not catch *Nephrops*. Recently, a new Regulation (Regulation (EU) 2019/1241, 2019b) repealed the one implemented in 1998 but kept the two boxes allowing fishing *Nephrops* only as bycatch.

With the aim of reducing effort on crustacean stocks, a Portuguese national regulation (Portaria no. 1142/2004, 2004) closed the crustacean fishery in January–February 2005 and enforced a ban in *Nephrops* fishing for 30 days in September–October 2005 in FUs 28–29. This regulation was revoked in January 2006, after the entry in force of the recovery plan and the amendment to the 1998' management plan, keeping only one month of closure of the crustacean fishery in January (Portaria no. 43/2006, 2006). This one-month closure period was extended for another month, until 29 February in 2016 (Portaria no. 8-A/2016, 2016). The national regulations are only applicable to the Portuguese fleet.

Portugal and Spain have bilateral agreements for fishing in each other's waters. The agreement for the period 2004–2013 was reviewed and extended. Under this agreement, a number of Spanish trawlers are licensed to fish crustaceans in Portuguese waters. No information from landings of these vessels is available for the years prior to 2011. A new bilateral agreement was signed in 2021 for 5 years since January 2022 (Dec. 23/2021). The number of Spanish trawlers allowed to fish crustaceans in Portuguese waters was set at five.

Unwanted catches from *Nephrops* are regulated by the discard plan for demersal fisheries in South-Western waters for the period 2019–2023 (Commission Delegated Regulations (EU) 2018/2033, replaced by 2019/2237 and later by 2020/2015), under which they are exempted from the landing obligation based on the species high survival rates as provided for in Article 5(4b) of Regulation (EU) No 1380/2013 (2013). This exemption applies to all catches of Norway lobster from ICES subareas 8 and 9 with bottom-trawls, and where all *Nephrops* discards shall be released immediately, and in the area where they were caught (Commission Delegated Regulation (EU) 2020/2015).

### 13.2.6 References

- Bell, E. 2019. Separable Length Cohort method (SCA). In Length-based reference point estimation. Presentation to WKNephrops 2019, Lisbon, 25 – 28 November 2019.
- Dobby, H. 2019. nepref: Calculates per recruit reference points for *Nephrops*. R package version 0.2.2.
- Commission Decision No 2010/370/EU. 2010a. Commission Decision No 2010/370/EU of 1 July 2010 on the allocation to Spain of additional days at sea within ICES Divisions VIIIc and IXa excluding the Gulf of Cádiz. Official Journal of the European Union, L168, p.22. <http://data.europa.eu/eli/dec/2010/370/oj>.
- Commission Decision No 2010/415/EU. 2010b. Commission Decision No 2010/415/EU of 26 July 2010 on the allocation to Portugal of additional days at sea within ICES Divisions VIIIc and IXa excluding the Gulf of Cádiz. Official Journal of the European Union, L195, p. 76. <https://extwprlegs1.fao.org/docs/pdf/eur96425.pdf>.
- Commission Delegated Regulation (EU) 2018/2033. 2018. Commission Delegated Regulation (EU) 2018/2033 of 18 October 2018 establishing a discard plan for certain demersal fisheries in South-Western waters for the period 2019–2021. Official Journal of the European Union, L327, p. 1–7. [https://eur-lex.europa.eu/eli/reg\\_del/2018/2033/oj](https://eur-lex.europa.eu/eli/reg_del/2018/2033/oj).
- Commission Delegated Regulation (EU) 2019/2237. 2019. Commission Delegated Regulation (EU) 2019/2237 of 1 October 2019 specifying details of the landing obligation for certain demersal fisheries in south-western waters for the period 2020–2021. Official Journal of the European Union, L336, p. 26–33. [https://data.europa.eu/eli/reg\\_del/2019/2237/oj](https://data.europa.eu/eli/reg_del/2019/2237/oj).
- Commission Delegated Regulation (EU) 2020/2015. 2020. Commission Delegated Regulation (EU) 2020/2015 of 21 August 2020 specifying details of the implementation of the landing obligation for

- certain fisheries in Western Waters for the period 2021–2023. Official Journal of the European Union, L415, p. 22 - 38. [http://data.europa.eu/eli/reg\\_del/2020/2015/oj](http://data.europa.eu/eli/reg_del/2020/2015/oj).
- Council Regulation (EC) No 850/98. 1998. Council Regulation (EC) No 850/98 of 30 March 1998 for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms. L125, p. 1–91. <https://data.europa.eu/eli/reg/1998/850/2014-01-01>.
- Council Regulation (EC) No 2166/2005. 2005. Council Regulation (EC) No 2166/2005 of 20 December 2005 establishing measures for the recovery of the Southern hake and Norway lobster stocks in the Cantabrian Sea and Western Iberian Peninsula and amending Regulation (EC) No 850/98 for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms. Official Journal of the European Union, L345, p. 5–10. <https://data.europa.eu/eli/reg/2005/2166/oj>.
- Council Regulation (EU) 2021/92. 2021. Council Regulation (EU) 2021/92 of 28 January 2021 fixing for 2021 the fishing opportunities for certain fish stocks and groups of fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters. Official Journal of the European Union, L31: 31–192. <https://data.europa.eu/eli/reg/2021/92/oj>.
- Council Regulation (EU) 2022/109. 2022. Council Regulation (EU) 2022/109 of 27 January 2022 fixing for 2022 the fishing opportunities for certain fish stocks and groups of fish stocks applicable in Union waters and for Union fishing vessels in certain non-Union waters. Official Journal of the European Union, L21: 1–164. <http://data.europa.eu/eli/reg/2022/109/oj>.
- Decreto no. 23. 2021. Aprova o Acordo sobre as Condições de Exercício da Atividade das Frotas Portuguesa e Espanhola nas Águas de Ambos os Países, entre a República Portuguesa e o Reino de Espanha, assinado em Luxemburgo, em 28 de junho de 2021. Diário da República, de 22 de Novembro de 2021, 1ª série, nº 226: 6-14.
- Gedamke, T., Hoenig, J.M. 2006. Estimating mortality from mean length data in non-equilibrium situations, with application to the assessment of goosfish. Transactions of the American Fisheries Society 135: 476–487.
- Hordyk, A., Ono, K., Sainsbury, K., Loneragan, N., Prince, J. 2015. Some explorations of the life-history ratios to describe length composition, spawning-per-recruit, and the spawning potential ratio. ICES Journal of Marine Science, 72 (1): 204–216. <https://doi.org/10.1093/icesjms/fst235>.
- ICES. 2012a. Report of the Study Group on *Nephrops* Surveys (SGNEPS), 6–8 March 2012, Acona, Italy. ICES CM 2012/SSGESST:19. 36 pp.
- ICES. 2012b. ICES Implementation of Advice for Data-limited Stocks in 2012 in its 2012 Advice. ICES CM 2012/ACOM 68. 42 pp.
- ICES, 2015. Report of the Fifth Workshop on the Development of Quantitative Assessment Methodologies based on Life-history Traits, Exploitation Characteristics and other Relevant Parameters for Data-limited Stocks (WKLIFE V), 5–9 October 2015, Lisbon, Portugal. ICES CM 2015/ACOM: 56, 157 pp.
- ICES, 2016. Report of the Workshop to consider MSY proxies for stocks in ICES category 3 and 4 stocks in Western Waters (WKProxy), 3–6 November 2015, ICES Headquarters, Copenhagen. ICES CM 2015/ACOM: 61, 183 pp.
- ICES, 2017. Report of the Working Group for the Bay of Biscay and Iberian Ecoregion (WGBIE), 4–11 May 2017, Cádiz, Spain. ICES CM 2017/ACOM: 12, 532 pp.
- ICES. 2020. Workshop on Methodologies for *Nephrops* Reference Points (WKNephrops; outputs from 2019 meeting). ICES Scientific Reports. 2:3. 106 pp. <http://doi.org/10.17895/ices.pub.5981>.
- ICES. 2021a. Benchmark Workshop on the development of MSY advice for category 3 stocks using Sur- plus Production Model in Continuous Time; SPiCT (WKMSYSPiCT). ICES Scientific Reports. 3:20. 317 pp. <https://doi.org/10.17895/ices.pub.7919>.
- ICES. 2021b. Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE). ICES Scientific Reports. 3:48. 1101 pp. <https://doi.org/10.17895/ices.pub.8212>

- ICES. 2021c. Tenth Workshop on the Development of Quantitative Assessment Methodologies based on LIFE-history traits, exploitation characteristics, and other relevant parameters for data-limited stocks (WKLIFE X). ICES Scientific Reports. 2:98. 72 pp. <http://doi.org/10.17895/ices.pub.5985>.
- ICES. 2023. Advice on fishing opportunities. In Report of the ICES Advisory Committee, 2023. ICES Advice 2023, section 1.1.1. <https://doi.org/10.17895/ices.advice.22240624>
- Pedersen, M.W., Berg, C.W. 2017. A stochastic surplus production model in continuous time. *Fish and Fisheries*, 18: 226–243. <https://doi.org/10.1111/faf.12174>.
- Portaria no. 1142/2004. 2004. Diário da República nº 216/2004 - I Série-B (2004-09-13). p. 5965. Ministério da Agricultura, Pescas e Florestas. <https://dre.pt/application/conteudo/619549>.
- Portaria no. 43/2006. 2006. Diário da República nº 9/2006 - I Série-B (2006-01-12). p. 319. Ministério da Agricultura do Desenvolvimento Rural e das Pescas. <https://dre.pt/application/conteudo/169055>.
- Portaria no. 8-A/2016. 2016. Diário da República nº 19/2016 – 1º Suplemento, Série I (2016-01-28). p. 308-(2). Ministério do Mar. <https://dre.pt/application/conteudo/73331265>.
- Regulation (EU) No 1380/2013. 2013. Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC. Official Journal of the European Union, L354: 22–61. <http://data.europa.eu/eli/reg/2013/1380/oj>.
- Regulation (EU) 2019/472. 2019a. Regulation (EU) 2019/472 of the European Parliament and of the Council of 19 March 2019 establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. Official Journal of the European Union, L83, p. 1–17. <http://data.europa.eu/eli/reg/2019/472/oj>.
- Regulation (EU) 2019/1241. 2019b. Regulation (EU) 2019/1241 of the European Parliament and of the Council of 20 June 2019 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures, amending Council Regulations (EC) No 1967/2006, (EC) No 1224/2009 and Regulations (EU) No1380/2013, (EU) 2016/1139, (EU) 2018/973, (EU) 2019/472 and (EU) 2019/1022 of the European Parliament and of the Council, and repealing Council Regulations (EC) No 894/97, (EC) No 850/98, (EC) No 2549/2000, (EC) No 254/2002, (EC) No 812/2004 and (EC) No 2187/2005. Official Journal of the European Union, L198: 105–201. <http://data.europa.eu/eli/reg/2019/1241/oj>.
- Then, A.Y. 2014. Estimating fishing and natural mortality rates, and catchability coefficient, from a series of observations on mean length and fishing effort, Chapter 3. In *Studies of Mortality Estimation*. PhD thesis, College of William and Mary, Williamsburg, VA. Available at: <http://www.vims.edu/library/Theses/Then14.pdf>.

### 13.2.7 Tables and figures

Table 13.2.1. *Nephrops* in FUs 28–29. Total landings (tonnes) per country.

Year	FU 28+29 SW+S Portugal					Total
	Spain		Portugal			
	28*	29	28+29			
	Trawl	Trawl	Artisanal	Trawl	Total	
1975	137	1510		34	34	1681
1976	132	1752		30	30	1914
1977	95	1764		15	15	1874
1978	120	1979		45	45	2144
1979	96	1532		102	102	1730
1980	193	1300		147	147	1640
1981	270	1033		128	128	1431
1982	130	1177		86	86	1393
1983				244	244	244
1984				461	461	461
1985				509	509	509
1986				465	465	465
1987			11	498	509	509
1988			15	405	420	420
1989			6	463	469	469
1990			4	520	524	524
1991			5	473	478	478
1992			1	469	470	470
1993			1	376	377	377
1994				237	237	237
1995			1	272	273	273
1996			4	128	132	132
1997			2	134	136	136
1998			2	159	161	161
1999			5	206	211	211
2000			4	197	201	201
2001			2	269	271	271
2002			1	358	359	359
2003			35	335	370	370
2004			31	345	375	375
2005			31	360	391	391
2006			17	274	291	291
2007			18	274	291	291
2008			35	188	223	223
2009			17	133	151	151
2010			16	131	147	147
2011		17	16	117	133	150
2012	0	14	3	211	214	229
2013		10	1	198	199	209
2014		8	3	183	186	193
2015		12	4	231	235	247
2016		21	8	254	262	283
2017		26	9	241	249	275

Year	FU 28+29 SW+S Portugal					Total
	Spain		Portugal			
	28*	29	28+29			
	Trawl	Trawl	Artisanal	Trawl	Total	
2018		25	10	263	273	299
2019		31	8	245	253	284
2020		31	7	209	216	247
2021		34	9	163	173	207
2022**		17	7	124	131	148

\* Spanish landings from FU 28 are included in FU 29.

\*\* Preliminary values.

Table 13.2.2.a. *Nephrops* in FUs 28–29. Length composition of males from landings 1984–2022.

Landings (thousands)		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
17	Year														
18															
19						4	21					0			
20				0	16	4			6	4					
21			17	9			84		16	37	9				
22		7	5	14	15		97	9	29	96	38	9			
23		24	7	7	8		143	5	19	55	34			8	4
24		14	40	121	209	51	272	27	53	202	42	18		17	9
25		109	83	115	81	97	229	116	69	181	149	34	3	23	6
26		250	170	137	446	128	205	182	111	263	72	68	0	36	43
27		282	326	170	718	208	269	149	94	185	95	77	0	54	95
28		374	500	289	871	399	280	337	139	506	272	157	0	56	78
29		439	559	341	727	456	283	415	159	462	382	95	28	38	88
30		412	742	328	584	442	317	695	239	725	548	187	11	68	104
31		277	670	389	742	457	230	813	325	755	548	231	24	92	172
32		373	784	680	806	446	367	866	260	670	674	383	108	151	283
33		339	531	213	236	428	265	702	133	345	365	149	83	70	90
34		389	635	609	721	656	328	785	239	451	655	270	215	159	251
35		478	525	590	245	664	291	755	171	296	475	224	169	147	169
36		378	463	519	342	572	295	449	138	399	639	221	147	78	154
37		528	346	322	406	424	356	465	77	351	391	107	262	172	149
38		496	383	606	355	571	302	479	120	378	344	179	134	113	58
39		353	309	361	240	326	332	611	126	348	306	95	151	62	46
40		447	337	323	156	366	316	829	200	248	174	144	232	83	82
41		247	230	316	335	164	314	797	141	243	158	93	247	78	37
42		371	246	507	264	215	360	628	174	246	170	168	293	85	33
43		199	156	198	62	102	364	335	121	242	107	127	65	31	21
44		194	233	422	215	128	481	553	125	371	179	150	88	42	28
45		165	144	233	206	93	339	324	90	220	150	87	27	22	21
46		148	178	189	170	72	231	228	128	167	55	79	58	21	33
47		129	161	140	74	76	191	202	122	191	96	68	31	38	20
48		176	212	149	79	85	193	121	62	178	102	78	25	15	9
49		89	138	104	58	43	73	92	78	111	47	47	16	20	4
50		91	142	50	34	53	94	58	67	69	30	50	12	9	3
51		66	120	63	27	34	114	59	44	50	38	29	4	6	7
52		64	135	66	44	38	77	33	40	35	15	46	11	16	7
53		45	99	32	37	23	40	19	16	29	18	22	5	6	6
54		73	101	35	45	22	35	27	29	50	23	18	5	8	16
55		20	67	25	31	22	37	30	26	29	19	9	3	4	10
56		20	35	14	20	16	20	30	19	5	5	11	2	4	3
57		10	33	5	15	12	22	7	10	6	5	11	3	7	16
58		13	14	8	14	11	17	14		11	4	6		5	3
59		7	10	3	9	4	16	5	2	9	3	10	0	5	2
60		3	6	3	4	3	13	2		10	8	1	1	1	4
61		3	1	4	4	1	5		1	3	2	1	0	1	9
62		3	1	2	1	2	3		1	7	5	1		2	7
63		1	1		1	1	4		5	0	1	0		2	3
64			2	0	2	1			1	3	1	2		0	4
65		0	0		2	2				3	1	1		0	4
66		0			0	1					1			0	4
67		0			0	0	0			6	5				6
68						0	2				0	1			0
69					0										0
70		0			1		0				2				0
71											0				
72					0		0				1				
73															0
74		0									1				
75															
76															
77															
78			0			0									
79															
80										0					
81															
82															
83															
84															
85															
Total		8106	9897	8709	9679	7925	8329	12255	4023	9249	7463	3766	2466	1854	2200
Landings (t)		292	353	315	277	249	318	351	345	304	232	139	98	65	74

**Table 13.2.2.a. *Nephrops* in FUs 28–29. Length composition of males from landings 1984–2022 (continued).**

Landings Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
17														
18														
19						0				2	0			
20		4			0	0	4			3	1	0	0	
21		3	3	0	2	0	0	33		5	0	0	0	
22	2	0	16	1	2	13	4	51	10	20	8	2		0
23		5	8	3	1	3	15	32	22	31	10	4		1
24	8	9	20	5	2	11	20	107	53	53	26	29	8	0
25	16	39	13	6	3	40	45	120	46	65	28	30	10	1
26	32	33	58	8	11	56	126	153	75	121	32	38	8	3
27	81	49	85	24	24	87	187	206	94	111	52	63	22	6
28	65	68	44	24	48	62	205	286	144	141	60	89	14	4
29	65	109	148	53	60	147	246	330	220	189	62	83	33	5
30	160	133	87	74	139	248	300	533	290	297	60	129	44	5
31	129	272	111	92	123	188	277	573	270	256	93	116	75	22
32	289	88	161	274	233	325	475	757	378	295	129	135	116	32
33	95	182	92	139	281	248	352	437	247	246	108	80	78	21
34	269	152	160	224	257	264	352	574	311	327	150	94	104	52
35	118	175	100	173	274	275	347	333	194	252	121	76	83	31
36	166	143	158	163	265	195	224	263	168	256	83	59	77	34
37	167	128	162	167	247	234	167	293	172	224	109	57	78	64
38	85	75	106	99	254	197	147	226	164	265	73	58	125	69
39	47	180	81	109	229	174	93	175	100	173	75	61	71	39
40	83	83	96	159	254	215	165	152	100	188	77	63	84	44
41	53	184	102	130	163	163	108	129	125	163	102	53	55	49
42	167	58	91	195	163	168	177	152	190	198	128	105	75	68
43	43	102	47	181	167	172	113	118	95	82	76	38	51	45
44	69	63	86	173	122	121	122	176	144	90	61	51	65	43
45	34	111	61	140	113	103	131	140	96	83	60	25	39	19
46	38	67	85	144	106	76	103	117	118	71	38	25	26	15
47	34	59	88	120	111	75	97	113	61	60	48	25	43	18
48	24	40	55	80	104	83	90	66	54	65	48	23	35	12
49	13	50	37	79	86	59	58	52	41	38	34	24	23	12
50	33	32	65	93	103	94	82	69	28	42	36	20	25	11
51	14	32	34	71	72	65	41	40	30	37	27	17	20	15
52	31	8	53	88	94	73	65	45	37	48	29	32	30	24
53	11	13	18	41	69	58	31	22	22	21	24	13	16	9
54	19	15	31	54	53	57	50	24	33	27	23	19	21	24
55	8	9	19	34	28	46	26	12	15	10	20	12	14	15
56	6	13	19	29	43	29	57	14	11	8	15	13	8	25
57	8	8	19	37	37	25	16	9	6	6	17	11	9	25
58	5	4	13	23	26	21	12	9	7	7	20	7	11	45
59	3	4	10	15	16	13	15	8	9	5	11	4	6	19
60	1	1	8	15	25	16	24	12	6	3	9	7	5	13
61	1	2	14	9	11	8	11	8	8	4	8	4	5	7
62	1	3	6	10	11	15	16	8	8	3	15	8	6	22
63	0	2	1	4	11	11	7	7	7	1	8	4	6	7
64	0	1	1	9	11	8	10	10	7	1	10	6	5	17
65		0	4	6	5	4	3	10	7	1	9	2	3	9
66	0		1	5	8	3	7	3	4	2	11	1	3	5
67	0			4	3	5	2	2	6	1	6	1	3	3
68	0			1	6	6	2	3	4	0	8	0	4	3
69	0		0	3	3	2	2	2	4	1	4	1	0	2
70	0		0	6	2	4	3	4	5	0	4	1	0	1
71	0			2	2	4	1	1	3	1	2	0	0	0
72	0			2	2	4	1	3	4	0	3	1	0	1
73			0	0	1	1	1	2	2		1	0	0	1
74				0	1	1	1	3	1		1	1	0	1
75				0	1	0	0	1	1		1	1	2	0
76				0	0	0	0	0	1		1	0	0	0
77					0	0	0	0	1		1	0	0	0
78							0	1			0			0
79					0		0	1	0		0	0		0
80								0			0			0
81									0		0	0		
82					0				0		0	0		
83											0			
84														
85														
Total	2491	2811	2680	3602	4486	4575	5233	7036	4259	4598	2280	1822	1649	1018
Landings (t)	88	116	117	190	222	205	205	231	162	159	114	73	79	72

Table 13.2.2.a. *Nephrops* in FUs 28–29. Length composition of males from landings 1984–2022 (continued).

Landings Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
17											
18											
19				1							
20											
21			0				1			0	
22	3		1				1			0	
23	0	3	1	0		8	20		0	1	0
24	8		1	1		4	28		11	1	3
25	27	8	6	5		8	180	22	16	26	7
26	37	6	7	3		23	89	19	10	12	8
27	47	27	15	8		68	162	70	30	14	10
28	37	25	12	10		109	201	34	30	16	14
29	143	55	35	27	10	149	241	86	80	36	25
30	158	84	36	71	27	324	321	163	149	92	36
31	248	82	49	112	51	293	382	188	131	50	50
32	573	217	120	138	36	345	433	189	169	81	61
33	329	109	47	96	75	207	281	124	163	44	27
34	436	276	119	162	166	277	334	222	195	71	66
35	356	155	144	263	128	295	387	325	290	191	145
36	248	191	119	202	173	138	146	115	101	84	63
37	211	145	108	191	155	145	191	158	112	77	47
38	206	216	144	179	240	82	89	136	82	76	41
39	126	95	129	125	300	71	116	106	59	66	34
40	112	162	160	139	247	114	128	174	88	102	64
41	114	113	90	117	179	86	69	119	66	57	35
42	140	171	129	142	185	101	112	138	76	56	53
43	79	64	58	85	182	64	45	89	43	50	48
44	87	89	104	127	222	94	82	105	70	39	54
45	52	42	59	92	187	108	64	111	57	57	81
46	46	81	59	62	211	75	23	59	64	37	68
47	47	89	83	61	129	53	42	49	66	44	76
48	30	67	26	28	157	18	26	26	21	34	50
49	32	53	36	48	92	32	33	25	30	33	43
50	19	59	25	58	69	41	53	48	43	31	44
51	17	37	32	56	58	27	47	28	34	23	33
52	33	47	64	70	26	46	57	33	37	24	29
53	22	18	25	45	34	38	34	26	29	20	19
54	32	36	44	48	52	46	54	37	46	28	19
55	15	16	24	60	41	38	45	36	47	21	19
56	24	20	20	43	51	30	30	29	38	17	11
57	20	15	20	27	36	22	33	32	34	14	8
58	7	12	10	14	45	5	19	12	10	9	6
59	7	8	9	16	38	12	18	15	19	10	6
60	4	10	7	10	30	10	15	9	11	13	5
61	9	7	4	4	21	4	10	5	5	6	2
62	3	1	12	4	10	5	8	2	2	6	2
63	2	4	3	3	14	2	3	1	1	7	2
64	2	3	8	3	10	2	4	4	1	8	4
65	1	1	2	1	9	2	9	5	4	6	5
66	3	2	3	2	6	3	5	5	2	5	3
67	3	1	2	1	4	2	5	4	3	4	2
68	3	1	1	0	4	1	2	3	11	1	1
69	1		1	0	8	1	3	4	9	3	1
70	3	1	1	0	3	1	4	3	8	3	3
71	1		1	0	3	1	0	1	3	2	0
72	3	0	1		2	0	2	1	0	0	1
73	1		1		0	0	0	2	3	1	0
74	1		1		0	0	0	2	0	1	0
75	1		0		0	0	3	2	0	2	1
76	0			0			0	0	2	1	
77	0				0		0	0	0	1	
78					0	0	0		1	1	
79	0				0		0		1	0	0
80							0		0		0
81											
82											
83											
84											
85								0	0		
Total	4170	2928	2217	2959	3725	3632	4693	3204	2615	1713	1434
Landings (t)	149	132	114	147	166	139	169.424	142	126	88	78

Table 13.2.2.b. *Nephrops* in FUs 28–29. Length composition of females from landings 1984–2022.

Landings (thousands)		1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Year																
17																
18						4										
19			0				35					0				
20		3	1	7		8	21				18					
21		1	1	22	3	21	102		21	9	49					
22		8	21	30	78		88	19	11	102	63			0	13	2
23		66	21	7	31	28	135	15	69	38	21	2		0	0	4
24		79	102	118	270	153	258	38	173	164	41	22	2	11	20	15
25		228	205	104	357	163	197	138	198	203	191	73		13	20	25
26		272	284	186	684	220	282	140	436	361	111	92	1	35	102	74
27		345	491	359	902	429	326	247	418	448	235	134	0	37	77	91
28		431	523	322	1421	471	231	345	598	597	413	170	6	36	152	148
29		443	672	419	1253	516	285	491	590	514	523	269	31	45	178	114
30		422	588	381	928	499	317	575	771	599	775	326	104	50	199	199
31		487	593	418	948	482	501	639	414	736	752	427	182	95	394	168
32		485	653	700	946	766	306	859	807	617	824	558	322	198	502	376
33		613	415	406	227	527	314	596	375	430	449	283	251	53	163	116
34		618	467	654	774	813	511	734	310	369	359	353	641	209	278	298
35		562	563	447	447	460	435	519	284	287	194	246	674	184	150	112
36		469	329	316	386	489	274	243	130	267	203	237	811	142	135	166
37		505	353	400	223	206	318	189	108	333	154	147	692	267	129	171
38		383	284	330	269	265	285	207	135	251	100	128	348	151	39	48
39		274	142	211	146	288	148	216	74	176	150	66	194	67	35	59
40		171	119	80	119	132	131	230	131	147	110	114	344	120	21	89
41		58	106	55	65	128	149	73	39	68	108	77	361	63	31	64
42		50	36	133	54	43	127	210	62	69	95	73	165	111	18	84
43		30	27	21	40	28	109	58	82	26	43	23	64	29	2	34
44		17	13	47	147	27	91	77	6	46	42	43	88	90	18	71
45		14	11	27	84	19	27	41	21	40	34	13	54	36	8	22
46		7	6	5	40	14	38	31	45	25	37	11	13	15	4	28
47		5	3	3	26	9	24	16	7	12	29	7	18	23	3	23
48		4	1		71	11	29	7	15	18	15	4	15	8	2	6
49		1	0	3	17	4	9	1	17	17	23	4	1	6	7	6
50		1	0		2	6	3	1	2	32	8	17	1	2	1	6
51		0	0	3	4	3	7	2	4	4	5	0			1	2
52		1			5	5	8	1		5	6	1	1	0	1	1
53		2			2	3	1			9	6	0			0	0
54					4	1	1			1	1			1	0	1
55					0	1	1			6	2					
56					3	0	2		5	14	5					0
57					0	0	1			4	1			0		0
58					0		0			4	1					
59					1	0	0									
60						0				1	0					
61							1									
62																
63										4	1					
64																
65																
66																
67																
68										4	1					
69																
70																
71																
72																
73																
74																
75																
76																
77																
78																
79																
80																
81																
82																
83																
Total		7052	7032	6218	10978	7243	6126	6962	6358	7059	6198	3920	5385	2095	2702	2621
Landings (t)		169	156	150	232	171	151	174	134	165	145	97	174	67	62	72

Table 13.2.2.b. *Nephrops* in FUs 28–29. Length composition of females from landings 1984–2022 (continued).

Landings Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
17					0								
18						0				0			
19					1				2	0			
20			0		0	0	8		4	1			
21		3	1	0	3	12	48	3	15	2	1		
22	5	18	0		3	10	88	14	26	12		0	
23	4	6	7	0	9	43	54	37	34	11	4	1	1
24	25	49	7	10	19	62	135	44	53	25	22	10	1
25	27	24	15	11	36	101	129	55	130	23	23	11	1
26	94	81	24	15	67	211	272	113	227	38	80	12	3
27	76	139	34	34	67	266	294	152	298	73	138	20	7
28	100	64	44	107	98	336	242	179	355	81	170	26	7
29	121	171	90	127	173	395	420	392	458	123	149	51	4
30	236	152	131	237	241	406	654	321	365	145	205	67	7
31	263	131	167	195	152	334	565	305	317	129	132	99	26
32	485	283	316	296	360	530	857	510	409	252	209	145	45
33	187	153	184	467	270	433	448	272	253	182	110	91	51
34	346	235	252	429	314	400	462	341	386	177	122	140	96
35	287	193	158	470	255	324	254	249	351	187	103	120	56
36	317	225	174	351	194	222	203	162	213	103	83	144	60
37	201	213	144	302	203	178	182	142	240	121	90	119	73
38	184	85	108	300	206	151	178	152	247	134	83	106	151
39	151	92	112	213	160	113	89	173	138	123	86	95	113
40	111	79	133	186	284	136	84	114	109	125	62	80	68
41	81	66	79	110	170	82	73	129	73	95	83	65	65
42	73	67	91	80	192	122	116	112	56	75	94	52	80
43	38	41	55	87	132	70	70	44	16	30	25	28	80
44	34	49	56	57	75	66	61	46	21	24	43	40	41
45	18	23	29	51	68	66	50	35	18	28	17	25	21
46	18	38	33	40	37	51	39	54	19	14	22	19	11
47	7	52	26	25	25	44	35	23	9	26	16	18	15
48	9	25	12	24	28	37	18	11	8	20	7	12	9
49	4	21	15	19	18	24	24	7	7	13	6	7	7
50	5	10	15	26	24	20	23	7	3	13	8	7	2
51	2	10	9	22	14	13	17	11	5	11	3	6	5
52	3	16	6	19	21	13	17	7	3	7	3	4	4
53		6	6	10	13	8	10	2	1	8	3	2	3
54		5	2	2	14	7	6	9	1	8	1	2	5
55		1	2	3	10	4	5	1	1	3	4	0	5
56		3	1	3	7	6	2	1	0	3	0	0	2
57		1	0	2	4	2	3	1		1	0	0	1
58			1	1	1	2	0	1	0	1	1	0	4
59		0	1	0	0	1	1	1			0	0	2
60			0		0		2			1		0	2
61		3	1		0	1					0	0	1
62				0	0	0	1	0				0	0
63			0	0			0				0	0	2
64						1	0		0	0	0		
65						0	0						0
66		0	0				0						
67													0
68													
69													
70						0					0		
71													
72													
73													
74													
75													
76													
77													
78													
79													
80													
81													
82													
83													
Total	3509	2829	2540	4332	3969	5304	6240	4229	4871	2449	2211	1628	1138
Landings (t)	95	84	79	135	130	140	151	112	114	74	60	52	45

Table 13.2.2.b. *Nephrops* in FUs 28–29. Length composition of females from landings 1984–2022 (continued).

Landings Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
17											
18											
19				0							
20											
21	7				4						
22		3	1		4		19		0	5	2
23		7	1	0	1		4	10	1	0	4
24	5	7	3		2	13	66	14	5	8	0
25	8	18	10	5	19	91	150	32	25	27	14
26	17	7	10	7	19	23	87	47	13	9	25
27	40	36	17	13	46	100	110	145	55	16	11
28	51	33	23	23	44	134	125	76	49	30	15
29	130	59	60	39	57	169	203	86	124	46	29
30	164	119	80	85	219	464	351	336	246	217	103
31	330	129	99	143	149	290	260	310	146	86	68
32	397	290	203	208	307	462	327	560	306	142	97
33	195	194	105	146	214	290	247	251	167	92	78
34	297	278	202	167	325	353	235	435	215	93	78
35	165	232	188	303	362	365	381	316	430	384	192
36	138	166	153	203	193	196	138	199	172	174	94
37	98	199	151	162	203	142	149	202	127	115	76
38	76	206	148	171	125	81	78	140	110	129	61
39	46	61	121	136	112	105	75	146	79	117	32
40	46	67	145	134	130	108	89	131	89	133	63
41	37	41	66	104	82	56	51	70	34	90	26
42	35	65	90	87	112	72	94	75	48	107	53
43	33	9	27	54	59	55	33	55	49	62	40
44	27	13	40	58	48	53	35	50	52	48	47
45	10	9	17	56	25	45	38	34	42	47	46
46	10	11	17	36	28	36	15	24	30	35	36
47	11	13	18	16	14	21	22	15	67	19	17
48	5	7	5	8	3	14	9	4	8	11	14
49	6	5	7	8	5	7	14	3	23	8	11
50	6	5	4	8	14	7	16	6	6	8	11
51	6	1	3	7	4	7	12	3	10	6	5
52	9	5	4	9	8	6	13	2	8	2	5
53	5	1	3	6	0	5	7	1	4	3	2
54	5	3	8	12	2	4	6	3	5	6	1
55	2	1	3	12	2	3	4	1	3	2	2
56	1	1	6	10	1	1	6	2	2	2	1
57	3	2	2	4	0	1	5	0	1	2	0
58	2	0		1	0	0	5	0	1	0	0
59	0	1	1	3	0	0	2		0	0	1
60	0		2	3	1	1	3	0	1	0	0
61	0					0	1		0		0
62	0	0	0	0			0		0		0
63	0						0		0		
64	0			0			2		0		
65				0		0			0	0	
66				0		0	0		0		0
67				0						1	
68							0		0		
69				0							
70				0							
71										0	
72											
73											
74											
75											
76											
77											
78											
79											
80											
81											
82											
83											
Total	2424	2306	2044	2446	2946	3782	3487	3783	2755	2283	1361
Landings (t)	65	66	66	85	88	102	94	103	83	75	46

**Table 13.2.3. *Nephrops* in FUs 28–29. CPUEs (kg/h) estimated from demersal (PtGFS-WIBTS-Q4, G8899) and crustacean (Nep S (FU 28-29), G2913) research trawl surveys from 1994–2022.**

Year	Demersal surveys			Crustacean surveys	
	CPUE (kg/hour)			Month and year of survey	CPUE (kg/hour)
	Summer	Autumn	Winter		
1994	ns	0.40	ns	May-94	2.3
1995	1.3	0.26	ns	No surveys 1995-96	
1996	ns	0.03	ns		
1997	0.7	0.06	ns		
1998	0.7	0.02	ns	Jun-97	2.7
1999	0.3	0.02	ns	Jun-98	1.4
2000	1.0	0.92	ns	Jun-99	2.5
2001	0.6	0.35	ns	Jun-00	1.6
2002	ns	0.02	ns	Jun-01	0.8
2003	ns	0.19	ns	Jun-02	2.8
2004	ns	0.51	ns	Jun-03	2.9
2005	ns	0.09	0.16	Jun-04	nr
2006	ns	0.19	0.06	Jun-05	5.3
2007	ns	0.04	0.73	Jun-06	2.8
2008	ns	0.13	0.25	Jun-07	2.9
2009	ns	0.13	ns	Jun-08	5.4
2010	ns	0.34	ns	Jun-09	2.8
2011	ns	0.11	ns	Jun-10	8.1
2012	ns	ns	ns	Jun-11	nc
2013	ns	0.64	ns	ns	ns
2014	ns	0.06	ns	Jun-13	2.5
2015	ns	0.21	ns	Jul-14	1.0
2016	ns	0.69	ns	Jul-15	3.2
2017	ns	1.21	ns	Jun-16	4.9
2018	ns	0.46	ns	Jul-17	5.0
2019	ns	ns	ns	Aug-18	5.0
2020	ns	ns	ns	ns	ns
2021	ns	0.34	ns	ns	ns
2022	ns	0.74	ns	Jun-21	3.1 (nc)
				Jun-22	3.5

ns = no survey nr = not reliable nc = whole area not covered

Note: Since 2021, survey performed with a new vessel. In 2021 survey not covering the whole area.

**Table 13.2.4. *Nephrops* in FUs 28–29. Mean sizes (mm CL) of male and females in Portuguese landings and the (PtGFS-WIBTS-Q4, G8899) and Nep S (FU 28-29), G2913) surveys from 1994–2022.**

Year	Landings		Demersal surveys						Crustacean surveys	
	Males	Females	Summer		Autumn		Winter		Males	Females
			Males	Females	Males	Females	Males	Females		
1994	37.4	33.6	ns	ns	39.0	33.6	ns	ns	ns	ns
1995	39.3	37.0	42.1	35.6	42.0	34.9	ns	ns	ns	ns
1996	36.9	36.6	ns	ns	38.6	32.2	ns	ns	ns	ns
1997	35.9	32.8	40.4	36.9	39.1	31.7	ns	ns	43.7	41.9
1998	36.8	34.5	36.0	33.9	40.6	35.9	ns	ns	39.5	36.7
1999	38.7	34.6	45.1	40.4	43.8	32.8	ns	ns	39.7	37.5
2000	38.9	35.2	40.8	37.1	39.0	35.1	ns	ns	41.7	40.2
2001	41.6	36.1	40.5	34.5	47.2	41.6	ns	ns	44.5	39.9
2002	40.7	36.2	na	na	35.0	39.0	ns	ns	44.8	40.7
2003	39.1	36.4	ns	ns	37.5	32.3	ns	ns	39.7	36.7
2004	37.3	33.8	ns	ns	36.7	31.3	ns	ns	39.0	37.0
2005	35.6	33.0	ns	ns	40.6	39.1	40.6	40.9	37.3	35.7
2006	37.2	34.1	ns	ns	36.1	32.8	31.7	35.0	37.7	35.2
2007	36.5	32.8	ns	ns	42.0	38.5	39.0	36.2	38.3	35.0
2008	40.1	35.5	ns	ns	43.2	41.4	46.7	40.6	40.1	36.7
2009	37.4	34.2	ns	ns	45.3	39.8	ns	ns	41.4	36.6
2010	40.1	36.5	ns	ns	39.7	33.7	ns	ns	37.7	36.6
2011	45.0	39.2	ns	ns	43.1	40.0	ns	ns	nc	nc
2012	36.9	34.4	ns	ns	ns	ns	ns	ns	ns	ns
2013	39.7	35.3	ns	ns	42.6	37.3	ns	ns	39.1	39.5
2014	41.3	36.7	ns	ns	46.5	39.2	ns	ns	37.8	35.2
2015	40.9	37.4	ns	ns	42.4	35.2	ns	ns	39.2	37.3
2016	39.5	35.8	ns	ns	43.7	41.6	ns	ns	38.7	36.1
2017	37.4	34.3	ns	ns	45.2	45.3	ns	ns	40.6	34.5
2018	36.2	33.8	ns	ns	43.5	37.9	ns	ns	37.7	34.0
2019	39.1	34.6	ns	ns	ns	ns	ns	ns	ns	ns
2020	39.7	35.6	ns	ns	ns	ns	ns	ns	ns	ns
2021	40.7	36.7	ns	ns	41.0	36.5	ns	ns	37.5	35.2
2022	41.9	36.9	ns	ns	36.3	35.7	ns	ns	35.8	32.9

ns = no survey nr = not reliable nc = whole area not covered

Note: Since 2021, survey performed with a new vessel. In 2021 survey not covering the whole area.

Table 13.2.5. *Nephrops* in FUs 28–29. Effort and CPUE (kg/h) of Portuguese trawlers from 1994–2022.

Year	No. of trawlers	CPUE (t/boat)	Estimated hours	CPUE** (kg/hour)
1994	31	7.6		
1995	30	9.1		
1996	25	5.3		
1997	25	5.5		
1998	25	6.4	412 135	0.4
1999	26	8.1	304 167	0.7
2000	27	7.4	524 884	0.4
2001	33	8.2	407 179	0.7
2002	31	11.5	195 227	1.8
2003	32	10.5	136 960	2.7
2004	23	15.0	250 134	1.5
2005	25	15.3	231 930	1.7
2006	25	11.0	134 807	2.2
2007	26	10.5	153 587	1.9
2008	27	7.0	99 950	2.2
2009	27	4.9	63 010	2.4
2010	25	5.2	72 969	2.0
2011	26	4.5	76 477	2.0
2012	21	10.2	79 477	2.9
2013	24	8.2	101 377	2.1
2014	24	7.5	99 505	1.9
2015	22	10.5	120 985	2.0
2016	22	11.5	107 933	2.6
2017	22	11.0	123 713	2.2
2018	22	12.0	102 788	2.9
2019	23	10.7	107 705	2.6
2020	24	8.7	89 496	2.4
2021	26	6.3	81 018	2.1
2022*	25	5.2	70 511	1.9

\* provisional; \*\* standardized CPUE

Table 13.2.6. *Nephrops* in FUs 28–29. Length-based indicators for males and females.

Sex	Year	Conservation				Optimizing Yield	MSY
		$L_c/L_{mat}$	$L_{25\%}/L_{mat}$	$L_{max5\%}/L_{inf}$	$P_{mega}$	$L_{mean}/L_{opt}$	$L_{mean}/L_{F=M}$
		>1	>1	>0.8	>30%	~1 (>0.9)	≥1
Males	2020	1.02	1.18	0.90	0.14	0.86	1.02
	2021	1.02	1.21	0.92	0.14	0.89	1.05
	2022	1.16	1.18	0.87	0.13	0.94	1.04
Females	2020	0.97	1.08	0.76	0.03	0.83	0.95
	2021	0.97	1.08	0.76	0.02	0.86	0.98
	2022	0.97	1.08	0.77	0.04	0.86	0.99

Table 13.2.7. *Nephrops* in FUs 28–29. Results from the application of the Mean Length Z approach.

		Males	Females
<b>Input:</b>			
LFD period		1984-2022	1984-2022
Effort series		1998-2022	1998-2022
Growth			
	Linf =	70	65
	K =	0.2	0.065
	t0 =	-0.15	-0.15
W~L relationship			
	a =	0.00028	0.00056
	b =	3.2229	3.0288
External M		0.3	0.2

Method	Results		
Gedamke & Hoenig	Z =	0.47	0.30
	F* =	0.17	0.10
THoG	q estimate =	0.0015	0.0006
	q estimate* =	0.007	0.003
	M estimate =	0.43	0.26
	F <sub>2022</sub> estimate =	0.010	0.004
	F <sub>2022</sub> estimate* =	0.05	0.02
Y/R	F <sub>MSY</sub> proxy: F <sub>0.1</sub> =	0.23	0.24

\* indicates estimates with external fixed M

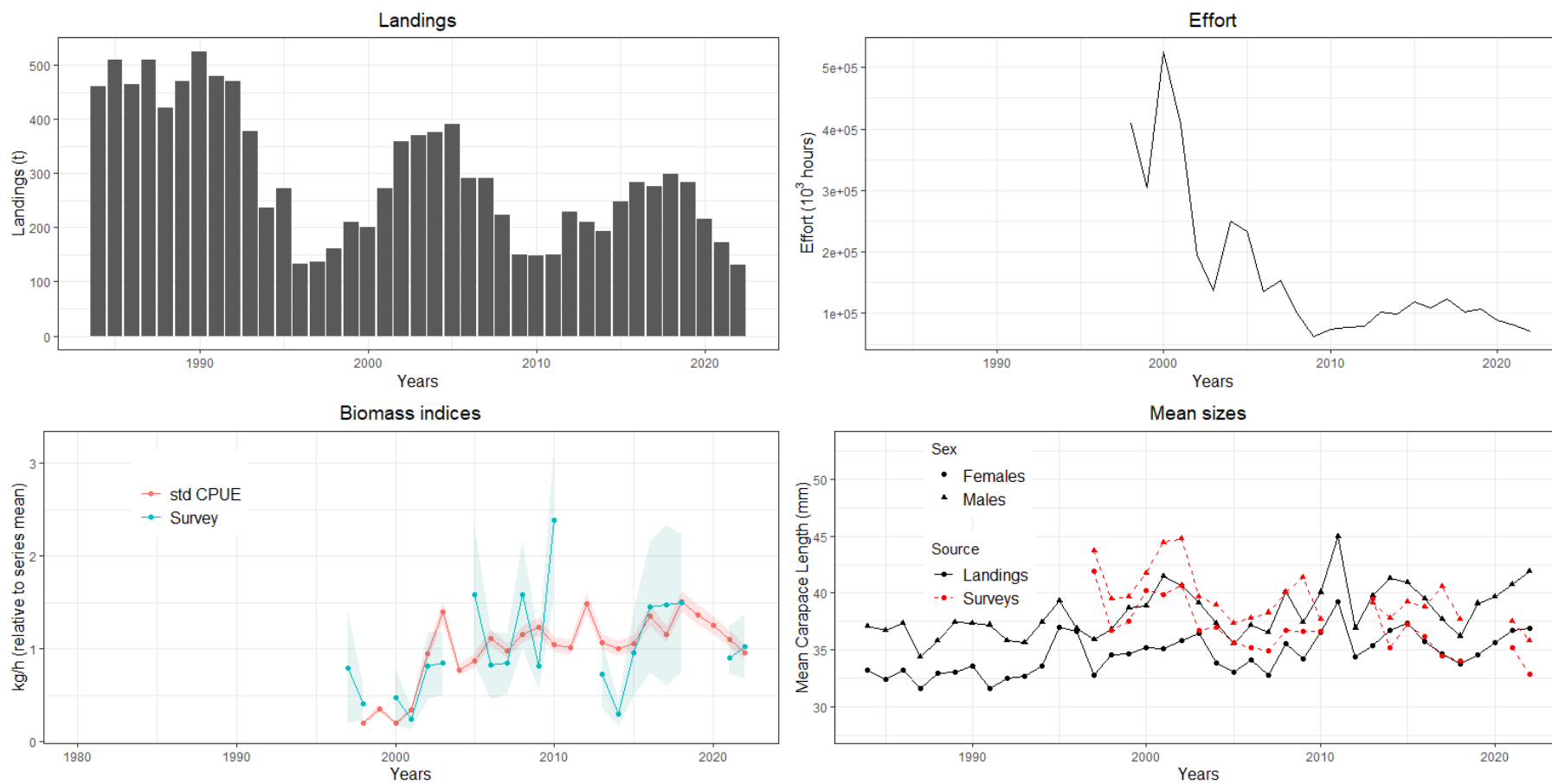
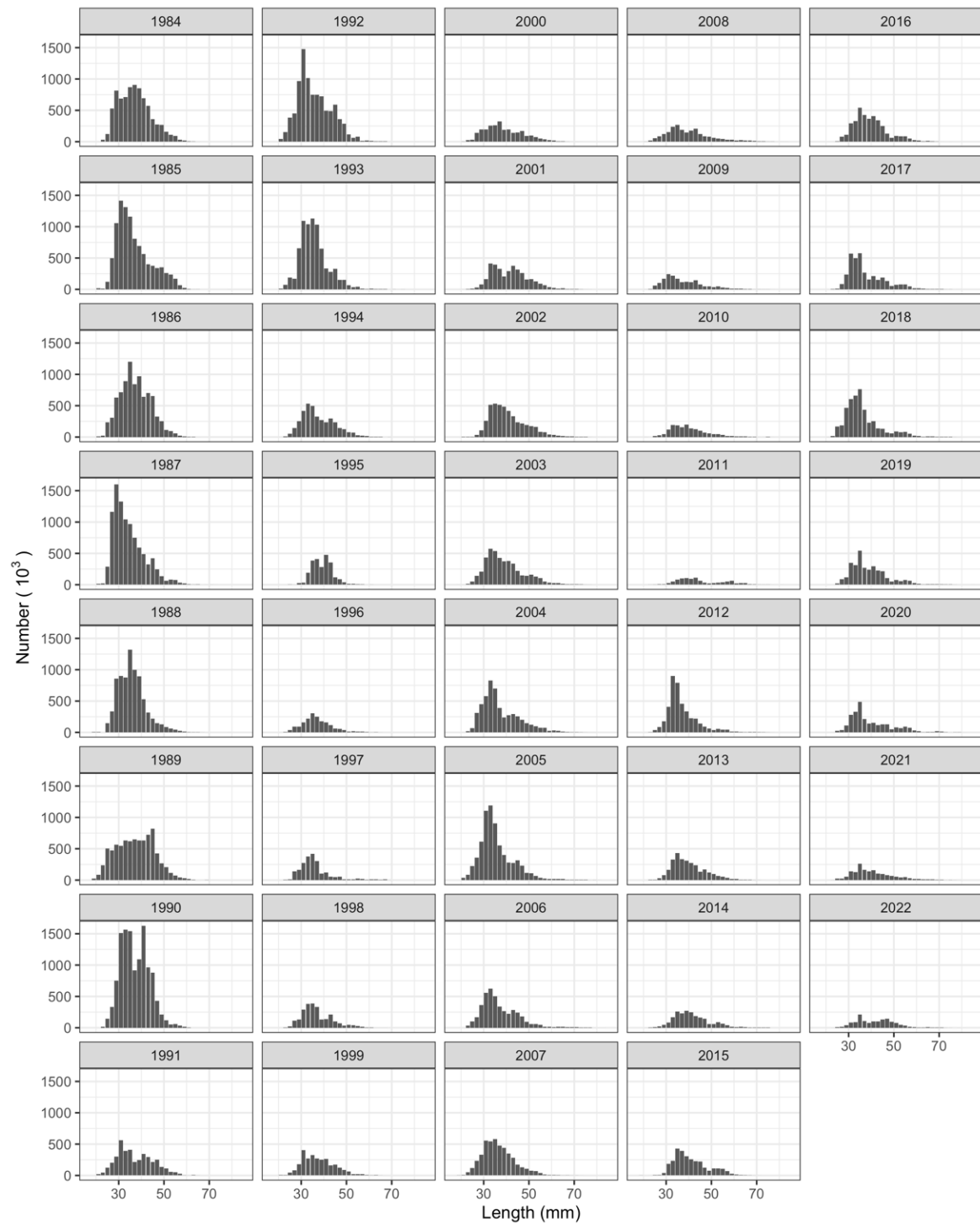


Figure 13.2.1. *Nephrops* in FUs 28–29. Annual landings (top left), effort (top right), biomass indices (bottom left) and mean sizes in Portuguese landings and surveys (bottom right).



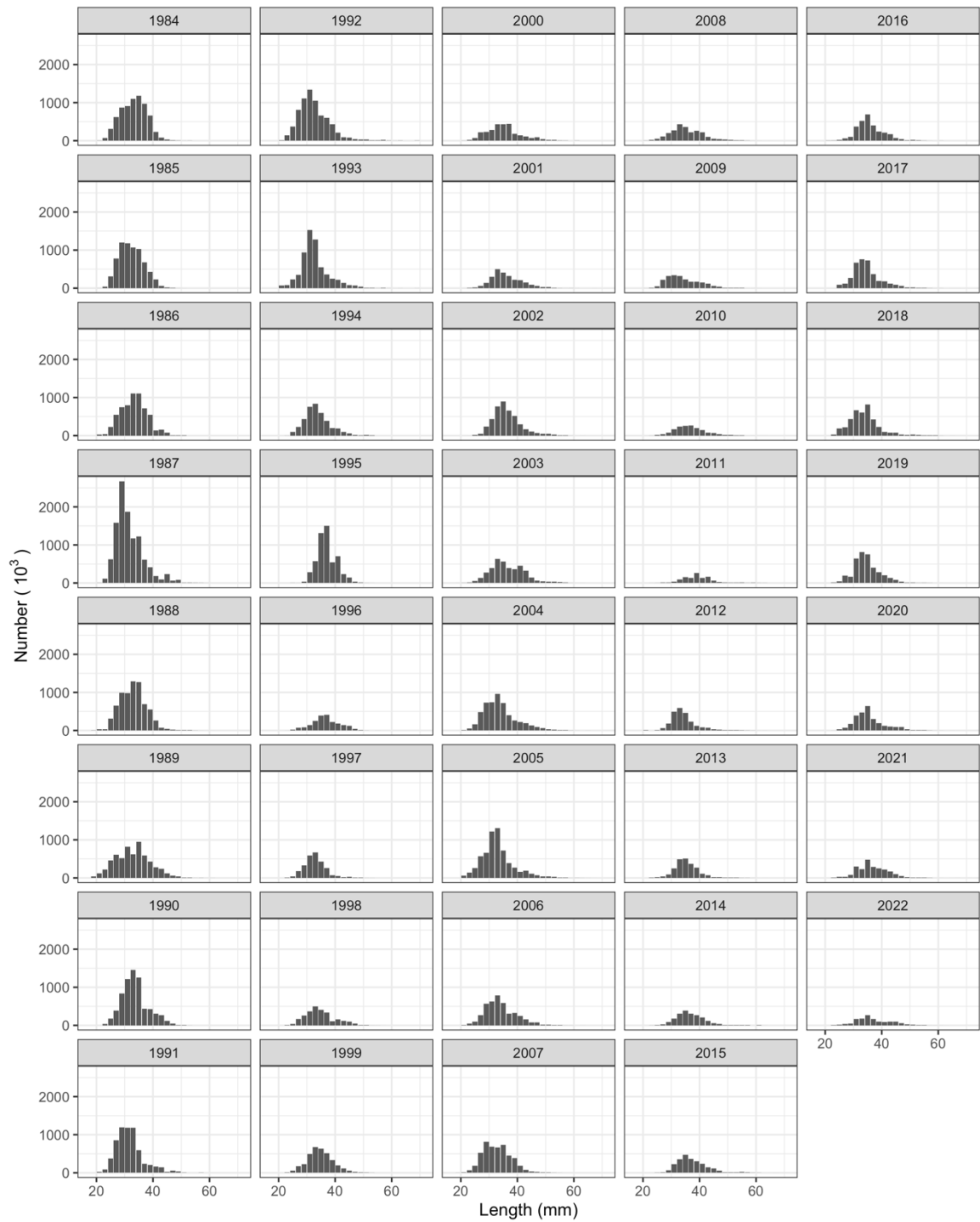


Figure 13.2.2.b. *Nephrops* in FUs 28–29. Females' length distributions for the period 1984–2022.

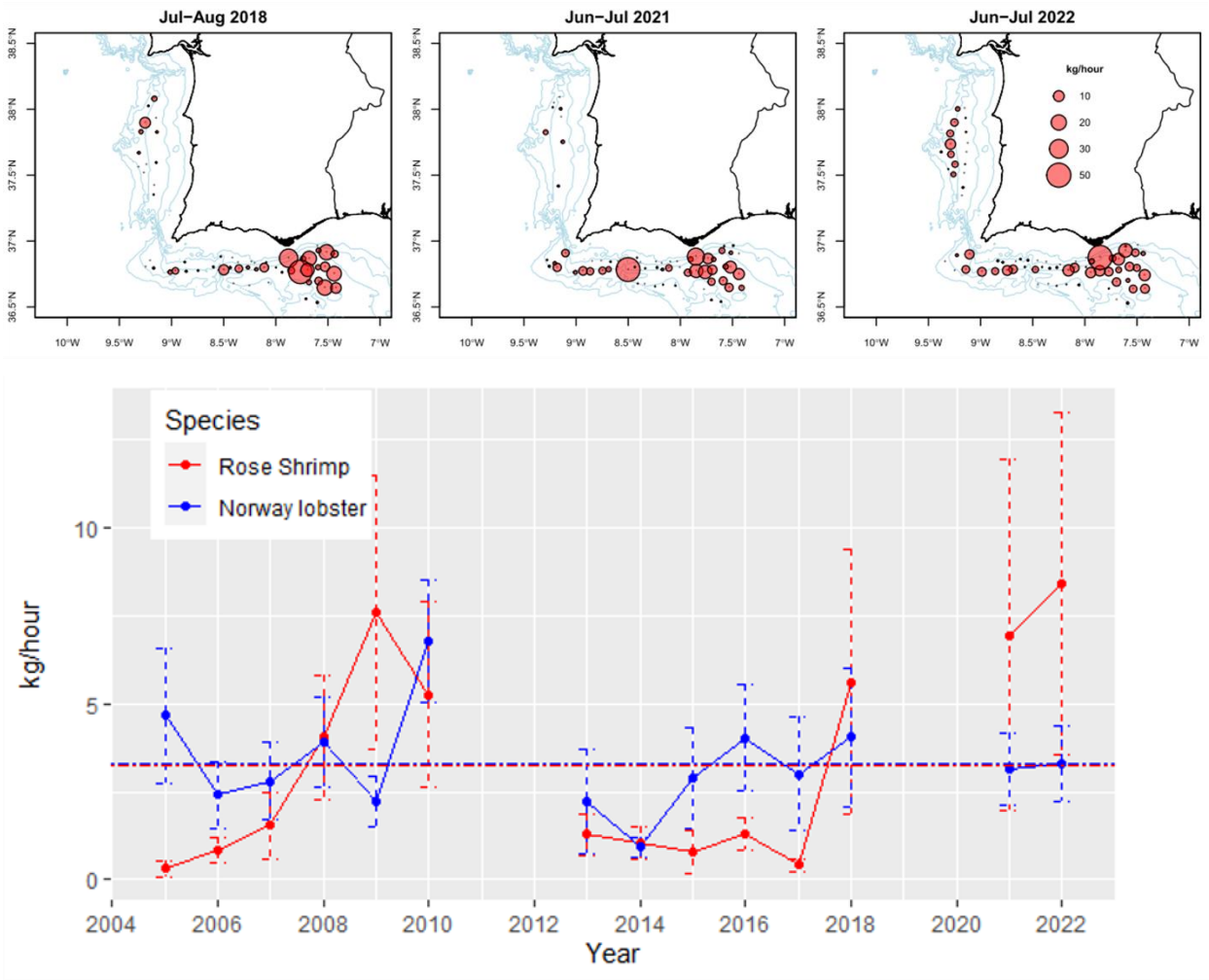


Figure 13.2.3. *Nephrops* in FUs 28–29. Spatial distribution of Norway lobster’s biomass survey index in 2018 and the period 2021–2022 (upper panel). Stratified mean biomass time-series (lower panel) with 95% confidence interval of Norway lobster (blue) and deep-water rose shrimp (red). Notes: (1) the 2021 survey did not cover the whole area; (2) horizontal lines represent the long-term average biomass indices.

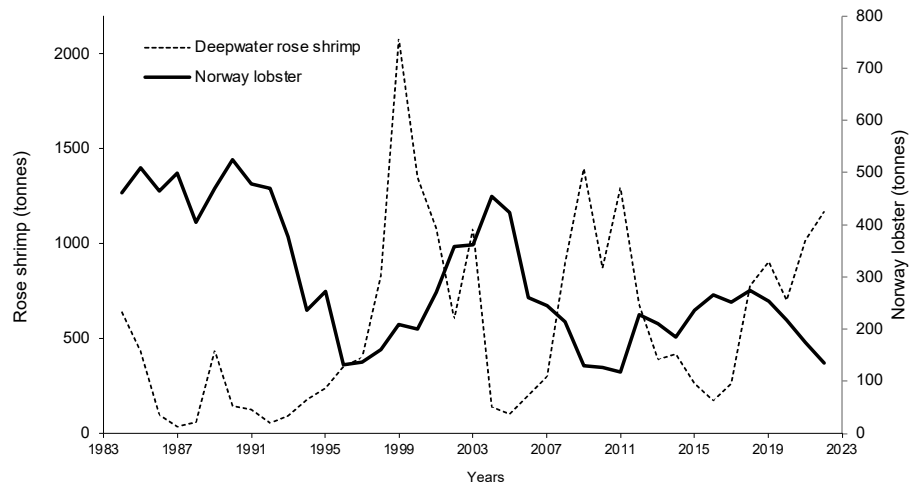


Figure 13.2.4 *Nephrops* in FUs 28–29. Landings (tonnes) of the two main target species of the crustacean fisheries in the period 1984–2022.

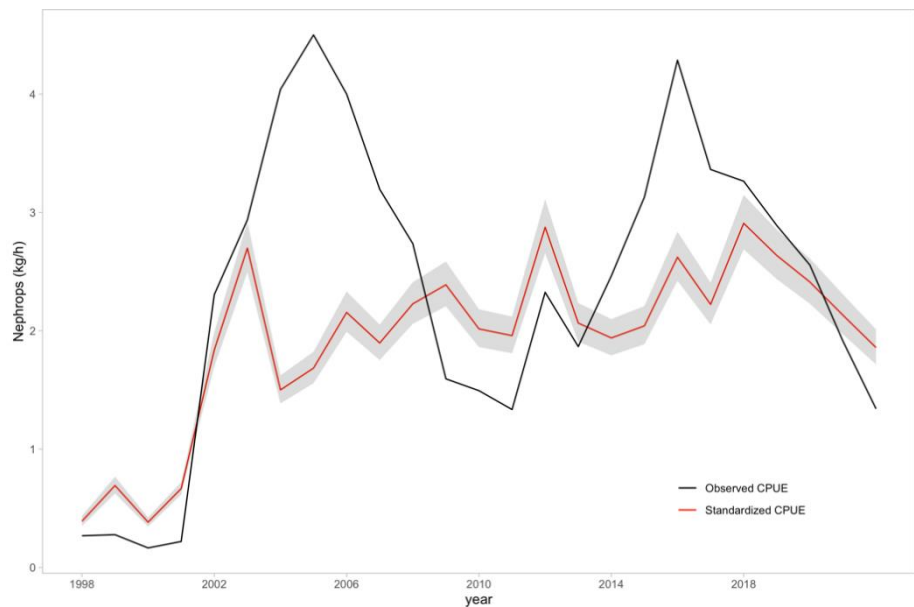


Figure 13.2.5. *Nephrops* in FUs 28–29. Comparison of the observed and standardized *Nephrops* CPUE trends using the standardization model. The shaded area represents the 95% confidence intervals.

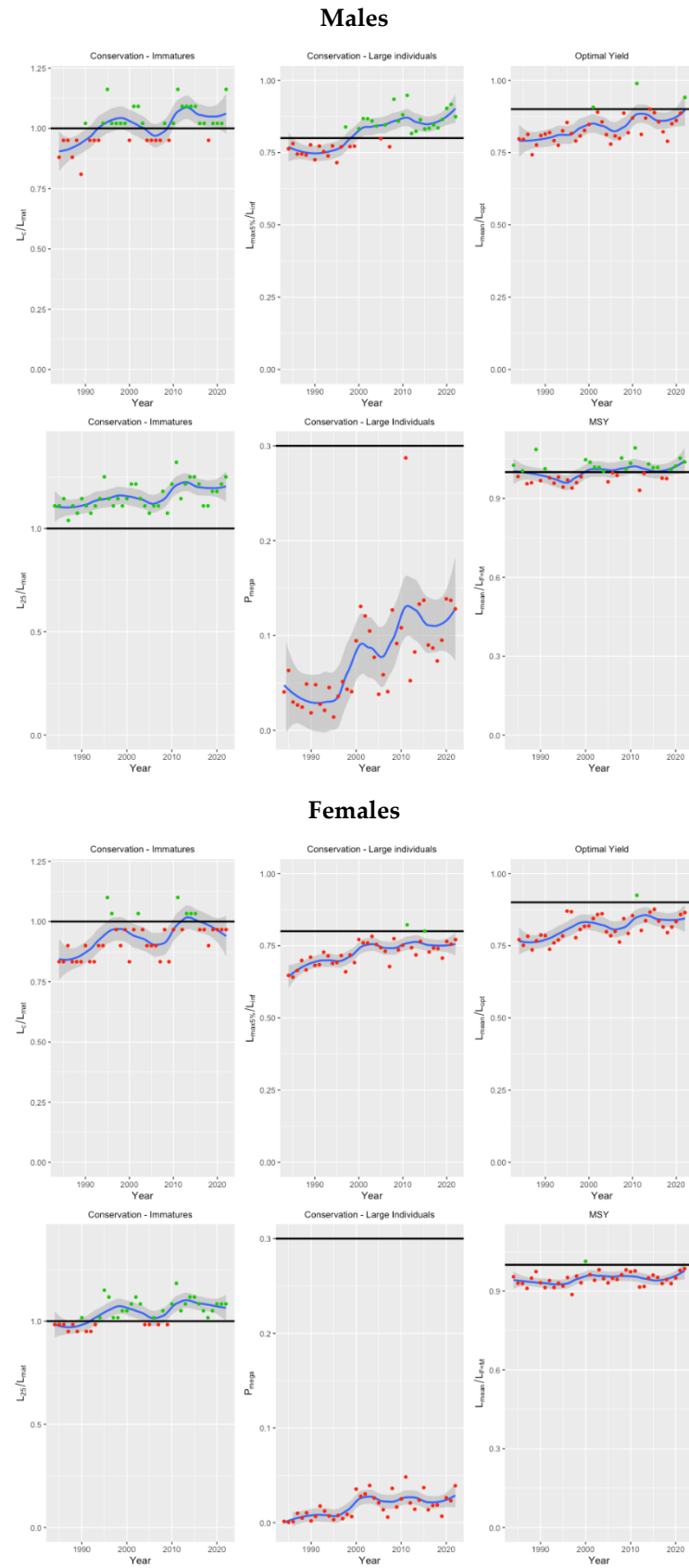


Figure 13.2.6. *Nephrops* in FUs 28–29. Length-based indicator ratios for males (above) and females (below).

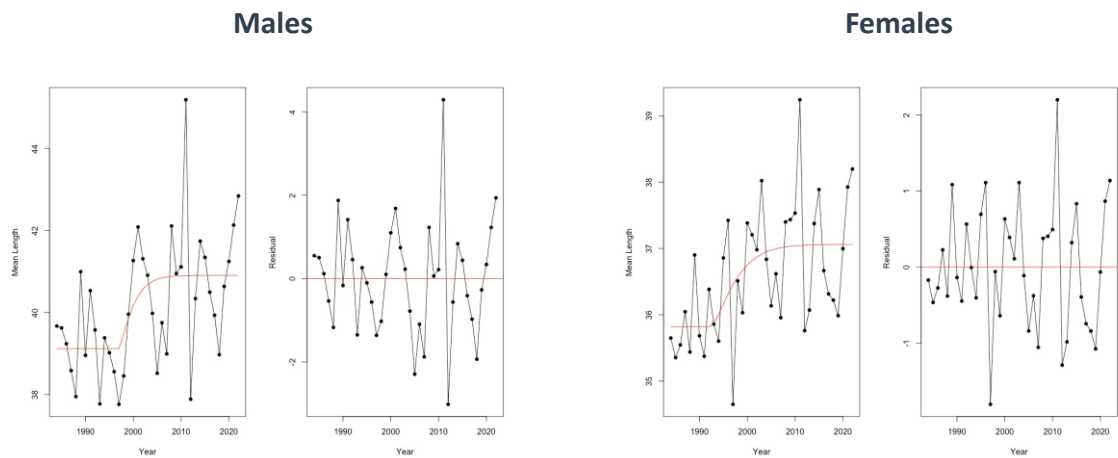


Figure 13.2.7. *Nephrops* in FUs 28–29. Gedamke & Hoenig Mean Length-Z model diagnostics for males (2 graphs on the left side) and females (2 graphs on the right side).

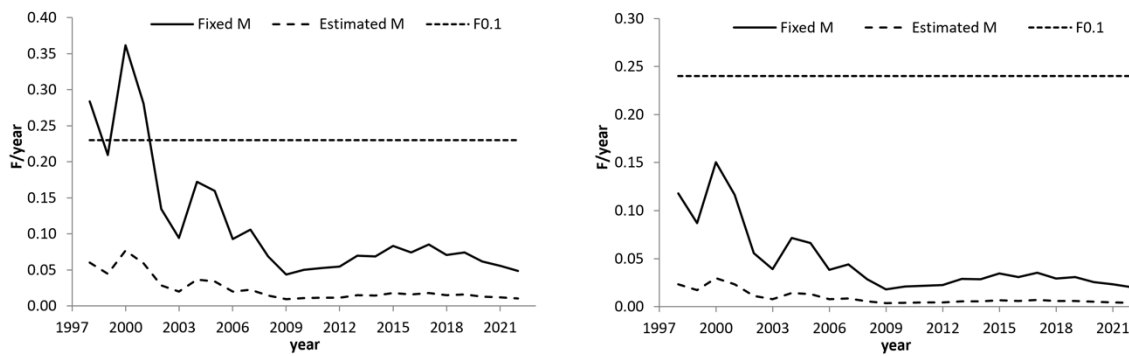


Figure 13.2.8. *Nephrops* in FUs 28–29. Fishing mortality from the THoG model using an external fixed M or an M estimated by the model. Left panel: males, right panel: females.

### 13.3 *Nephrops* in Gulf of Cádiz (FU 30)

*Nephrops* FU 30 was benchmarked by WKNEP in 2016 (ICES, 2017a). A UWTV survey-based approach was considered appropriate to provide scientific advice on the stock abundance in this FU. However, a stock-specific MSY harvest rate could not be derived. The basis of advice for this stock followed a category 3 assessment using the 2-over-3 rule since 2019 (ICES, 2023b). When the stock-specific MSY reference points can be estimated, *Nephrops* FU 30 will meet the requirements for category 1 assessment (ICES, 2023a; b).

#### 13.3.1 General

##### 13.3.1.1 Ecosystem aspects

See Stock Annex.

##### 13.3.1.2 Fishery description

See Stock Annex.

##### 13.3.1.3 ICES advice for 2023 and management applicable for 2022 and 2023

###### ICES Advice for 2023

ICES advises that when the precautionary approach is applied, catches in 2023 should be no more than 32 t.

To ensure that the stock in FU 30 is exploited sustainably, ICES advises that management should be implemented at the FU level (ICES, 2023a; b).

###### Management applicable for 2022 and 2023

The European Parliament and the Council have published a multiannual management plan (MAP) for the Western Waters (EU, 2019a). This plan applies to demersal stocks including *Nephrops* in FU 30.

An increase of mesh size to 55 mm was established since September 2009 (Orden ARM/2515/2009) for the bottom trawl fleet.

The TAC for the whole Division 9.a was set at 355 and 298 t for 2022 and 2023, respectively, of which no catch is allowed in FUs 26 and 27. In FU 30, no more than 50 and 32 t can be taken in 2022 and 2023, respectively.

A modification of the Fishing Plan for the Gulf of Cádiz was established in 2014 (AAA/1710/2014). This regulation established an assignment of *Nephrops* quotas by vessel. A closed season in autumn for the bottom trawl fleet of the Gulf of Cádiz is implemented since 2004. Since 2018, this closed season is from 16 September to 31 October (APM/453/2018) annually.

#### 13.3.2 Data

##### 13.3.2.1 Commercial catch and discard

Landings in this FU are reported by Spain, and in minor quantities, by Portugal. Spanish landings are based on sales notes which are compiled and standardized by IEO-CISC. Since 2013, trips from sales notes are also combined with their respective logbooks, which allow georeferencing the catches.

The total landings have been estimated by this WG since 2016 when the concurrent sampling was satisfactorily implemented. The Spanish concurrent sampling is used to raise the FU 30 observed landings to total effort by *métier*. When the estimated landings exceed the official landings, the difference is provided to InterCatch as non-reported landings.

Since the WGHMM meeting in 2010 (ICES, 2010), *Nephrops* landings in Ayamonte port were incorporated in the Gulf of Cádiz landings time-series as well as directed effort and LPUE from 2002 (Table 13.3.1 and Table 13.3.5). *Nephrops* total landings in FU 30 decreased from 108 t in 1994 to 49 t in 1996. After that, there has been an increasing trend, reaching 307 t in 2003 but sharply declined to 147 t in 2004, which is more than a 50% drop. After a new increase in 2005 (246 t), landings declined up to 120 t in 2008. In 2008–2012, landings remained relatively stable at around 100 t. Landings declined again in 2013–2015 up to a mean value of 22 t. Since the quota in 2012 was exceeded, the European Commission applied a sanction to be paid within 3 years, 2013–2015 (Figure 13.3.1). The TAC advice was reduced, limiting the fishery, during this 3-year period. Moreover, the *Nephrops* fishery was closed in 2013 and vessels could only go *Nephrops* fishing for only a few days during summer and winter (ICES, 2017a). Total estimated landings increased in 2016 and 2017 (124 and 140 t, respectively), representing almost six times the landings observed in 2013–2015. Landings estimation was 75 t in 2018, representing 46% less than the previous year (Figure 13.3.1). Landings show a declining trend since that year. In 2022, landings were 44 t, representing 68% less than in 2017 when landings recorded were higher than 100 t. Total landings estimates since 2016 are considered the best information available.

A modification of the regulation implemented for the Spanish Administration for the Gulf of Cádiz grounds in 2014 (Orden AAA/1710/2014) established the assignment of *Nephrops* quotas by vessel. This regulation may have caused unreported *Nephrops* landings in the period 2016–2018. The highest value of non-reported landings was recorded in 2017. In 2019, the non-reported landings were lower than 10% of the official landings and were considered zero. Non-reported landings were not recorded since 2019.

Information on discards is submitted to the WG through InterCatch. The discard rate of *Nephrops* in this fishery fluctuates annually but is always very low, if not zero. Thus, discards are considered negligible (Table 13.3.2). The discard sampling program in 2020 was suspended partially as a result of the COVID-19 disruptions and administrative issues. Therefore, no information on *Nephrops* discards was obtained for that year. In 2022, the percentage of discards remains low but it was 3.3% higher in weight and 27.2% higher in number. The number of individuals, mainly of very small-sized ones, discarded increased significantly. The mean size of the discarded fraction was 15.6 mm CL, the lowest value recorded in the whole time series (Table 13.3.2 and Figure 13.3.2). The highest mean carapace length of the discarded fraction was observed in 2017 (24.2 mm CL). Discards in 2022 were estimated at 0.82 t. Figure 13.3.2 shows the estimated length–frequency distributions (LFDs) of the discarded and retained *Nephrops* per trip for the annual discarding programme (2005–2022).

### 13.3.2.2 Biological sampling

The species sampling level is given in Table 1.4. Figure 13.3.3 shows the annual landings length distribution for males, females and both sexes combined during the period 2001–2022. The length composition of landings was considered biased from 2001 to 2005 since the landings sampling was not stratified by commercial categories (Silva *et al.*, 2006). A new sampling scheme was applied from 2006 to 2008, making information more reliable (Stock Annex). The mean sizes for both sexes remained relatively stable after the sampling scheme was changed, around 29 mm CL for both sexes combined.

Since 2009, onboard concurrent sampling is carried out as required by the Data Collection Framework (DCF; EU, 2007). Outside the *Nephrops* fishing season, a larger proportion of observer trips

are likely not sufficient to cover *Nephrops* catches, whereas, when the directed *Nephrops* sampling was carried out in harbours during the past, the LFDs of landings were covered for all months. This insufficiency of *Nephrops* catches coverage could reduce the consistency of the catch-at-length distribution data. The number of samples between 2013 and 2015 was influenced by the EU sanction in this period coupled with the closure of *Nephrops* fishery in 2013 (ICES, 2017a). The sampling effort has been increasing since summer of 2016 as a result of the additional *Nephrops*-directed sampling to improve the quality of the commercial LFDs. In 2019, the sampling level decreased in the third quarter and was zero during the fourth quarter. This fact could have had some impact on the annual estimation of the sex ratio, the mean length and the mean weight in landings. Summer is the main *Nephrops* fishing season, when females are out from their burrows for reproduction thus, making them more accessible to the fishery. Therefore, sex ratio and mean weight might be affected by the sampling effort distribution along the year.

Onboard sampling was partially conducted in 2020 because of the COVID-19 disruptions and administrative issues. Only one *Nephrops* sampling survey was carried out in the third quarter of 2020, but it was not considered representative of the stock size composition. In order to estimate the landings size composition in 2020, the average LFDs of the last three years (2017–2019) was used to raise and estimate the total landings for 2020. The estimated 2020 total annual landings in number was used to estimate the harvest rate (%) for that year and, consequently, could have certain impacts on the stock assessment in 2021 (ICES, 2021a). During the WGBIE in 2023, a revision of the 2020 landings size composition was estimated using the information available in the years 2018, 2019 and 2021. Results obtained are more realistic as the 2017 size compositions that were previously used differ significantly from the recent years' values used. The sampling levels in 2021 and 2022 were slightly lower compared from previous values mainly due to the COVID-19 disruptions in 2020. However, the main issue remains regarding the incomplete coverage of all the quarters samplings such that the second quarter in 2021 was not sampled while the fourth one is missing in 2022.

Mean sizes of males and females (mm CL) in the *Nephrops* landings time series (2001–2022) are shown in Figure 13.3.1. The mean sizes show a slightly increasing trend from 2006 to 2013 (35.3 and 31.9 mm CL for males and females, respectively). In 2014 and 2015, the mean size in females was higher than for males, the opposite of what should be expected and as was observed in previous years. It could be as a result of sampling problems. This fact was investigated in collaboration with the observers. The number of samples and the number of individuals sampled were low in both years. This sample paucity could distort the sex ratio and the mean size in both sexes. The LFDs in both sexes improved since 2016 when additional *Nephrops*-directed samplings were implemented. However, in the last two years, these *Nephrops*-directed samplings decreased. The mean sizes for both sexes (32.0 and 30 mm CL for males and females, respectively) remained relatively stable for the period 2016–2018. The LFD shows an increase of small-sized individuals in 2017 and 2018 (see Figure 13.3.3). The mean sizes for both sexes fluctuated from 2019 onwards despite a slightly increasing trend. In 2022, mean sizes decreased for both sexes compared to the previous year but especially for males, 34.4 mm CL, while is at 33.0 mm CL for females.

The proportion of males in the sex ratio of the landings is shown in Figure 13.3.4. The proportion of males remained stable, around 50% since 2009, despite an increase observed in 2017 and 2019 (representing 60% and 65% of the landings, respectively). Nevertheless, the increases observed during these two years might be influenced by the low sampling level during the third quarter. Females, on the other hand, are more accessible to the fishing gear in summer (the main *Nephrops* fishing season) when they are out of their burrows for reproduction. In 2020, the sex ratio was estimated from the average LFDs from the years 2018, 2019 and 2021 because the sampling was not conducted due to the COVID-19 disruptions and administrative issues. In 2022, the proportion of males in the landings decreased to about 10%.

### 13.3.2.3 Mean weight in landings

The mean weights in landings are shown, for the whole time-series, in Figure 13.3.5. Since 2009, an increasing trend of the mean weight was observed. In 2013, it declined but remained stable at about 31 g until 2015 (period affected by the 2013 sanction and rebatement in TAC limitation for 3 years). In 2016, a decline in the landings' mean weight was observed again then remained stable in 2017 and 2018, reaching a mean value of 23.4 g during these last three years. The mean weight increased up to 32.4 g in 2019. The low level of sampling when females are more accessible to the *Nephrops* fishery could have caused an increment in the mean weight of the annual landings as males tend to be larger and heavier than females. Mean weight in 2020 (29.2 g) has been estimated from the average LFD from the years 2018, 2019 and 2021 as a consequence of the pandemic and administrative problems explained before. The mean weight in landings was 39.2 g in 2021 while in 2022, a decrease was observed and it was estimated at 30.7 g.

### 13.3.2.4 Abundance indices from surveys

#### Trawl surveys

The biomass and the abundance indices time-series (1993–2022) of *Nephrops* by depth strata, estimated from the Spanish Gulf of Cádiz IBTS-Q1 (G7511) are shown in Table 13.3.3. No survey was conducted in 2021 due to some administrative and technical issues with the vessel encountered that year.

The overall abundance index trend decreased from 1993 to 1998 and remained stable from 1999 to 2009 despite the occurrence of strong fluctuations in some years. In 2003, the survey was not conducted due administrative issues. The lowest values in the time-series were recorded in 2004 and 2012. In 2010, the deeper strata (500–700 m) were not sampled as a result of a reduction in the number of days at sea as a consequence of adverse weather conditions. Therefore, only the abundance index for the 200–500 m strata is available for 2010 and its value is similar to the corresponding strata in previous years. The abundance index increased significantly in 2013 and 2014 (Table.13.3.3). The survey index has fluctuated since 2015 then declined in 2017 and 2018. Results in 2019 and 2020, showed an increasing trend reaching the highest value recorded in 2020 for the whole time series (Figure 13.3.6). In 2022, survey index dropped at the same level as that of 2011. It should be noted that this survey is not specifically directed to *Nephrops* and is not carried out during the main *Nephrops* fishing season. In addition, *Nephrops* spatial distribution and density are strongly related to the substratum such that the stock's abundance index might differ depending on the allocation of the hauls within the strata.

The length distributions of *Nephrops* obtained in the Spanish Gulf of Cádiz IBTS-Q1 (G7511) during the period 2001–2022 are presented in Figure 13.3.7. As previously indicated, no survey was conducted in 2021. An increase of smaller individuals was observed in 2015 and 2016. The mean size for both sexes increased in 2017 while remaining relatively stable in 2018 and 2019 (~36 mm CL in males and ~30 mm CL in females). In 2020, the mean size decreased to 33.9 mm CL in males while remained stable at around 30 mm CL in females. However, the mean size in males increased but declined in females in the last year (38.1 and 27.5 mm CL for males and females, respectively). This is the lowest mean size recorded for females in the time series. The time-series for the *Nephrops*' mean sizes by sex that were obtained from this survey is shown in Figure 13.3.8. No apparent trends are observed. The mean size ranged between 27.5 and 32.7 mm CL for females while 31.9 and 42.9 mm CL for males.

#### UWTV surveys

An exploratory *Nephrops* UWTV survey on the Gulf of Cádiz fishing grounds, also known as the ISUNEP-CA UWTV (U9111) survey, was carried out within a project framework supported by Biodiversity Foundation (Spanish Ministry of Agriculture, Food and Environment) and

European Fisheries Fund (EFF) in 2014 (Vila *et al.*, 2014). This survey was initially considered exploratory in 2014 and, currently, data from seven UWTW surveys are available (2015 to 2022). UWTW survey was not conducted in 2020 as a result of the COVID-19 disruptions.

The ISUNEPCA UWTW (U9111) surveys are based on a randomized isometric grid design with stations spaced by 4 nm. The methods used during the surveys are according to WKNEPHTV (ICES, 2007), WKNEPHBID (ICES, 2008), and SGNEPS (ICES, 2012) and WGNPS (ICES, 2020b, 2021b). A description of the ISUNEPCA UWTW (U9111) surveys carried out in FU 30 since 2014 is documented in the Stock Annex.

Results from the ISUNEPCA UWTW (U9111) surveys were evaluated during the WKNEP benchmark workshop on *Nephrops* stocks in 2016 (ICES, 2017a). During this workshop, it was concluded that this survey in FU 30 is appropriate for providing scientific advice on stock abundance.

Data compiled during ISUNEPCA UWTW (U9111) survey series (2015-2021) suggested that the previously sampled survey area was probably not adequate as surface size than what should be considered for the evaluation of this stock. Therefore, it was concluded that a review and revision of the survey area should be carried out because it could directly affect the *Nephrops* abundance estimate and, as a consequence, the scientific advice. According to SGNEPS, the boundary definition of the survey area should also be assessed on a regular basis (ICES, 2012). In this sense, a new area for the ISUNEPCA UWTW (U9111) survey was proposed last year since nowadays new and more accurate information is available. A working document explaining details about the re-definition of the survey area was presented in advance to WGBIE in 2022 (Vila and Burgos, 2022) for the WG to recommend a review by external experts to evaluate the validity of the revised sampling area for the ISUNEPCA UWTW (U9111) survey in 2022, following the WGNPS recommendation in 2021 (ICES, 2022c).

The *Nephrops* fishing activity was analysed using the Andalusia Regional Government vessel monitoring system, called SLSEPA (“Sistema de Localización y Seguimiento de embarcaciones Pesqueras Andaluzas”) and sales notes in 2019. SLSEPA is a special vessel monitoring system on vessels using GPRS/GSM, a cellular network technology that sends the vessel exact position and speed data every three minutes instead of the usual two-hour transmitted data obtained from a traditional VMS. Additionally, information obtained from the bottom trawl surveys (SpSGFS-cspr-WIBTS-Q1 (G7511) and SpGFS-caut-WIBTS-Q4 (G4309)) indices time-series for the period 1994–2020 and the beam trawl and sediment samples from the ISUNEPCA UWTW survey (U9111) from 2017 to 2019 which are coupled with a more detailed and recent information on seabed morphology and the sediment-habitat relationships in the Gulf of Cádiz (Lozano *et al.*, 2019; Lozano *et al.*, 2020; Urra *et al.*, 2021) were also used to redefine the survey area in FU 30 (ICES, 2022b; c).

**The new surface area coverage considered after the WGNPS (ICES, 2022c) in 2021 is 2 332.13 Km<sup>2</sup>, representing approximately 20% less than the previous survey area. The kriged density estimates for the ISUNEPCA UWTW (U9111) survey and the geostatistical abundance of burrows were updated for the whole of the time series based on the new defined area before October 2022, when the advice for this stock was released. ns Not survey**

**\*\* Strata not sampled**

Na abundance and biomass not available

Table 13.3.4 shows the results of the updated geostatistical analysis based on the redefined survey area. In 2022, the number of stations considered for the estimation of a new geostatistical abundance is lower due to the reduction of the surveyed area. A sampling grid with a 3.5 nm stations-spacing was agreed and was first implemented in the ISUNEPCA UWTW (U9111) survey in 2022 and will now be used annually instead of the 4 nm spacing previously used in the time-series to estimate the abundance (ICES, 2021a). The revision of the distance between stations was made in order to increase the number of stations for the geostatistical analysis.

The highest mean burrow density (adjusted to the cumulative bias) was obtained in 2017. This value slightly decreased in 2018 and has declined considerably from 2019 to 2021. Mean burrow density in 2022 decreased slightly compared to the previous year, reaching the lowest value of the time-series (ns Not survey)

**\*\* Strata not sampled**

Na abundance and biomass not available

Table 13.3.4).

Abundance estimates obtained after the survey area re-definition in 2015 and 2016 were lower than before the surface area revision (17% and 10% less, respectively) but were higher in 2017 and 2018 (3% and 13% more, respectively) (ns Not survey)

**\*\* Strata not sampled**

Na abundance and biomass not available

Table 13.3.4). The new abundance estimates in 2019 and 2021 were 3% and 9% lower, respectively, than those estimated before the survey area. Nevertheless, despite the change in abundance values due to the surface area revision, the general trend observed is similar to that of the previous time series (ICES, 2022b). The updated model of density surfaces for the all the time-series (2020 unavailable) using the revised survey area is shown as heat maps and bubble plots in **Error! Reference source not found.9**.

The updated abundance estimate derived from the kriged burrow surface (and adjusted for the cumulative bias) increased from 249 in 2015 to 383 million burrows in 2017 but with a lower value recorded in 2016 (209 million burrows). In 2018, the new geostatistical abundance estimate (370 million burrows) was slightly lower than the previous year. However, the heat map of the abundance estimates in the main patch within the *Nephrops* distribution area where the commercial bottom-trawl fishery operates, shows an increase value compared to 2017. The geostatistical abundance estimate shows a decreasing trend since 2019 (110 million burrows) which was 50% less than in 2021 (66 million burrows). The abundance in 2022 was estimated at 53 million burrows. The ISUNEP-CA UWTU (U9111) survey in 2020 could not be conducted as a result of the COVID-19 pandemic.

The coefficient of variation of the updated time-series was in general higher than the previous series (ICES, 2022b). Values ranged between 6.7% in 2018 and 12.1% in 2016 (ns Not survey)

**\*\* Strata not sampled**

Na abundance and biomass not available

Table 13.3.4), although always below of the 20% threshold established by the WGNPS (ICES, 2012).

### 13.3.2.5 Commercial catch and effort data

Figure 13.3.1 and Table 13.3.5 show directed *Nephrops* effort estimates and LPUE series revised after the incorporation of data from Ayamonte port since 2002. Directed effort is estimated from trips that land at least 10% of *Nephrops*. The directed fishing effort trend is clearly increasing from 1994 to 2005, where the highest value of the time-series was recorded (4 336 fishing days). After that, the effort declined up to 2008 (73%) remaining relatively stable during the 2009–2012 period. As a consequence of the sanction in 2012 (referred in section 13.3.2.1), the effort dropped (mean value 283 fishing days) in 2013–2015. Fishing effort increased from 2016 (443 fishing days) to 2019 (675 fishing days), remaining relatively stable at around 600 fishing days in 2020 and 2021. In 2022, *Nephrops* directed effort decreased by 63% in relation to the previous year (Figure 13.3.1).

The commercial LPUE obtained from the directed effort shows a gradual decrease from 1994 to 1998 followed by a slight increase from 1999 until 2003. This dropped again in 2004 to a low value of 44.3 Kg/fishing day. In general, the commercial LPUE has fluctuated during the time-series (Figure 13.3.1). During the last period, the commercial abundance index has declined since 2019 reaching the estimated value of 48.7 Kg/fishing day in 2021. However, directed LPUE slightly increased to 54.4 Kg/fishing day in 2022.

It should be noted that the commercial LPUE for the period 2013–2015 must be taken with caution as during this period a penalty for exceeding the quota in 2012 was applied, which increases the uncertainty associated with the LPUE index. Moreover, the assignment of *Nephrops* quotas by vessel implemented in 2014 might have caused unreported landings and contributed to increasing the uncertainties around the commercial LPUE index estimated since then. On the other hand, the commercial LPUE index was estimated using the official (reported) and not the total landings estimated by the WG since 2016. This factor might contribute to an increase of the commercial LPUE abundance index uncertainty.

13.3.3 Assessment

This *Nephrops* stock was benchmarked in October 2016 (ICES, 2017a). The assessment is based on the ISUNEPCA UWTW (U9111) survey trends according to a category 3 stocks (ICES, 2022a; 2023b).

13.3.4 Catch options

The prediction of landings for the FU 30, using the procedure agreed upon at WKNEP in 2016 (ICES, 2017a) and outlined in the Stock Annex, is usually made on the basis of the ISUNEPCA UWTW (U9111) survey estimated abundance obtained in the advice year and is presented in October for the provision of advice (ICES, 2023a). The 2023 ISUNEPCA UWTW (U9111) survey is scheduled from 31 May to 12 June. The input table for the catch options to provide advice for 2023 is given below and Figure 13.3.6.:

Variable	Value	Source	Notes
Stock abundance	available in October	ICES (2023a)	UWTW survey 2023
Mean weight in landings	33.1 g	ICES (2023a)	Average 2020-2022
Mean weight in discards	-	ICES (2023a)	Not relevant
Discard proportion	0%	ICES (2023a)	Negligible
Discard survival rate	-	ICES (2023a)	Not relevant
Dead discard rate	0%	ICES (2023a)	Negligible

13.3.5 Biological reference points

$F_{MSY}$  proxy ( $F_{0.1}$ ) derived from the Separable Cohort Analysis (SCA; Pope and Shepherd, 1982) model during the WKNEP in 2016 (ICES, 2017a), corresponds to a harvest rate (HR) of 9.5% but this resulted in a much higher catch advice than the historical values observed. WKNEP 2016 decided to derive the HR from historical catches of this stock and the exploitation in similar stocks as an interim solution until a more consolidated basis for generating an advice from ISUNEPCA UWTW (U9111) survey abundance estimates can be developed (ICES, 2017a). Taking into account the history of the fishery in *Nephrops* FU 30, HR was estimated to range between 1.5% in 2010–2012 and 4% in 2003 when landings reached the highest value for the whole time series. The TACs for the period 2013–2015 were not considered since these limited the fishery as a consequence of the penalty applied for exceeding the TAC in 2012. Thus, in 2016 the WKNEP recommended setting an initial  $F_{MSY}$  proxy to 4% and moving gradually towards this level despite the absence of a current transition scheme definition. As the ISUNEPCA UWTW (U9111) survey was just recently implemented in the FU 30 during WKNEP 2016, caution was recommended in the definition of the transition scheme towards  $F_{MSY}$  proxy (ICES, 2017a).

WKNEP (ICES, 2017a) in 2016 also recommended a new EG that will examine the estimation methodology for all *Nephrops* reference points with focus on natural mortality (M) and growth.

The ADGNEP agreed in October 2017 that in the absence of a stock-specific MSY HR, normally used for calculating the  $F_{MSY}$  for category 1 *Nephrops* stocks (ICES, 2023a; b), *Nephrops* in FU 30 should follow the category 4 approach as the basis of advice for this stock (ICES, 2023a) due to the poor fits in length–frequency model analyses. ADGNEP recommended that once the stock-specific MSY reference points can be estimated, *Nephrops* in FU 30 will meet the requirements for a category 1 stock assessment.

The WGBIE in 2017 supported the proposal of a specific intersessional workshop before the 2018 WGBIE meeting (ICES, 2017b). Unfortunately, the WK*Nephrops* was only finally held in November 2019 (ICES, 2020c). Different assessment models were applied and explored for this stock during the WK*Nephrops* workshop. Some of them are methods developed for data-limited stocks (DLS) such as the Length-Based Indicators (LBIs) or Mean Length-Z (MLZ) based on the WKLIFE V (ICES, 2015) workshop were implemented while the Separable Cohort Analysis (SCA R package version 1.2.0; Bell, 2019) and Separable Length Cohort Analysis (Leocádio *et al.*, 2018; SLCA–*nepref* R package version 0.2.2; Dobby, 2019;) were used for calculating MSY Reference Points for Category 1 *Nephrops* stocks. The SCA model gave estimates for the *Nephrops* in FU 30 stock far below those estimated based on the ISUNEPCA UWTV (U9111) survey. Factors as the uncertainties around M and growth parameters can affect the shape of the catch-at-length distribution and can produce different magnitudes of stock abundance. On the other hand, the abundance from the ISUNEPCA UWTV (U9111) input value in the model for FU 30 seems to be very sensitive, where lower survey inputs resulted in a model with a better fit. Some exploratory runs were carried out using SLCA but the resulting HRs were also very high (ICES, 2020c).

To conclude, the MSY reference point could not be properly derived for FU 30 during the WK*Nephrops* in 2019 (ICES, 2020c). Other methods need to be explored in order to obtain specific FU 30 MSY reference points and upgrade this *Nephrops* stock to category 1. Nevertheless, methods as SCA or SLCA should be tested again since the UWTV survey area and the geo-statistical abundance of *Nephrops* burrows was updated last year.

Estimates from LBIs and MLZ methods as defined in WKLIFE-V (ICES, 2015) and WKProxy (ICES, 2016) are used for category 3 stocks. These estimates were updated during this WGBIE for *Nephrops* in FU 30.

From length-based analysis of the period 2009–2022, LBI results indicate that the fishing mortality (F) is above the MSY indicator in males while below in females (Table 13.3.7). The MLZ model results show the values of  $F_{0.1}$  as proxies of  $F_{MSY}$  are 0.23 for males and 0.24 for females. According to these models, the stock is being fished in different ways for males and females in relation to the reference point (Figure 13.3.11). Males are fished above the  $F_{MSY}$  and females below the  $F_{MSY}$ . No proxy for  $B_{MSY}$  was identified. However, reference points resulting from the application of these methods are only indicative. In stocks assessed using the ISUNEPCA UWTV (U9111) surveys, the F reference point is expressed as a HR (in percentage).

### 13.3.6 Management considerations

*Nephrops* fishery is taken in mixed bottom-trawl fisheries. Therefore, the harvest control rules (HCRs) applied to other species will affect this stock.

During the WGBIE meeting this year, the WG was informed about the new guidelines for estimating HCRs for categories 2 and 3 stocks (ICES, 2022a). As a category 3 stock, the HCR for this stock...

In 2013 and 2014, the *Nephrops* fishery was closed for most of the year because the quota in 2012 was exceeded and the European Commission applied a sanction to be paid in 3 years (2013–2015).

A Recovery Plan for the Iberian stocks of hake and *Nephrops* was approved in December 2005 (EU, 2005). This recovery plan was based on a precautionary reference point for southern hake. By derogation, a different method for effort management was applied to the Gulf of Cádiz. A multiannual management plan (MAP) for the Western Waters was published by the European Parliament and the Council (EU, 2019a) and repealed the former recovery plan. This multiannual management plan applies to demersal stocks including *Nephrops* in FU 30 in ICES Division 9.a.

Different Fishing Plans for the Gulf of Cádiz have been established by the Spanish Administration since 2004 in order to reduce the fishing effort of the bottom trawl fleet (ORDENES APA/3423/2004, APA/2858/2005, APA/2883/2006, APA/2801/2007, ARM/2515/2009, ARM/58/2010, ARM/2457/2010; AAA/627/2013). These plans established a closed fishing season of 45 days, between September and November, plus an additional 5 days to be selected by the shipowner during the duration of this Plan. The potential effect of the closed seasons on the *Nephrops* population has not been evaluated. Additionally, an increase of the mesh size to 55 mm or more was implemented at the end of 2009 in order to reduce discards of individuals below the minimum landing size (MLS). In 2014, a modification of the last Fishing Plan for the Gulf of Cádiz was established (AAA/1710/2014, modified by AAA/1406/2016). This new regulation established the assignment of *Nephrops* quotas by fishing vessel. The Fishing Plan for the Gulf of Cádiz (APM/453/2018) changes the closed season for the bottom trawl fleet to the period from 16 September to 31 October.

Several regulations were established by the Regional Administration with the aim of distributing the fishing effort throughout the year (Resolutions: 13 February 2008, BOJA nº 40; 16 February 2009, BOJA nº 36; 23 November 2009, BOJA nº 235; 15 October 2010, BOJA nº 209). These regional regulations control the days and time when the Gulf of Cádiz bottom trawl fleet can enter or leave the fishing ports. Although the regulations varied among them, they generally allowed a large flexibility during late spring and summer (e.g. the 2010 Regulation established a continuous period from Monday 3 am to Thursday 9 pm during May–August, that was implemented in 2011) which is the main *Nephrops* fishing season and a more restricted implementation of the regulation during other months. This fishing flexibility during summer might have induced fleets from the ports closer to the *Nephrops* grounds, such as Ayamonte or Isla Cristina, to direct their fishing effort to this species between 2008 and 2011. Currently, this regulation is no longer implemented.

Unwanted catches from *Nephrops* are regulated by the discard plan for the demersal fisheries in southwestern waters for the period 2019–2023 (EU, 2018 replaced by EU, 2019b and later by EU, 2020), under which the *Nephrops* stocks are exempted from the landing obligations if the species has a high survival rates. This exemption applies to all bottom trawl catches of Norway lobster from ICES subareas 8 and 9, with the immediate release of all discards in the area where they were caught.

### 13.3.7 References

- Bell, E. 2019. Separable Length Cohort method (SCA). In Length-based reference point estimation. Presentation to WKNephrops 2019, Lisbon, 25 – 28 November 2019.
- Boletín Oficial de la Junta de Andalucía (BOJA). 2008. Resolución de 13 de febrero de 2008, de la Viceconsejería, por la que se convocan, para el año 2008, ayudas a las Federaciones de Cooperativas Agrarias, a Entidades Representativas del Medio rural Andalúz e Organizaciones Profesionales Agrarias. Consejería de Agricultura y Pesca. 120 p.
- Dobby, H. 2019. nepref: Calculates per recruit reference points for *Nephrops*. R package version 0.2.2.

- EU. 2005. Regulation (EC) No 2166/2005 of 20 December 2005 establishing measures for the recovery of the Southern hake and Norway lobster stocks in the Cantabrian Sea and Western Iberian peninsula and amending Regulation (EC) No 850/98 for the conservation of fishery resources through technical measures for the protection of juveniles of marine organisms (repealed).
- EU. 2007. Regulation (EC) No 1343/2007 of 13 November 2007 amending Regulation (EC) No 1543/2000 establishing a Community framework for the collection and management of the data needed to conduct the common fisheries policy.
- EU. 2018. Regulation (EC) 2018/2033 of 18 October 2018 establishing a discard plan for certain demersal fisheries in South-Western waters for the period 2019–2021.
- EU. 2019a. Regulation (EU) 2019/472 of the European Parliament and of the Council of 19 March 2019 establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. Official Journal of the European Union, L83: 1–17. <http://data.europa.eu/eli/reg/2019/472/oj>
- EU. 2019b. Commission Delegated Regulation (EU) 2019/2237 of 1 October 2019 specifying details of the landing obligation for certain demersal fisheries in south-western waters for the period 2020–2021. Official Journal of the European Union, L336, p. 26–33. [http://data.europa.eu/eli/reg\\_del/2019/2237/oj](http://data.europa.eu/eli/reg_del/2019/2237/oj)
- EU. 2020. Commission Delegated Regulation (EU) 2020/2015 of 21 August 2020 specifying details of the implementation of the landing obligation for certain fisheries in Western Waters for the period 2021–2023. Official Journal of the European Union, L415, p. 22 - 38. [http://data.europa.eu/eli/reg\\_del/2020/2015/oj](http://data.europa.eu/eli/reg_del/2020/2015/oj)
- Gedamke T., Hoenig J.M. 2006. Estimating mortality from mean length data in nonequilibrium situations, with application to the assessment of goosefish. Transactions of the American Fisheries Society, 135: 476–487.
- ICES, 2007. Workshop on the use of UWTV surveys for determining abundance in *Nephrops* stocks throughout European waters. ICES CM 2007/ACFM: 14.
- ICES, 2008. Report of the Workshop and training course on *Nephrops* burrow identification (WKNEPHBID). ICES CM 2008/LRC: 03.
- ICES. 2010. Report of the Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim (WGHMM), 5–11 May 2010, Bilbao, Spain. ICES CM 2010/ACOM: 11, 599 pp.
- ICES. 2012. Report of the Study Group on *Nephrops* Surveys (SGNEPS), 6–8 March 2012, Acona, Italy. ICES CM 2012/SSGESST: 19, 36 pp.
- ICES. 2015. Report of the Fifth Workshop on the Development of Quantitative Assessment Methodologies based on Life-history Traits, Exploitation Characteristics and other Relevant Parameters for Data-limited Stocks (WKLIFE V), 5–9 October 2015, Lisbon, Portugal. ICES CM 2015/ACOM: 56, 157 pp.
- ICES. 2016. Report of the Workshop to consider MSY proxies for stocks in ICES category 3 and 4 stocks in Western Waters (WKProxy), 3–6 November 2015, ICES Headquarters, Copenhagen. ICES CM 2015/ACOM: 61, 183 pp.
- ICES. 2017a. Report of the Benchmark Workshop on *Nephrops* Stocks (WKNEP), 24–28 October 2016, Cádiz, Spain. ICES CM 2016/ACOM: 38.
- ICES. 2017b. Report of the Working Group for the Bay of Biscay and the Iberian waters Ecoregion (WGBIE) 4–11 May 2017 ICES HQ, Cádiz, Spain. ICES CM/ACOM: 12, 552 pp.
- ICES. 2020b. Working Group on *Nephrops* Surveys (WGNEPS; outputs from 2019). ICES Scientific Reports. 2:16. 85pp. <http://doi.org/10.17895/ices.pub.5968>
- ICES. 2020c. Workshop on Methodologies for *Nephrops* Reference Points (WKNephrops; outputs from 2019 meeting). ICES Scientific Reports. 2:3. 106 pp. <http://doi.org/10.17895/ices.pub.5981>

- ICES. 2021a. Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE). ICES Scientific Reports. 3:48. 1101 pp. <https://doi.org/10.17895/ices.pub.8212>
- ICES. 2021b. Working Group on *Nephrops* Surveys (WGNEPS; outputs from 2020). ICES Scientific Reports. 03:36. 114pp. <https://doi.org/10.17895/ices.pub.8041>
- ICES. 2022a ICES technical guidance for harvest control rules and stock assessments for stocks in categories 2 and 3. In Report of ICES Advisory Committee, 2022. ICES Advice 2022, Section 16.4.11. <https://doi.org/10.17895/ices.advice.19801564>
- ICES. 2022b. Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE). ICES Scientific Reports. 4:52. 847 pp. <https://doi.org/10.17895/ices.pub.20068988>.
- ICES. 2022c. Working Group on *Nephrops* Surveys (WGNEPS; outputs from 2021) ICES Scientific Reports. 4:29. 183pp. <https://doi.org/10.17895/ices.pub.19438472>
- ICES. 2023a. Advice on fishing opportunities. In Report of the ICES Advisory Committee. ICES Advice 2023. Section 1.1.1. <https://doi.org/10.17895/ices.advice.22240624>
- ICES. 2023b. ICES Guidance for completing single-stock advice 2023, 64 pp.
- Leocádio, A., Weetman, A., Wieland, K. (Eds). 2018. Using UWTV surveys to assess and advise on *Nephrops* stocks. ICES Cooperative Research Report No. 340. 49 pp. <https://doi.org/10.17895/ices.pub.4370>
- Lozano, P., Rueda, J.L., Gallardo-Núñez, M., Farias, C., Urrea, J., Vila, Y., López-González, N., Palomino, D., Sánchez-Guillamón, O., Vázquez, J.T., Fernández-Salas, L.M., 2019. Habitat distribution and associated biota in different geomorphic features within a fluid venting area of the Gulf of Cádiz (South Western Iberian Peninsula, NE Atlantic Ocean). In: Seafloor Geo-morphology as Benthic habitat. GeoHAB Atlas of Seafloor Geomorphic Features and Benthic Habitats, chapter 52. 2<sup>a</sup> edition. Eds: P. Harris and E. Baker. 10.1016/B978-0-12-814960-7.00052-X.
- Lozano, P., Fernández-Salas, L.M., Hernández-Molina, F., Sánchez-Leal, R.F., Sánchez-Guillamón, O., Palomino, D., Farias, C., Mateo-Ramírez, A., López-González, N., García, M., Vázquez, J.T., Vila, Y., Rueda, J.L. 2020. Multi-process interaction shaping geoforms and controlling substrate types and benthic community distribution in the Gulf of Cádiz. Marine Geology. 423. 106139. 10.1016/j.margeo.2020.106139.
- Order AAA/627/2013, of 15 April, by which establishes a Plan of management for the ships of the censuses of the national Caladero of the Gulf of Cádiz.
- Order AAA/1406/2016, of 18 August, by which establishes a Plan of management for the ships of the censuses of the National Caladero of the Gulf of Cádiz.
- Order AAA/1710/2014, of 11 September, by which modifies the Order AAA/627/2013 of 15 April, by which establishes a plan of management for the ships of the censuses of the National Caladero of the Gulf of Cádiz.
- Order APA/2801/2007, of September 27, which establishes a fishing plan for the bottom trawl fishery in the National Fishing Area of the Gulf of Cádiz.
- Order APA/2883/2006, of September 19, establishing a fishing plan for the bottom trawl fishery in the national fishing ground of the Gulf of Cádiz.
- Order APA/2858/2005, September 14, establishing a plan for the conservation and sustainable management of the bottom trawl fishery in the Gulf of Cádiz National Fishing Area.
- Order APA/3423/2004, of October 22, establishing an urgent plan for the conservation and sustainable management of the bottom trawl fishery in the National Fishing Area of the Gulf of Cádiz.
- Order APM/453/2018, of 25 April, which modifies the Order AAA/1406/2016, of 18 August, by which establishes a Plan of management for the ships of the censuses of the National Caladero of the Gulf of Cádiz.
- Order APM/664/2017, which modifies the Order AAA / 1406/2016, Management plan for the vessels of the census of the National Fishing Area of the Gulf of Cádiz.
- Order ARM/58/2010, of January 21, which modifies Order ARM/2515/2009, of September 17, which regulates the minimum mesh of the gear and establishes a fishing plan for the Bottom trawl fishery in the Gulf of Cádiz National Fishing Area.

- Order ARM/2457/2010, of September 21, establishing a fishing plan for the bottom trawl fishery in the National Fishing Area of the Gulf of Cádiz.
- Order ARM/2515/2009, of 17 September, by which regulates the minimum mesh of the arts and establishes a plan of fishing for the fishery of trawl of bottom in the National Caladero of the Gulf of Cádiz.
- Pope, J.G., Shepherd, J.G. 1982. A simple method for the consistent interpretation of catch-at-age data. *J. Cons. Expl. Mer.*, 40: 176–184.
- Silva, L., Fariña, A.C., Sobrino I., Vila, Y. 2006. Inconsistencies in the annual length compositions series (2001–2005) of *Nephrops* from the Gulf of Cádiz, FU 30 (ICES Division 9.a). Working document presented to the WGHMM (Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrin).
- Urra, J., Palomino, D., Lozano, P., González-García, E., Farias, C., Mateo-Ramírez, A., Fernández-Salas, L.M., López-González, N., Vila, Y., Orejas, C., Puerta, P., Rivera, J., Henry, L-A., Rueda, J.L., 2021. Deep-sea habitat characterization using acoustic data and underwater imagery in Gazul mud volcano (Gulf of Cadiz, NE Atlantic). *Deep Sea Research Part I* 169. 103458. <https://doi.org/10.1016/j.dsr.2020.103458>.
- Vila, Y., Burgos, C., Soriano, M., Rueda, J.L., Gallardo, M., Farias, C., González Herráiz, I., Sobrino, I., Gil, J. 2014. Estimación de la abundancia de cigala *Nephrops norvegicus* en el golfo de Cádiz a través de imágenes submarinas. Informe final proyecto AC1\_20123118. Funded by La Fundación biodiversidad and FEP. 90 pp.
- Vila, Y., Burgos, C. 2022. New area proposed for the ISUNEPCA UWTV survey in the gulf of Cadiz (FU 30). Working Document presented to the WGBIE (Working Group for the Bay of Biscay and Iberian waters Ecoregion) (WD07). ICES. 2022. Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE). ICES Scientific Reports. 4:52. 847 pp. <https://doi.org/10.17895/ices.pub.20068988>.

### 13.3.8 Tables and figures

Table 13.3.1. *Nephrops* in FU 30. Gulf of Cádiz: Landings (in tonnes) by country and discards.

Year	Spain*	Portugal	Non-reported	Discards	Total
1994	108				108
1995	131				131
1996	49				49
1997	97				97
1998	85				85
1999	120				120
2000	129				129
2001	178				178
2002	262				262
2003	303	4			307
2004	143	4			147
2005	243	3			246
2006	242	4			246
2007	211	4			215
2008	117	3			120
2009	117	2			119
2010	106	1			107
2011	93	3			96
2012	115	1			116
2013	26	< 1			27
2014	14	< 1			15
2015	25	< 1			25
2016	35	< 1	89		124
2017	38	< 1	101		140
2018	49	< 1	27		75
2019	65	0	0		65

Year	Spain*	Portugal	Non-reported	Discards	Total
2020	55	8	0		63
2021	43	6	0		49
2022	44	0	0	<1	45

\* Ayamonte landings are included since 2002.

**Table 13.3.2. *Nephrops* in FU 30. Gulf of Cádiz. Mean carapace length (in mm) of the discarded and retained fraction and percentage of discard in weight and number (2005–2022) for the annual discarding program.**

Year	Mean carapace length (mm)		% Discarded	
	Discarded fraction	Retained fraction	Weight	Number
2005	23.4	33.5	5.2	15.2
2006	20.5	29.4	4.6	11.8
2007	23.2	33.7	0.5	1.4
2008	20.8	35.2	2.5	7.7
2009	21.2	30.2	2.7	4.0
2010	21.9	31.7	1.3	4.5
2011	-	32.7	0.0	0.0
2012	-	32.6	0.0	0.0
2013	23.9	32.7	3.7	10.9
2014	-	34.5	0.0	0.0
2015	21.2	33.6	2.0	5.4
2016	20.5	31.0	0.0	0.1
2017	24.2	29.8	2.5	3.0
2018	23.5	32.0	2.9	7.6
2019	21.4	35.6	1.6	7.2
2020*	n/a	n/a	n/a	n/a
2021	22.6	34.6	0.6	7.2
2022	15.9	35.9	3.3	27.2

\* Discard sampling was only partially conducted as a result of the COVID-19 pandemic and administrative problems in IEO.

**Table 13.3.3. *Nephrops* in FU 30. Gulf of Cádiz. Abundance index from Spanish Gulf of Cádiz International Bottom Trawl Surveys Q1 (G7511).**

Year	200–500 meters		500–700 meters		200–700 meters	
	Kg/60'	Nb/60'	Kg/60'	Nb/60'	Kg/60'	Nb/60'
1993	0.77	19	1.16	34	0.95	26
1994	1.23	31	0.60	8	0.94	21
1995	0.55	8	**	**	na	na
1996	0.56	10	1.33	29	0.93	19
1997	0.08	2	0.70	23	0.38	12
1998	0.40	16	0.23	7	0.30	11
1999	0.50	15	0.28	7	0.41	12
2000	0.22	7	0.57	15	0.37	10
2001	0.32	8	0.61	14	0.44	11
2002	0.49	17	0.45	11	0.47	14
2003	ns	ns	ns	ns	ns	ns
2004	0.15	5	0.15	4	0.15	5
2005	0.54	18	0.76	25	0.64	21
2006	0.24	6	0.66	20	0.42	12
2007	0.44	16	0.23	9	0.35	13
2008	0.88	26	0.81	14	0.85	20
2009	0.64	18	0.30	4	0.37	9
2010	0.63	20	**	**	na	na
2011	0.35	11	0.08	2	0.23	7
2012	0.15	4	0.22	4	0.18	4
2013	0.36	13	1.39	51	0.79	29
2014	2.97	84	0.50	9	1.92	52
2015	1.04	45	1.58	52	1.27	48
2016	4.38	194	0.5	15	2.73	118
2017	2.27	79	0.86	20	1.67	54
2018	0.49	15	0.23	5	0.38	11
2019	1.49	46	1.14	27	1.34	38

Year	200–500 meters		500–700 meters		200–700 meters	
	Kg/60'	Nb/60'	Kg/60'	Nb/60'	Kg/60'	Nb/60'
2020	7.07	262	4.93	405	6.16	323
2021	ns	ns	ns	ns	ns	ns
2022	0.33	12	0.14	3	0.25	8

ns Not survey

\*\* Strata not sampled

Na abundance and biomass not available

**Table 13.3.4. *Nephrops* in FU 30. Gulf of Cádiz. Summary table of results from the geostatistical analysis for ISUNEPCA UWTv (U9111) survey.**

Year*	Nº stations***	Mean density adjusted	Domined Area	Geoestatistical Abundance estimate adjusted	CV on burrow estimate
		Burrow/m2	Km2	Millions burrows	%
2015	48	0.1043	2332.13	249	7.7
2016	48	0.087	2332.13	209	12.1
2017	46	0.1659	2332.13	383	10.3
2018	47	0.1506	2332.13	370	6.7
2019	48	0.0499	2332.13	110	11.3
2020**	NA	NA	NA	NA	NA
2021	46	0.0272	2332.13	66	12.0
2022	67	0.0215	2332.13	53	10.8

\* Updated in 2023 using the new survey area established during wgbie2022.

\*\*UWTv Survey in 2020 was not carried out due the COVID-19 disruption.

\*\*\* Sampling grid with stations spacing 4 nm from 2015 to 2021 and 3.5 nm in 2022.

**Table 13.3.5. *Nephrops* in FU 30. Gulf of Cádiz. Total landings and landings, LPUE and effort of the bottom-trawl fleet fishing trips with at least 10% of *Nephrops* catches.**

Year	Total landings (t)*	Landings (t)**	LPUE (Kg/day) **	Effort (Fishing days) **
1994	108	90	98.6	915
1995	131	107	99.4	1079
1996	49	40	88.2	458
1997	97	75	79.2	943
1998	85	51	62.3	811
1999	120	83	66.2	1259
2000	129	90	60.6	1484
2001	178	130	67.7	1924
2002	262	196	69.4	2827

Year	Total landings (t)*	Landings (t)**	LPUE (Kg/day) **	Effort (Fishing days) **
2003	307	214	75.4	2840
2004	147	98	44.3	2206
2005	246	228	52.7	4336
2006	246	227	64.0	3555
2007	215	198	63.7	3105
2008	120	84	72.9	1150
2009	119	83	50.0	1653
2010	107	73	45.5	1603
2011	97	62	54.6	1135
2012	116	80	58.0	1380
2013	27	24	92.1	262
2014	15	12	40.1	293
2015	25	17	58.8	294
2016***	124	29	64.6	443
2017	140	24	45.5	535
2018	76	31	47.1	658
2019	65	50	73.7	675
2020	63	37	59.0	625
2021	49	30	48.7	611
2022	45	21	54.4	386

\*Ayamonte landings are included since 2002.

\*\*Landings, LPUE and fishing effort from fishing trips with at least 10% of *Nephrops* catches.

Table 13.3.6. *Nephrops* in FU 30. Gulf of Cádiz. Summary for the assessment which will be updated after the 2022 ISUNEPCA UWTV (U9111) survey.

Year	Landing in number	Total discards in number*	Removals in number	UWTV Abundance estimates	95% conf. intervals	Harvest Rate	Mean weight in landings	Mean weight in discards	Discard rate	Dead discard rate
	millions	millions	millions	millions	millions	%	g	g	%	%
2014**	0.48	0	0.48	282		0.2	31.2	0	0	0
2015	0.80	0	0.80	249	38	0.3	30.8	0	0	0
2016	5.35	0	5.35	209	50	2.6	23.2	0	0	0
2017	5.95	0	5.95	383	77	1.6	23.3	0	0	0
2018	3.21	0	3.21	370	48	0.9	23.4	0	0	0
2019	1.99	0	1.99	110	24	1.8	32.5	0	0	0
2020***	2.55	0	2.55	NA	NA	-	29.2	0	0	0
2021	1.25	0	1.25	66	16	1.9	39.3	0	0	0
2022	1.45	0	1.45	53	11	2.7	31.5	0	0	0

\* Discards are considered negligible and not included in the assessment.

\*\* UWTV survey in 2014 considered only exploratory. Abundance estimate not adjusted by cumulative bias.

\*\*\* UWTV survey in 2020 not carried out as a result of the COVID-19 disruptions. Sampling for landings length distribution in 2020 not carried out as a result of pandemic disruption and administrative issues. Landings in number in 2020 estimated as the average of the LFDs for the years 2018, 2019 and 2021 raised to the 2020 total landings.

Table 13.3.7. *Nephrops* in FU 30. Gulf of Cádiz . Length Based Indicator (LBI) results for both sexes.

MALES

	Conservation				Optimizing Yield	MSY
Year	$L_c / L_{mat}$	$L_{25\%} / L_{mat}$	$L_{max\ 5} / L_{inf}$	$P_{mega}$	$L_{mean} / L_{opt}$	$L_{mean} / L_F = M$
2020	1.02	1.09	0.74	0.02	0.79	0.94
2021	1.09	1.16	0.79	0.04	0.86	0.99
2022	0.95	1.02	0.75	0.02	0.76	0.94

FEMALES

	Conservation				Optimizing Yield	MSY
Year	$L_c / L_{mat}$	$L_{25\%} / L_{mat}$	$L_{max\ 5} / L_{inf}$	$P_{mega}$	$L_{mean} / L_{opt}$	$L_{mean} / L_F = M$
2020	1.02	1.09	0.67	0.15	1.01	1.01
2021	1.02	1.09	0.73	0.37	1.09	1.08
2022	0.94	1.09	0.69	0.33	1.05	1.10

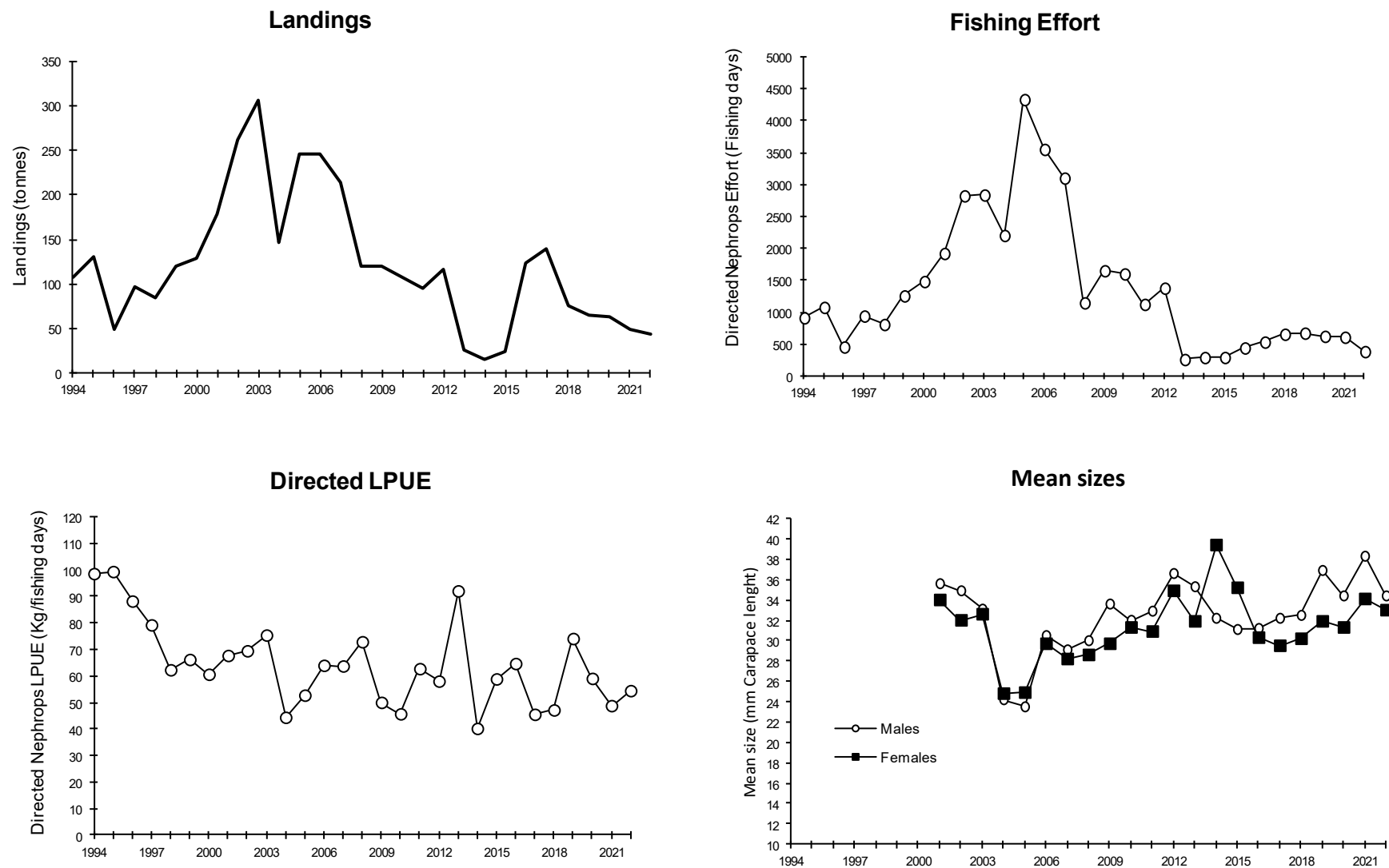


Figure 13.3.1. *Nephrops* in FU 30. Gulf of Cádiz. Long-term trends in the landings, *Nephrops*-directed effort and LPUE and mean sizes.

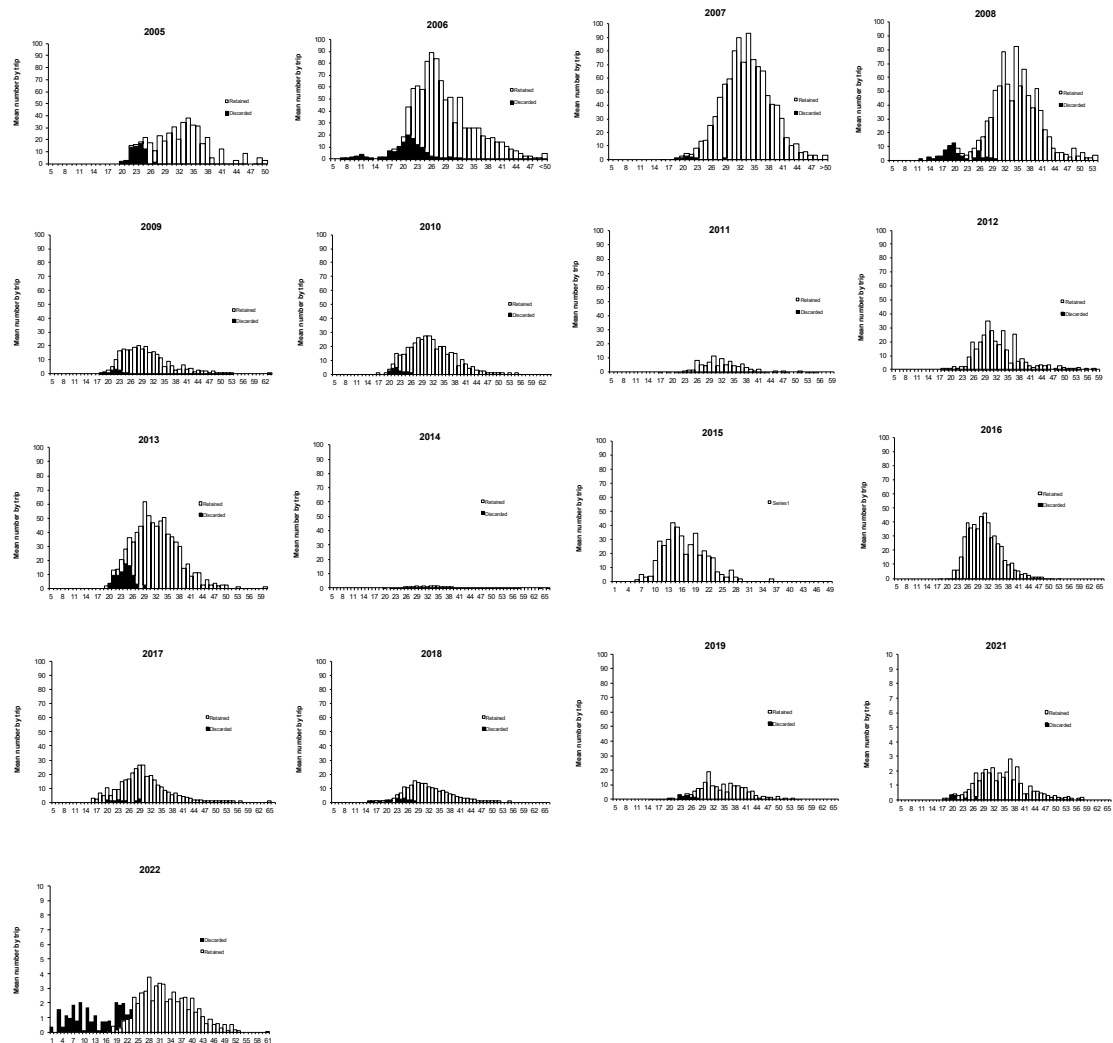


Figure 13.3.2. *Nephrops* in FU 30. Gulf of Cádiz. Length–frequency distribution of *Nephrops* retained and discarded fractions from the discards program (2005–2022). Discard sampling was partially carried out as a result of COVID-19 pandemic and administrative problems in 2020. No data are available in 2020.

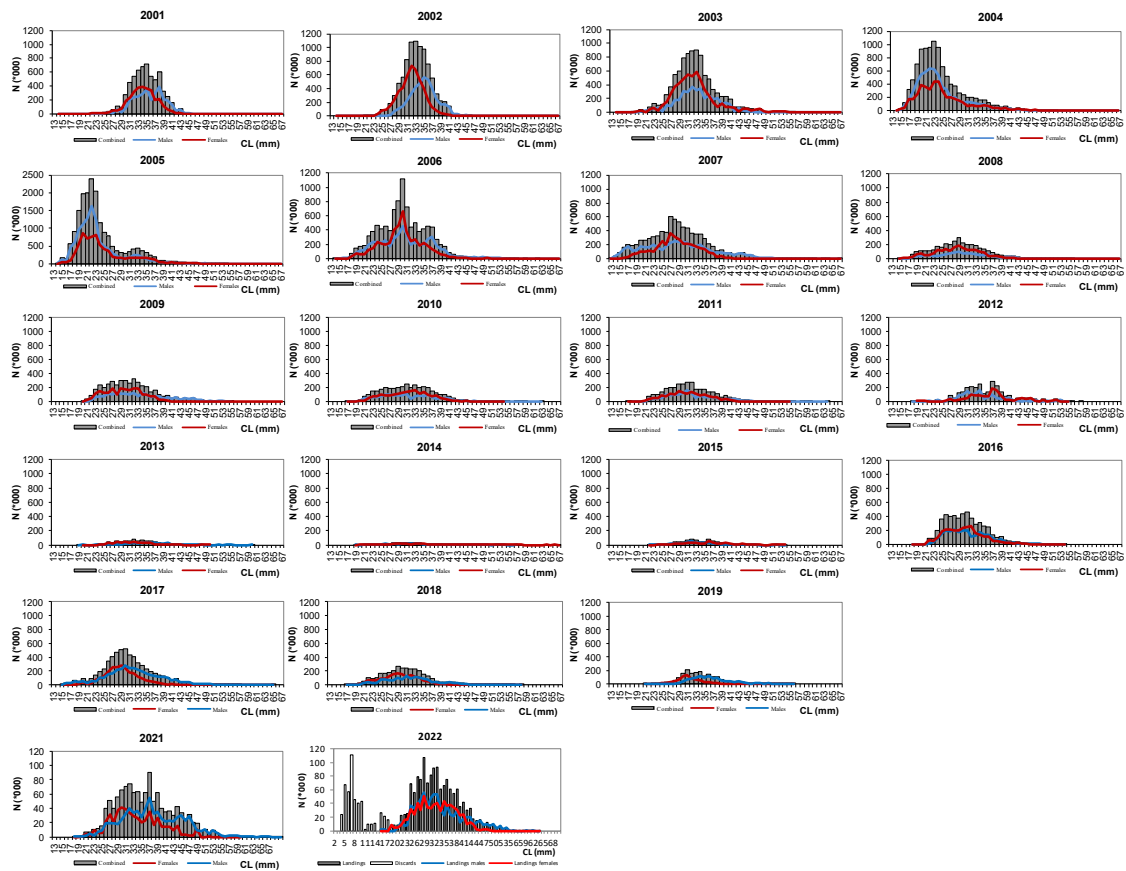


Figure 13.3.3. *Nephrops* in FU 30. Gulf of Cádiz. Length distributions of landings for the period 2001–2022. Landings size composition in 2020 has been estimated as the average length-frequency distribution from 2018, 2019 and 2021 years and raised to the total landings in 2020. Y-axis has been modified to provide more clarity in 2021 and 2022.

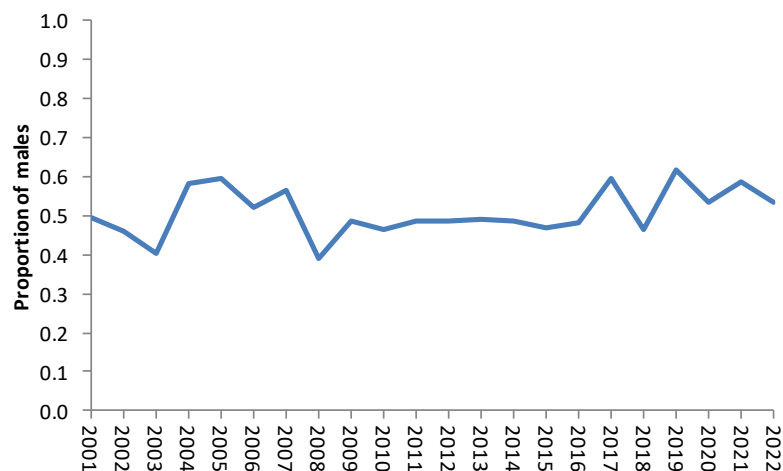


Figure 13.3.4. *Nephrops* in FU 30. Gulf of Cádiz. Proportion of males in landings for the time-series. Sex-ratio in 2020 has been estimated from the average length–frequency distribution for the years 2018, 2019 and 2021.

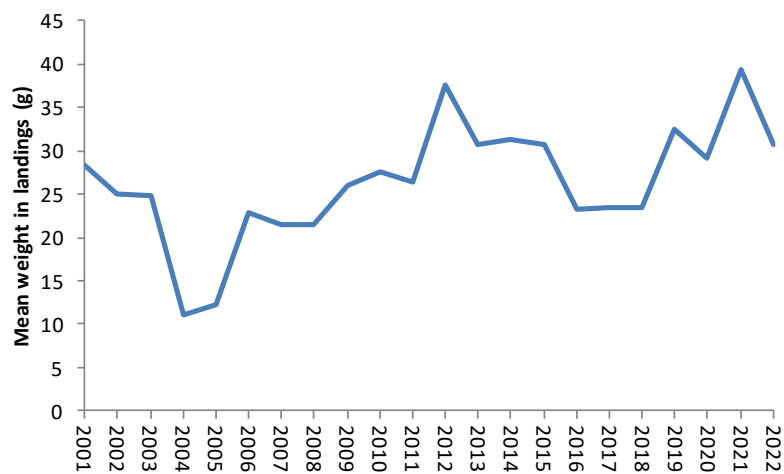
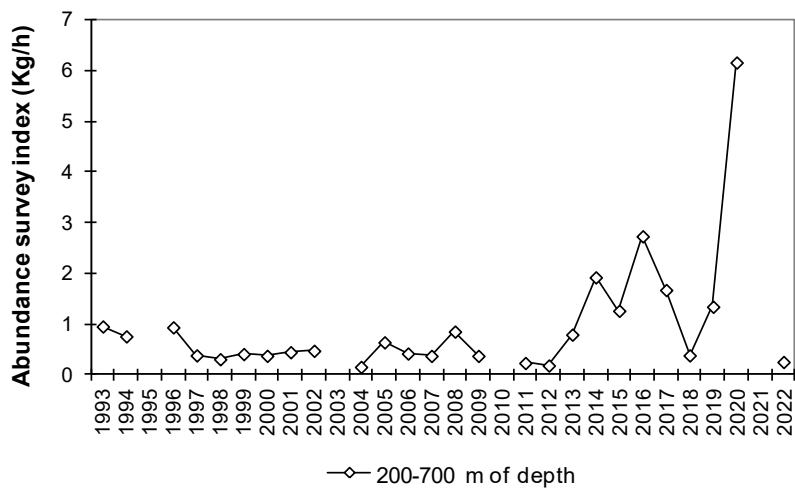


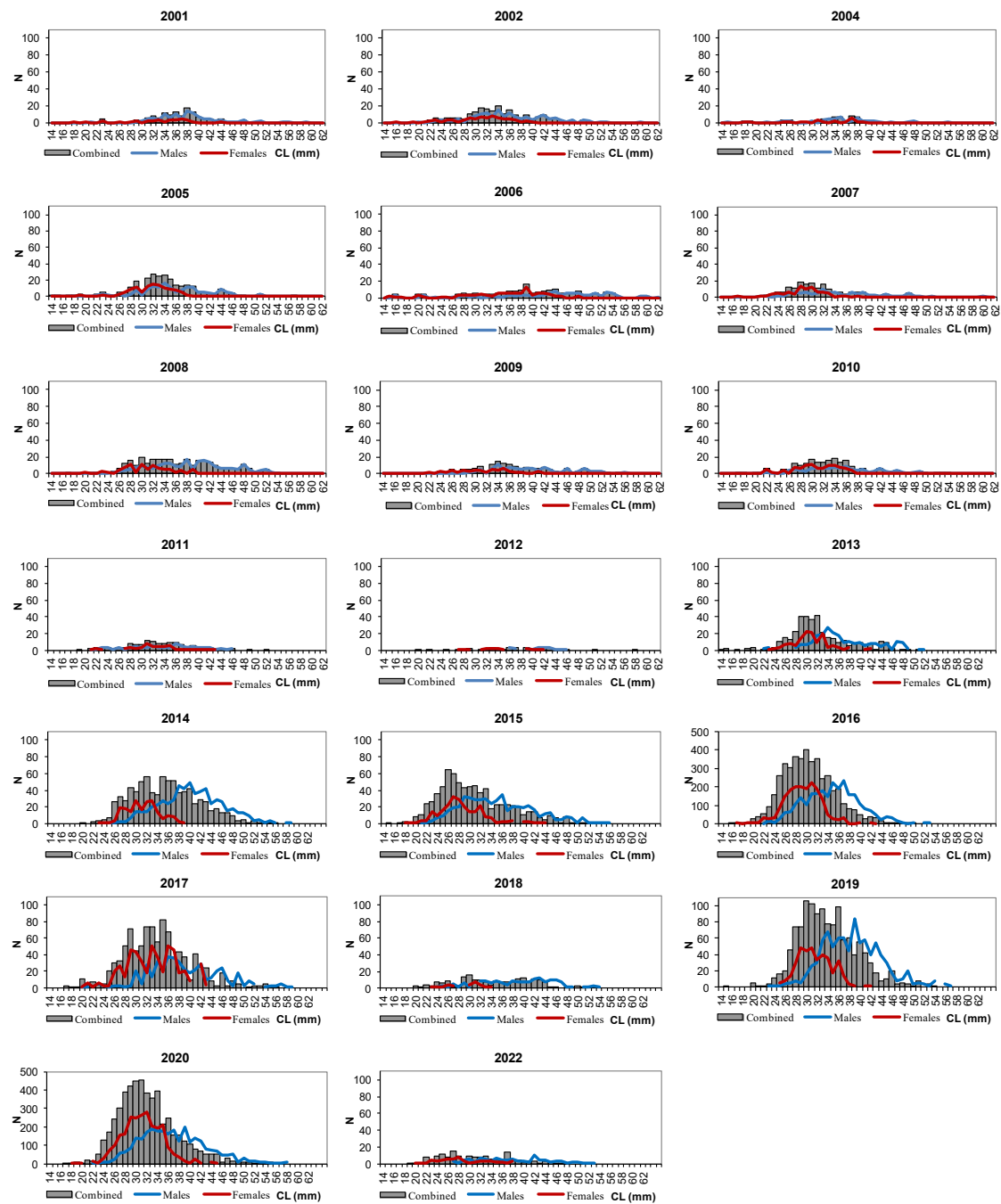
Figure 13.3.5. *Nephrops* in FU 30. Gulf of Cádiz. Time-series of the mean weight trend in commercial landings. Data in 2020 has been estimated from the average length–frequency distribution for the years 2018, 2019 and 2021.



\* 1995 and 2010: strata 500-700 m no sampled

\*\* 2003 and 2021: no survey

Figure 13.3.6. *Nephrops* in FU 30. Gulf of Cádiz, Abundance index from Spanish International Gulf of Cádiz Bottom Trawl Surveys Q1 (G7511). No survey was conducted in 2021 as a result of technical and administrative issues.



**Figure 13.1.7. *Nephrops* in FU 30. Gulf of Cádiz. Length–frequency distributions from Spanish International Gulf of Cádiz Bottom Trawl Surveys Q1 (G7511) for the period 2001–2022. No survey was conducted in 2021 as a result of technical and administrative issues.**

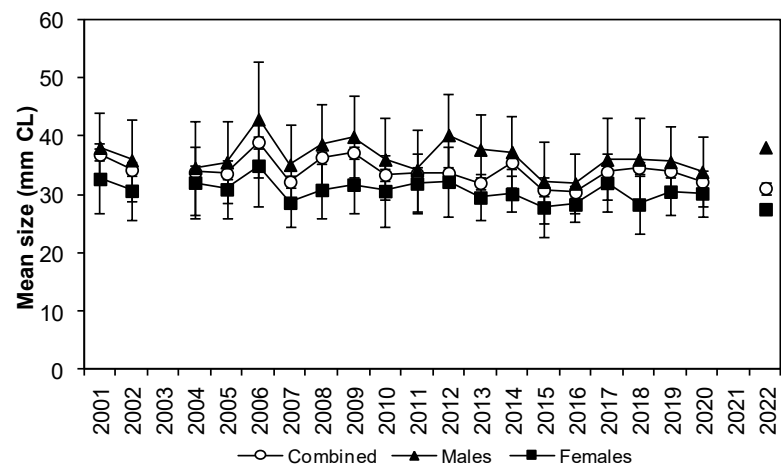


Figure 13.3.8. *Nephrops* in FU 30, Gulf of Cádiz. Mean size in Spanish International Gulf of Cádiz Bottom Trawl Surveys Q1 (G7511) for the period 2001–2022. No survey was conducted in 2021 as a result of technical and administrative issues.

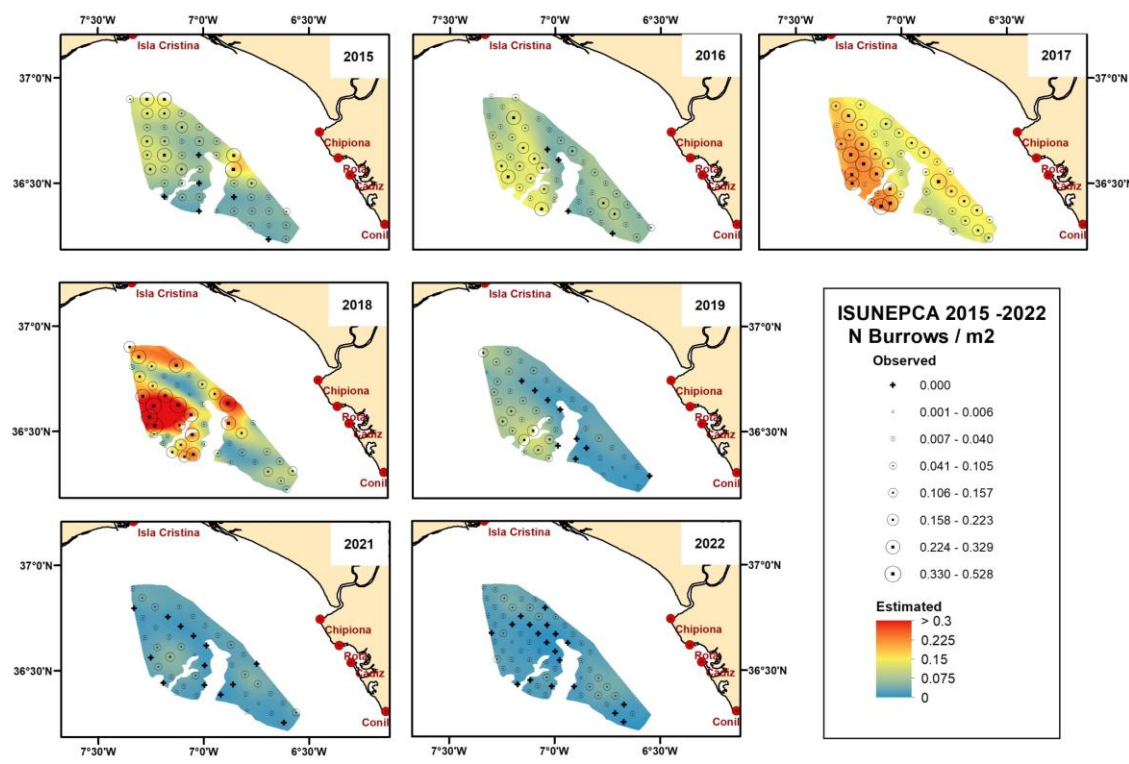


Figure 13.1.9. *Nephrops* in FU 30, Gulf of Cádiz. Contour plots of the krige density estimates for the ISUNEPCA UWTV (U9111) surveys for the period 2015–2022 that were updated after the re-definition of the survey area. No UWTV survey was conducted in 2020 as a result of the COVID-19 disruptions.

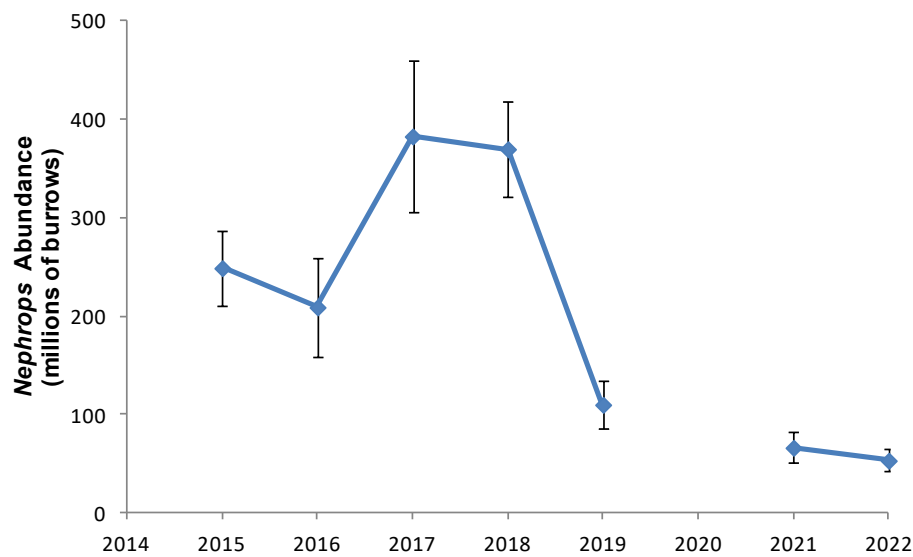


Figure 13.3.10. *Nephrops* in FU 30. Gulf of Cádiz. Geostatistical abundance estimate. Data time-series was updated after the re-definition of the survey area. Error bars correspond to the 95% confidence interval.

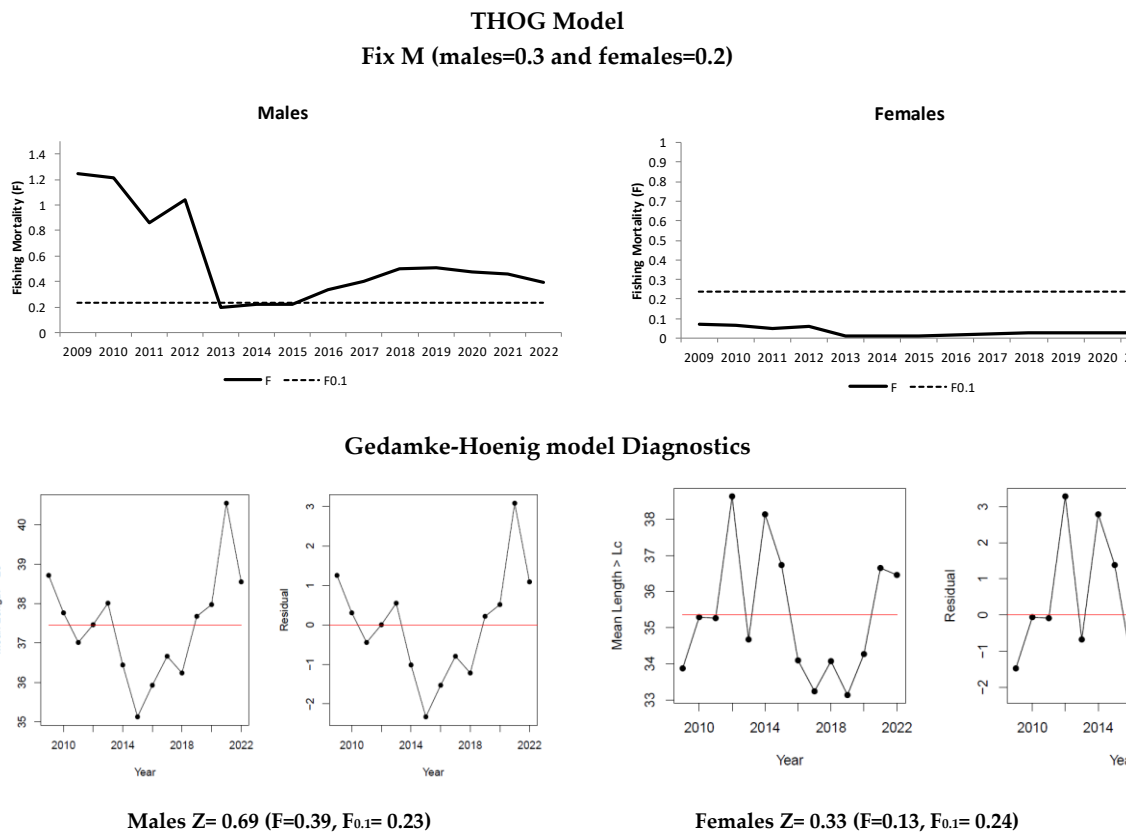


Figure 13.1.11. *Nephrops* in FU 30. Gulf of Cádiz. Mean Length-Z model results. THOG Model with fixed natural mortality (M) (above). Gedamke-Hoenings (2006) model diagnostics (below).

## Contents

13	Norway lobster in Atlantic Iberian waters East, western Galicia, northern, southwestern and southern Portugal, and Gulf of Cádiz .....	502
13.1	<i>Nephrops</i> in western Galicia and northern Portugal (FUs 26–27) .....	502
13.1.1	General .....	502
13.1.2	ICES advice for 2023, 2024 and 2025 and management applicable to 2022 and 2023 .....	502
13.1.3	Data.....	503
13.1.4	Biomass index from surveys .....	504
13.1.5	Assessment .....	506
13.1.6	Quality considerations .....	506
13.1.7	Management Considerations.....	507
13.1.8	References .....	507
13.1.9	Tables and Figures .....	509
13.2	<i>Nephrops</i> in Functional Units (FUs) 28–29 (SW and S Portugal).....	524
13.2.1	General .....	524
13.2.2	Data.....	524
13.2.3	Assessment .....	528
13.2.4	Biological reference points .....	529
13.2.5	Management considerations .....	529
13.2.6	References .....	530
13.2.7	Tables and figures .....	533
13.3	<i>Nephrops</i> in Gulf of Cádiz (FU 30).....	552
13.3.1	General .....	552
13.3.2	Data.....	552
13.3.3	Assessment .....	558
13.3.4	Catch options .....	558
13.3.5	Biological reference points .....	558
13.3.6	Management considerations.....	559
13.3.7	References .....	560
13.3.8	Tables and figures .....	564