

11 Northern and central Bay of Biscay Norway lobster

nep.fu.2324 – *Nephrops norvegicus* in divisions 8.a and 8.b, FUs 23-24

Type of assessment: Update assessment.

The northern and central Bay of Biscay Norway lobster, *Nephrops norvegicus*, in divisions 8a,b (Functional Units 23-24) is classified as a category 1 stock since 2016 (ICES, 2017a; ICES 2021a).

Advice basis: MSY approach. The advice for this stock is annual.

Data and method revisions

Main changes from the last assessment (ICES, 2020): In 2016, the stock was benchmarked (ICES, 2017a) and assessment based on UWTV survey (ICES code: U6811) conducted since 2014 was validated as an analytical method. Assessment will be updated in September-October 2023, when the UWTV survey results will be available and taken into account.

ICES description: 8.a and 8.b

Functional Units (FU): Bay of Biscay North, 8a (FU 23), Bay of Biscay Central, 8b (FU 24).

11.1 General

11.1.1 ICES Advice for 2023

Previously, advice for this stock was provided biennially under category 3, with only trends of the annual assessment taken into account for the advice. The UWTV survey (U6811), routinely carried out since 2014, was validated as the standard assessment method for this stock during the 2016 benchmark workshop WKNEP (ICES, 2017a). The stock was upgraded to category 1 and the advice is provided annually. The latest ICES advice provided in 2022 recommended that when the MSY approach is applied, catches in 2023 should be no more than 6 734 t, corresponding to 4 631 t of landings considering the revised survival rate for discards to 50% instead of 30% adopted during the WKN*Nephrops* (ICES, 2020b).

11.1.2 Management applicable for 2022 and 2023

The *Nephrops* fishery is managed by a TAC [articles 3, 4, 5(2) of Regulation (EC) No 847/96] along with technical measures. The agreed TAC for 2022 was 3 880 t and for 2023, the TAC was set at 4 631 t.

For a long-time, a minimum landing size (MLS) of 26 mm carapace length (CL; 8.5 cm total length) was adopted by the French producer's organisation, which is larger than the EU MLS set at 20 mm CL *i.e.* 7 cm total length. Since December 2005, a new French MLS regulation (9 cm total length) was established. This change significantly impacted the data used by the WG (see report WGHMM in 2007; ICES, 2007).

A mesh size change was implemented in 2000, increasing the minimum codend mesh size (MMS) in the Bay of Biscay to 70 mm, which replaced the 50 mm mesh size implemented in 1990-91. Technical regulations have also been introduced to reduce *Nephrops* by-catch in the Bay of Biscay fishery. In 2002, the European Commission (EC) established technical measures for the recovery of the northern stock of European hake, under which the minimum codend mesh size (MMS) was increased from 70 to 100 mm in the hake box to reduce the high level of hake discarding by

Nephrops trawlers in the Bay of Biscay (EU Reg. 2341/2002). In 2006 and 2007, *Nephrops* trawlers were allowed to fish in the hake box with mesh size smaller than 100 mm once they have adopted a square mesh panel of 100 mm. This derogation was maintained onwards.

As cited in paragraph 24 of the preamble of the European Regulation (EC) No. 41/2007, fixing the fishing opportunities for 2007: "*In order to ensure sustainable exploitation of the hake stocks and to reduce discards, the latest developments on selective gears should be maintained as transitional measures in ICES zones VIIIa, VIIIb and VIId.*" In agreement with this, the National French Committee of Fisheries (deliberations 39/2007, 1/2008) fixed the rules for trawling activities targeting *Nephrops* in the areas 8a and 8b applicable from the 1st of April 2008. All vessels catching more than 50 kg of *Nephrops* per day must use a selective device from at least one of the following: (1) a ventral panel of 60 mm square mesh; (2) a flexible grid or (3) a 80 mm codend mesh size. The majority of *Nephrops* directed vessels (districts of South Brittany) chose the increase of the MMS whereas the ventral squared panel was adopted by multi-purpose trawlers mainly in harbours outside of Brittany.

A licence system was adopted in 2004 and, since then, there has been a cap of 250 *Nephrops* trawlers operating in the Bay of Biscay. This limit of *Nephrops* trawlers decreased to 160-180 in 2018-2022. In the beginning of 2006, the French producers' organisations adopted regulations (*e.g.*, monthly quotas) which had some effects on fishing effort limitation. From 2017 onwards, some additional decisions were implemented by the producers' organisations, such as spreading landings sales over several days, in order to prevent any excess in productivity and/or quota over-shot.

Since the 1st of January 2017, the use of a discarding quick-chute system onboard has become compulsory. There has been an impact on the survival rate of discards which is currently considered higher (50%; Mérillet *et al.*, 2018) than the historical value of 30% (Charuau *et al.*, 1982). This rate was taken into account during the WK*Nephrops* in 2019 (ICES, 2020b) for future assessment and advice of the stock.

11.2 Data

11.2.1 Commercial catches and discards

Total catches, landings and discards, of *Nephrops* in divisions 8a, b for the period 1960-2022 are provided in Table 11.1.

During the mid-1960s, the French landings gradually increased to a peak value of 7 000 t in 1973-1974, then decreased with values fluctuating between 4 500 and 6 000 t during the '80s and the mid-'90s. An increase has been noticeable during the early 2000s. Landings showed a decreasing trend from 3 991 t in 2005 to 2 987 t in 2009. In 2010 and 2011, total landings increased (3 398 and 3 559 t, respectively), followed by a strong reduction in 2012 and 2013 (2 520 and 2 380 t, respectively). During the period 2014-2016, landings increased continuously (2 807 t in 2014; 3 569 t in 2015; 4 091 t in 2016). In 2017, landings decreased again by -17% (3 412 t) due to the implementation of more constraining regulations cited above. The lowest levels of landings in the stock time series were observed in 2018 (2 125 t), 2019 (2 154 t) and 2020 (2 273 t) whereas in 2021 landings increased steeply (3 006 t, +32% compared to 2020). In 2022, a decrease of landings by -10% (2 694 t) occurred.

In 2005, when the northern hake stock was under a recovery plan, the use of dorsal mesh square panels became mandatory for the trawlers targeting *Nephrops* in the Bay of Biscay, as this area is known to be an important nursery area for the hake stock. The implementation of the selective devices previously referred (a ventral panel of 60 mm square mesh or a 80 mm codend mesh

size) coincided with a peak of discarded hake in weight and in proportion following a slightly lower proportion of discarded hake in 2006-2007. Similarly in 2008, *Nephrops* length distribution in discards remained unchanged despite the mandatory use of the above mentioned selective modifications (Nikolic *et al.*, 2015). The decrease in discarded *Nephrops* weight in recent years may be due to the decreasing fishing mortality imposed to the stock since 2006 which consequently resulted in lower catches (ICES, 2012b), rather than due to a change in selectivity.

Males usually predominate in the landings with the sex ratio (defined as number of females divided by the total number of both sexes) fluctuating between 0.28 and 0.46 for the overall period (1987-2022) with the historically lowest value in 2017. In 2022, the sex ratio of landings was 0.40. The same predominance, although to a lesser degree, was observed for the removals (sex ratio in the range 0.35-0.49) which shows a sex ratio of 0.42 in 2022. Females are less accessible in winter because of their burrowing behaviour during the egg-bearing period.

Discards represent most of the catches of the smallest individuals as indicated by the available data (Figure 11.1). The average weight of discards per year in the period up to early 2000s (not routinely sampled) is about 1 543 t whereas discards estimate for the most recent sampled years (2003-2022) reached a higher level (1 834 t). This change in the amount of discards could be due to 1) the restriction of individual quotas, 2) the strength of some recruitments in mid-2000s and 3) the change in the MLS (which tends to increase the discards), although improvements in selectivity may contribute to reduce the discards. The relative contribution of each of these three factors remains unknown. In 2019, the minimum level of discards had been observed (59 million individuals, 634 t) since the start of the European Union Data Collection Framework (DCF; Commission Regulations (EC) Nos. 1639/2001 and 199/2008) and the discard rate had decreased (38% against 58% in 2017 and 65% in 2018). In 2020, discards considerably increased up to 154 million individuals (1 908 t; discard rate of 61%) but a reduction was observed in 2021 (106 million; 1 126 t; discard rate of 45%) and 2022 (86 million; 791 t; discard rate of 42%).

11.2.2 Biological sampling

11.2.2.1 Landings

French sampling at auction started in 1984, but only from 1987 onwards can the data be used on a quarterly basis. Since 2003, additional landings data was also provided from onboard routine sampling for estimating discards under the European DCF. As the landed fraction of *Nephrops* is usually size graded, the sampling plan is stratified by time and commercial category *vs.* size. The numbers of sampling units by quarter and year as well as the numbers of sampled landed individuals of *Nephrops* are presented in Tables 11.2 and 11.3, respectively.

During the first two quarters of 2017, the French onshore sampling program at auctions was discontinued due to a planned shift towards a subcontracted program as already performed for the French onboard sampling. The delay in the call for tenders disrupted the onshore sampling collection for six months. Compared to other onshore species, the Bay of Biscay *Nephrops* was less impacted as complementary biological parameters (such as maturity) were collected by other ongoing European projects during the first half of the year which resulted in a satisfactory sampling rate. In order to compensate for the lack of Q1 and Q2 landings data in 2017, a simulation was performed using the method proposed by Quemar *et al.* (2018) to generate missing auction sampling units from onboard samples using stratified estimators (quarter/harbour/commercial category *vs.* size). This method was not specifically developed for the FU23-24 *Nephrops* and only actually sampled units were retained for quarterly and global estimates.

The particular problem of lower sampling rate for landings during the 1st and 2nd quarters 2017 due to the delay on the sampling shift between operators, as explained above, affected the precision of estimates (decrease of the sampling units and of measured *Nephrops* at auction)

although it did not change the overall perception for the stock status (LFDs and mean weight for landings). As shown by unpublished studies on recent DCF sampled years (2014-2017), the LFDs for landings by sex did not significantly change their overall shape when the raising is undertaken on the exclusive database from the sampling onboard despite the higher CVs obtained. This problem was resolved in 2018 and 2019 and the global sampling levels were more satisfactory than previously.

In 2020, the auction and onboard samplings were impacted by the COVID-19 pandemic restrictions especially during the first severe lockdown (mid-March/mid-May) enforced in France. The coverage of the most substantial quarter for this fishery (2nd quarter) was consequently reduced to only one month of sampling (June) although a first sensitivity analysis demonstrated that this dataset gap did not strongly modify the LFDs shape when compared with completely sampled data in previous years. Moreover, this procedure did not increase the uncertainties. In 2021 and 2022 more regular conditions for applying the sampling designs at auction as well as onboard were ensured.

11.2.2.2 Discards

Discards data from onboard sampling are available for the years 1987, 1991 and 1998 and then from 2003 onwards. Since the former WGNEPH, for the intermediate years up to 2002, discarded numbers-at-length were derived using the "proportional method" where discards by sex for years with no onboard sampling were estimated by applying identical quarterly LFDs of the preceding sampled year raised to the quarterly landings *i.e.* for years 1992-1997 derivation used quarterly LFDs from 1991. This method was suspected to induce inter-dependence throughout the time series, therefore, lack of contrast for annual recruitment. IBP *Nephrops* 2012 (ICES, 2012a) investigated the probabilistic (logistic) approach developed for the WGHMM since 2007, although it was not conclusive (Table 11.4; see Stock Annex).

Since 2003, discards have been estimated from catch sampling programmes onboard the *Nephrops* trawlers (776 trips and 2 035 hauls have been sampled over 20 years). In spite of improvements in the agreement between logbook declarations and auction hall sales since mid-2000s, the quality of crossed information fluctuates between years. For instances, for years 2007-2022, the percentage of cross-validation item by item between logbooks and sales ranged from 69 to 90% with an improvement in the last period (85% for 2016, 88% in 2017, 90% in 2018, 88% in 2019 and 2020, 92% in 2021, ≈100% in 2022). Therefore, the total number of trips, not well known in the past, is more accurately provided for the recent years and can be reliably used as raising factor for discards. Nevertheless, the number of trips mostly represented by the number of sales at auction is heterogeneous as the boats in the northern part of the Bay of Biscay conduct daily trips whereas in the southern part, trips last 2-3 days with a more diverse profile of catches. Discards sampling from the southern part of the Bay of Biscay fishery was carried out only once in the past (2005), but the sampling plan has been routinely applied since 2010. The numbers of sampled units by quarter and for the whole year and those of discarded sampled *Nephrops* are summarized in Table 11.5. As for the landings, COVID-19 restrictions disrupted the routinely conducted onboard sampling for the major part of the 2nd quarter of 2020. Moreover, the sampling rate onboard during the 1st quarter 2020 was also reduced due to meteorological conditions. In 2021, the 1st quarter's sampling rate onboard also remained low but the situation was improved in 2022.

The length distribution of landings, discards and catches from the DCF sampling since 2003 are presented in Tables 11.6.a-c and in Figure 11.1 (for LFDs from years 1987-2002: see Stock Annex). Combined sex mean lengths are presented for catches, landings and discards in Figure 11.2. Figure 11.3 provides the annual LFDs by sex and their CVs for landings and discards in 2022. Similar information for years 2014-2021 is available in the Stock Annex.

11.2.3 Abundance indices from surveys

11.2.3.1 Trawl survey (LANGOLF)

For many years, abundance indices were not available for this stock. LANGOLF series (see Section 2 of this report and Stock Annex), specially designed survey to evaluate abundance indices of *Nephrops*, started in 2006 being conducted during the most appropriate season (2nd quarter), hours (around dawn and dusk) and fishing gear (twin trawl). This survey occurred once a year in May and its sampling design was stratified based on the sedimentary structure. Therefore, based on the investigations carried out during the IBP *Nephrops* in 2012 (ICES, 2012a), the abundance indices were included in the assessments of WGHMM 2012 and 2013 (ICES, 2012c; ICES, 2013) and WGBIE 2014 (ICES, 2014). Nevertheless, the relative improvement in retrospective analysis did not substantially modify the quality of the stock assessment performed by XSA model. The time series provided by this survey ended in 2013.

11.2.3.2 UWTV survey (LANGOLF-TV; ICES code: U6811)

An experimental survey for counting UWTV burrows, as routinely operated for many *Nephrops* stocks in areas 6 and 7, has been conducted since 2014 on a yearly basis. In the first two years, this UWTV survey, named "LANGOLF-TV", aimed to demonstrate the technical feasibility of such a survey in the local context and to identify the necessary competences and equipment for its sustainable use. Burrow counting was carried out by the Irish research vessel "Celtic Voyager" on the basis of a systematic sampling plan. In this period, UWTV experiments were combined with trawling operations by two commercial vessels applying the same sampling plan (stratified random) and using the same twin trawls (20 mm codend mesh size) as those of the former LANGOLF trawl survey with the purpose of providing *Nephrops* LFDs by sex and estimating the proportion of other burrowing crustaceans (mainly *Munida sp.*) which can induce bias in the burrows counting.

From 2016 onwards, the trawling operations were cancelled as these were considered no longer necessary for further analytical investigations on the stock exclusively based on the UWTV tools. A longer survey duration in the period 2016-2022 allowed to cover the area within the outline of the central mud bank not belonging to any sedimentary stratum (Figure 11.4). This area is not heavily trawled due to the rough sea bottom crossed by muddy channels but concentrates a moderate fishing effort targeting *Nephrops*. Investigations based on stratified statistical estimators (Table 11.7) as well as on geostatistics (Table 11.8; Fig. 11.5 and 11.6) were carried out and then examined during the WKNEP (ICES, 2017a) which validated the UWTV approach. The number of sampled stations decreased between 2016 and 2017 (from 196 validated ones to 124) because a larger area than the Central Mud Bank was covered in 2017 in order to accurately delimit the actual outline of the stock following the recommendations of the WGNeps in 2016 (ICES, 2017b). In 2018-2021, 184, 145, 134 and 175 valid stations were respectively sampled in the area. Between 2016 and 2017, the total number of burrows decreased by -19% (3,373 billion in 2017 against 4,167 in 2016) whereas an increase (+12%) was observed in 2018 (3,788 billion) and (+9%) in 2019 (4,113 billion).

The annual survey occurred in different seasons (September 2014, July 2015, May 2016, 2017 and 2019, end April 2018, 2021 and 2022) as sampling period was constrained and determined by the availability of the UWTV equipment and staff from the Marine Institute of Ireland.

In 2020, due to the COVID-19 pandemic, the survey initially scheduled in late April to early May was strongly compromised, before being rescheduled to the end of July. During the 2020 UWTV survey, only two Irish experienced scientists were able to participate in order to respect the social distancing obligation on board. This also led to the reduction of the sampling plan to 134 finally validated stations but still with an acceptable statistical precision level of estimates and all the

video interpretations were carried out by a limited number of Ifremer staff in the laboratory after the end of the survey. A first investigation of the footage was undertaken by only one staff member of Ifremer by sampling unit in order to satisfy constraints linked to the stock assessment and advice in late September/early October. The number of burrows was estimated at 3,425 billion (-17% against 2019's survey) and the stock was advised for 2021 on this basis. According to WGNPS 2020 recommendations (ICES, 2021b), a second reader per sample is needed, and in several cases a third one can be necessary, in case of divergence between experts *vs.* the statistical Lin's concordance correlation coefficient (CCC; Lin, 1989, 2000). The revised estimate 2020 a number of burrows was equal to 3,602 billion (-12% compared to the 2019's estimate).

In 2021, the pandemic constraints remained, although in a lesser degree, therefore the survey was conducted in the initially scheduled period (late April) by only two specialized scientists among them the one from Ifremer. The exploration of the recorded samples was also carried out in lab although by a sufficient number of readers as the survey occurred in spring and it was more realistic to anticipate the schedule for reading in lab. The number of burrows was estimated at 3,431 billion (-5% compared to 2020).

A WD was presented in the WGBIE 2022 aiming to more accurately define the polygon surface of this stock by eliminating area with repetitively zero burrows. The WD was examined by the WG and a final version was validated in September 2022 and included in the assessment and advice process 2023. The updated stock surface (14 640 km² instead of 16 164 km² considered by the benchmark workshop 2016) reduced by less than -9% the number of sampling units (in years 2016-2021, 179, 113, 175, 139, 132 and 175 stations are respectively contained in the new stock polygon). The overall perception of the stock abundance remained unchanged : in years 2016-2021, the revised numbers of burrows were respectively 4,189, 3,346, 3,752, 4,030, 3,399 and 3,236 (in billion).

In 2022, COVID-19 constrains also impacted the UWTV survey although the exploration of footage (174 validated stations) was totally realized onboard. On the recently revised surface of the stock the number of burrows is equal to 3872 billion (+20% compared to 2021).

11.2.4 Commercial catch-effort data

Up to 1998, the majority of the vessels were not obliged to keep logbooks because of their size and fishing forms were established by inquiries. Since 1999, logbooks became compulsory for all vessels longer than 10 m. The available logbook data cannot be currently considered as representative for the fishing effort of the whole fishery during the overall time series. Hence, since 2004, attempts to define a better effort index were done.

Effort data indices, landings and LPUE for the "Le Guilvinec District" *Nephrops* trawlers in the 2nd quarter (noted GV-Q2) are available for the overall time series (Table 11.9; Figure 11.7). Effort increased from 1987 to 1992, but there has been a decreasing trend since then. In recent years, the lowest fishing effort value for the whole period was observed.

In 2019, the fishing effort remained almost stable compared to 2018 (-2%) which further decreased in 2020 (-12%) mainly because of the COVID-19 disruptions. In 2021, an increase of the fishing effort was observed (+12%) but a decrease occurred in 2022 (-12%). The overall downward trend in effort can be explained by the reduction in the number of fishing vessels following the decommissioning schemes implemented by the EU. The LPUEs of the GV-Q2 fleet were reasonably stable for a long period, fluctuating around a long-term average of 14.1 kg/h (Figure 11.7), with four peaks (1988, 2001, 2010 and 2017). LPUE reached the historically highest level in the middle of the last decade (2015: 19.5 kg/h; 2016: 19.7 kg/h; 2017: 21.9 kg/h), but declined in 2018 (-22%; 17.0 kg/h) then was reduced again in 2019 (-7%, 15.7 kg/h) and remained at the same level in 2020 (15.6 kg/h), 2021 (15.9 kg/h) and 2022 (16.6 kg/h).

Changes in fishing gear efficiency and individual catch capacities of vessels imply that the time spent fishing may not be a good indicator of effective effort and, hence, the LPUE trends are possibly biased. Since the early '90s, the number of boats using twin-trawls increased (10% in 1991, more than 90% in recent years, almost 100% in the northern part of the fishery) and also the number of vessels using rock-hopper gear on the rough sea bottom of the extreme NW part of the central mud bank of the Bay of Biscay. Moreover, an increase in onboard computer technology has occurred. The effects of these changes are difficult to quantify as twin-trawling is not always recorded explicitly in the fisheries statistics and improvement due to computing technology is not continuous for the overall time series.

11.3 Assessment

An analytical assessment based on the adopted UWTV survey was carried out for the first time in November 2016 after the WKNEP benchmark (ICES, 2017a) in order to propose advice 2017 for the stock. An update of the stock data is performed in spring of each year covering the LFDs and mean weights for landings and discards of the three preceding years but the results from the UWTV survey of the same year are not yet available. The estimated *status quo* harvest rates for 2016, calculated as the removals divided by the UWTV abundance, was equal to 7.2% (under the historical value of 30% for the survival rate of discards and after the recalculation of the stock abundance accordingly to the revised surface of the stock polygon (WD09; WGBIE 2022)). After the adoption of the survival rate of 50% as consequence of the compulsory quick chute system for discards since January 2017, the harvest rates for years 2017-2022 on the revised stock surface were 7.3%, 4.3%, 3.1%, 5.2%, 5.7% and 4.1%, respectively which are much below the MSY target (7.7%), with the exception of the year 2017 close to the reference value.

The summary from the assessment 2022 is provided in the table below (ICES, 2022a).

Variable	Value	Source	Notes
Abundance in TV assessment	3872.311	ICES (2022b)*	UWTV 2022 (results available before stock assessment and advice in autumn 2022)
Mean weight in landings	22.633	ICES (2022b)	Average 2019-2021
Mean weight in discards	11.241	ICES (2022b)	Average 2019-2021
Discard rate (total)	47.76%	ICES (2022b)	Average 2019-2021 (proportion by number)
Discard survival rate	50.00%	ICES (2022b)	Only applies in scenarios where discarding is allowed.
Dead discard rate (total)	31.90%	ICES (2022b)	Average 2019-2021 (proportion by number), only applies in scenarios where discarding is allowed.

11.4 Catch options and prognosis

For 2023, the catch options containing updated information on the fishery (mean weight for landings and discards, discard rate, survival rate for discards) is given below.

Variable	Value	Source	Notes
Abundance in TV assessment	autumn 2023	ICES (2023b)*	UWTV 2023 (results available before stock assessment and advice in autumn 2023)
Mean weight in landings	22.953	ICES (2023b)	Average 2020-2022
Mean weight in discards	10.736	ICES (2023b)	Average 2020-2022
Discard rate (total)	49.30%	ICES (2023b)	Average 2020-2022 (proportion by number)
Discard survival rate	50.00%	ICES (2023b)	Only applies in scenarios where discarding is allowed.
Dead discard rate (total)	33.10%	ICES (2023b)	Average 2020-2022 (proportion by number), only applies in scenarios where discarding is allowed.

* This Working Group report, to be updated in October 2022

11.5 Biological reference points

The F_{MSY} reference point (harvest rate of 7.7%; ICES, 2017a) is based on the average realised harvest rates (HR) of *Nephrops* functional units with an observed history of sustainable exploitation, while also taking into account the low harvest rates applied to the FUs 23-24 stock in the recent past. As the WK*Nephrops* 2019 (ICES, 2020b) was not conclusive at the aim of defining new reference points for this stock exclusively based on the SCA outputs and the scenarios under $F_{0.1}$ provided irrelevant results, the current reference value of HR=7.7% was kept.

11.6 Comments on the assessment

The French *Nephrops* trawlers onboard sampling programme avoids the use of “derived” data for missing years (14 over 36 years). Since 2009, there has been a relevant improvement of the sampling design as many trips were sampled in the Southern part of the fishery. Derivations based on the probabilistic approach should improve knowledge on further analytical retrospective investigations on this stock.

The upgrade to category 1 stock is the consequence of a representative sampling survey on the whole Central Mud Bank of the Bay of Biscay as performed in 2016-2022. In addition to the unbiased spatial fishery information, such as the VMS data, these results demonstrate the accurate knowledge of the stock area and of its sedimentary heterogeneous structure.

11.7 Information from the fishing industry

Several meetings were held between scientists and the fishing industry prior to the WG in order to discuss the partnership for the UWTV survey. The scientific methodological and financial supporting project conducted on years 2017-2019 and extended to the period 2020-2022 is replaced from 2023 onwards by a scheme based on the European DCF. Many discussions prior to the WG had underlined the steep decrease of landings in the period 2016-2020 which was considered by the industry as a temporary status and not as a signal of a declining trend. They argued that this situation had already been observed in the recent past: the positive dynamics in 2014-2016 occurred after the downwards moving in 2011-2013. The industry underlined the heterogeneous feature of the whole area of the stock and debated about the overall declining trend for the southern part of the Bay of Biscay considered problematic. Divergent interpretations were advanced for this decline although all of them converge that it might be the consequence of a gradual modification of the sediment nature of this area from a typically muddy to a more mixed one.

The industry was satisfied by the realization of the UWTV surveys in three years 2020-2022 under heavy constraints mainly for the first two ones allowing an actual update on the stock status. The industry praised the efficient and flexible partnership between the French and Irish scientists participating in the survey.

11.8 Management considerations

Some positive signals in the mid-2010s (increase of LPUEs, landings, removals) and relative stability of burrow indices from the 2014-2016 UWTV surveys suggested a stock status within safe limits. However, the oscillating trends of UWTV indices since 2017, *i.e.* the steep decrease in 2017 followed by an increase in 2018-2019 and a slight decline in 2020-2021, in spite of the increase in 2022 combined with the historically lowest landings level in 2018-2020 suggest considering cautiously the current situation which will be examined after including the 2023 UWTV survey results.

11.9 References

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11.10 Tables

Table 11.1. *Nephrops* in FUs 23-24 Bay of Biscay (8a,b). Estimates of catches (t) by FU for 1960-2022.

Year	Landings (1)				Total VIIIa,b used by WG	Total Discards		Catches	
	FU 23-24 (2)		FU 23	FU 24		FU 23-24		Total	
	VIIIa,b	VIIIa	VIIIb	Unallocated (MA N)(3)		VIIIa,b		VIIIa,b	
1960	3524	-	-	-	3524	-		3524	
1961	3607	-	-	-	3607	-		3607	
1962	3042	-	-	-	3042	-		3042	
1963	4040	-	-	-	4040	-		4040	
1964	4596	-	-	-	4596	-		4596	
1965	3441	-	-	-	3441	-		3441	
1966	3857	-	-	-	3857	-		3857	
1967	3245	-	-	-	3245	-		3245	
1968	3859	-	-	-	3859	-		3859	
1969	4810	-	-	-	4810	-		4810	
1970	5454	-	-	-	5454	-		5454	
1971	3990	-	-	-	3990	-		3990	
1972	5525	-	-	-	5525	-		5525	
1973	7040	-	-	-	7040	-		7040	
1974	7100	-	-	-	7100	-		7100	
1975	-	6460	322	-	6782	-		6782	
1976	-	6012	300	-	6312	-		6312	
1977	-	5069	222	-	5291	-		5291	
1978	-	4554	162	-	4716	-		4716	
1979	-	4758	36	-	4794	-		4794	
1980	-	6036	71	-	6107	-		6107	
1981	-	5908	182	-	6090	-		6090	
1982	-	4392	298	-	4690	-		4690	
1983	-	5566	342	-	5908	-		5908	
1984	-	4485	198	-	4683	-		4683	
1985	-	4281	312	-	4593	-		4593	
1986	-	3968	367	99	4335	-		4335	
1987	-	4937	460	64	5397	1767	*	7164	
1988	-	5281	594	69	5875	4123		9997	
1989	-	4253	582	77	4835	2634		7470	
1990	1	4613	359	87	4972	627		5599	
1991	1	4353	401	55	4754	1213	*	5967	
1992	0	5123	558	47	5681	1354		7034	
1993	0	4577	532	49	5109	1007		6116	
1994	0	3721	371	27	4092	741		4833	
1995	0	4073	380	14	4452	706		5159	
1996	0	4034	84	15	4118	495		4614	
1997	2	3450	147	41	3610	805		4415	
1998	2	3565	300	40	3865	1453	*	5318	
1999	2	2873	337	26	3209	1148		4357	
2000	0	2848	221	36	3069	1455		4523	
2001	1	3421	309	22	3730	2537		6267	
2002	2	3323	356	36	3679	2620		6299	
2003	1	3564	322	49	3886	1977	*	5863	
2004	na	3223	348	5	3571	1932	*	5503	
2005	na	3619	372	na	3991	2698	*	6689	
2006	na	3026	420	na	3447	4544	*	7990	
2007	na	2881	292	na	3176	2411	*	5587	
2008	na	2774	256	na	3030	2123	*	5154	
2009	na	2816	212	na	2987	1833	*	4820	
2010	na	3153	245	na	3398	1275	*	4673	
2011	na	3240	319	na	3559	1263	*	4822	
2012	na	2290	230	na	2520	1012	*	3532	
2013	na	2195	185	na	2380	1521	*	3900	
2014	na	2699	108	na	2807	1326	*	4133	
2015	na	3425	144	na	3569	1822	*	5391	
2016	na	3873	217	na	4091	2531	*	6622	
2017	na	3283	129	na	3412	2387	*	5799	
2018	na	2038	86	na	2125	1571	*	3696	
2019	na	2065	89	na	2154	634	*	2789	
2020	na	2200	73	na	2273	1908	*	4181	
2021	na	2925	81	na	3006	1126	*	4132	
2022	na	2565	129	na	2694	791	*	3485	

(1) WG estimates (2) landings from VIIIa and VIIIb aggregated until 1974 (3) outside FU 23-24

Italic font: revised value between WGBIE 2019 and 2020 (from 1627 t to 1571 t)

Table 11.2. *Nephrops* in FUs 23-24 Bay of Biscay (8a,b). Quarterly and yearly number of sampled units in the landings sampling program.

Year	Q1			Q2			Q3			Q4		
	auc-tion	sea	Σ	auc-tion	sea	Σ	auc-tion	sea	Σ	auc-tion	sea	Σ
2014	96	23	119	122	82	204	107	64	171	106	30	136
2015	119	37	156	119	71	190	123	70	193	114	12	126
2016	108	30	138	139	93	232	112	109	221	142	23	165
2017	26	30	56	27	36	63	63	47	110	92	19	111
2018	70	14	84	90	45	135	86	43	129	70	16	86
2019	86	18	104	92	46	138	64	29	93	80	17	97
2020	68	6	74	30	24	54	31	12	43	28	31	59
2021	30	4	34	73	17	90	54	25	79	19	24	43
2022	26	18	44	71	42	113	78	36	114	23	10	33
Total	629	180	809	763	456	1219	718	435	1153	674	182	856

Table 11.3. *Nephrops* in FUs 23-24 Bay of Biscay (8a,b). Quarterly and yearly number of sampled landed individuals.

year	Q1			Q2			Q3			Q4		
	auc-tion	sea	Σ	auc-tion	sea	Σ	auc-tion	sea	Σ	auc-tion	sea	Σ
2014	3774	855	4629	5400	3662	9062	4957	2321	7278	4642	1115	5757
2015	5347	1488	6835	5520	2760	8280	5695	2835	8530	4905	345	5251
2016	4562	1130	5692	6367	3340	9707	4801	3751	8552	6150	765	6915
2017	951	949	1900	1191	1606	2797	2863	1259	4122	4080	670	4750
2018	3528	554	4082	4285	1911	6196	3630	1661	5291	2991	470	3461
2019	3669	635	4304	3770	1554	5324	2632	819	3451	3257	566	3823
2020	2669	228	2897	1222	970	2192	1217	435	1652	1185	1061	2246
2021	1265	62	1327	3008	698	3706	2283	1018	3301	810	856	1666
2022	1258	723	1981	3261	1491	4752	3637	1309	4946	981	462	1443
Total	27023	6624	33647	34024	17992	52016	31715	15408	47123	29001	6310	35312

Table 11.4. *Nephrops* in FUs 23-24 Bay of Biscay (8a,b). Derivation and estimation of discards.

1987	sampled
1988-1990	from 1987's logistic function of sorting by quarter+density of probability
1991	sampled
1992-1997	from 1991's logistic function of sorting by quarter+density of probability
1998	sampled
1999-2002	from 1998's logistic function of sorting by quarter+density of probability
since 2003	sampled

Table 11.5. *Nephrops* in FUs 23-24 Bay of Biscay (8a,b). Quarterly and yearly discards from onboard sampling program.

year	quarter	sampled FO	total FO	nb_trips	total trips	Nb <i>Nephrops</i>
2014	1	7	13	4	2689	377
	2	25	91	13	5615	1146
	3	21	99	12	5274	712
	4	10	27	8	3973	436
	total	63	230	37	17551	2671
2015	1	16	28	7	2785	655
	2	36	124	14	5598	1334
	3	28	131	13	4999	747
	4	7	31	3	3480	194
	total	87	314	37	16862	2930
2016	1	16	39	7	3441	549
	2	40	119	15	6207	1168
	3	46	153	17	5443	1135
	4	15	85	8	3906	256
	total	117	396	47	18997	3108
2017	1	20	97	9	3719	516
	2	29	138	12	6139	932
	3	23	55	9	4850	793
	4	10	26	17	3498	332
	total	82	316	37	18206	2573
2018	1	8	25	6	3015	237
	2	28	65	11	5784	1222
	3	25	67	14	4895	898
	4	9	29	8	3058	215
	total	70	186	39	16752	2572
2019	1	10	24	8	3366	367
	2	24	58	14	5610	1076
	3	16	42	9	4381	360
	4	8	20	5	2791	234
	total	58	144	36	16148	2037
2020	1	3	6	3	2622	118
	2	12	27	8	5178	527
	3	6	14	5	4660	280
	4	16	50	9	2768	476
	total	37	97	25	15228	1401
2021	1	3	15	3	3599	30
	2	9	39	7	5658	386
	3	13	30	7	4426	562
	4	13	30	9	2378	352
	total	38	114	26	16061	1330
2022	1	9	23	5	2719	247
	2	21	41	12	5034	780
	3	19	42	10	4220	644
	4	5	17	5	2104	214
	total	54	123	32	14077	1885

Table 11.6.a. *Nephrops* in FUs 23-24 Bay of Biscay (8a,b) landings length distributions in 2003-2022.

Landings CL mm/°	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
10																				
11																				
12																				
13																				
14																				
15																				
16																				
17	20	7																		
18	14		25	5	4	12									6					9
19		14	27						1		5				18					50
20	87	47	82	5	4	77	37	14	22	35	31	1	16	21	24	18		81	100	217
21	280	249	270	70	14	191	73	75	6	25	151	74	130	138	320	106	15	232	310	523
22	661	899	771	131	18	208	288	252	11	235	682	180	575	532	368	90	153	230	642	661
23	1614	2194	2588	227	48	322	473	386	111	334	1002	764	1121	772	1155	185	331	480	1458	1399
24	3966	5664	6511	822	188	721	1929	1238	515	1399	3162	1836	2523	1341	1787	410	1166	1479	2279	2269
25	8164	10630	13678	2844	1201	2742	3670	3940	1803	3843	7873	4419	3478	3842	3845	1823	4325	3502	5668	4789
26	13297	13998	17811	6576	5684	6319	8258	8499	4773	7875	13242	7910	9702	6651	7285	4362	8273	7187	9535	8812
27	17614	16094	22006	12010	9439	10891	12759	14173	7530	11079	14926	12869	9702	12566	14413	6905	11811	11125	14067	11170
28	18572	15350	21879	14647	13248	12640	15732	15390	8991	11920	13260	13788	14431	16617	14546	7753	12245	12670	14468	12760
29	16843	14808	18027	14591	12516	12890	13524	15340	9602	11120	13397	14560	13726	18269	17209	9186	11409	10421	13680	12868
30	17264	14143	15570	13690	12219	10726	13271	15736	8821	9636	10296	12662	13690	16596	16695	8812	10076	11320	14357	10261
31	13345	12353	12634	11814	10698	9772	10859	12749	8253	8393	9137	11051	12456	16820	12979	8307	7377	10397	10286	10154
32	11276	10322	9907	9694	9274	8845	9310	11366	6954	7414	7116	10354	12021	13096	12950	6417	6352	7660	9702	11747
33	8253	8020	7800	8421	7859	7436	7086	8851	6175	6069	5558	6509	9882	12519	7752	7079	5178	6198	7770	6395
34	6195	6298	6537	7112	6539	6425	5985	7140	5467	4505	4123	6657	7881	8416	7638	4991	4882	3911	6201	5519
35	4653	4673	5100	5135	6529	5366	4568	5852	4541	3507	2783	4961	6122	6809	5052	3676	4423	3802	4612	4681
36	3818	3308	3369	4104	4735	3867	3697	3626	4260	2649	1978	3264	5219	6474	4829	3537	2292	3126	3502	3062
37	3075	2875	2597	3196	3839	3121	2565	3024	3648	1976	1472	2682	4511	4785	2620	2263	1749	1718	2685	1616
38	2660	2098	2380	2662	2639	2398	1871	2247	3911	1563	998	1783	3311	3342	2005	1890	1189	1684	2204	1158
39	2174	1683	1650	1956	2245	2043	1491	1630	3472	1314	936	1844	2726	2850	2176	1775	946	696	1598	1492
40	1936	1555	1628	1599	1711	1633	1190	1280	3296	1103	518	843	2676	1976	1294	1232	942	788	1157	680
41	1423	1188	1154	1171	1227	1190	878	966	2740	878	438	669	1635	1394	1020	652	530	441	896	978
42	1403	889	953	990	1111	1015	742	742	2497	635	351	412	1284	1185	779	329	329	374	626	694
43	1054	774	842	741	710	805	540	560	2157	558	320	343	883	749	585	388	330	317	479	516
44	810	707	640	633	746	706	473	509	1762	536	249	234	637	658	471	319	129	192	350	304
45	808	613	605	595	518	536	396	442	1177	478	177	206	467	708	442	296	107	151	360	367
46	535	485	415	479	373	405	307	305	1024	441	181	159	236	368	271	153	79	118	205	220
47	456	388	353	440	311	361	262	290	858	378	88	151	216	332	261	86	80	113	238	171
48	339	313	339	382	257	294	245	237	656	381	98	87	149	230	143	80	46	77	159	90
49	206	318	288	319	237	262	196	204	557	212	74	72	200	195	100	51	30	66	146	66
50	253	306	276	287	190	228	156	160	501	160	46	63	108	123	126	68	36	53	107	102
51	170	214	176	246	163	201	115	135	383	132	37	58	68	83	53	32	27	26	78	47
52	150	152	184	201	138	116	110	120	296	128	32	24	46	88	96	36	24	26	56	42
53	120	111	142	137	140	121	98	97	198	96	24	42	33	56	37	21	13	12	33	33
54	80	90	104	156	115	95	63	95	271	93	17	18	29	59	49	18	11	6	31	35
55	57	47	109	137	79	73	75	79	152	58	15	11	26	23	38	10	5	8	8	40
56	23	86	69	117	60	67	54	75	132	46	8	5	15	21	24	8	2	2	3	16
57	47	49	58	134	70	41	31	67	98	48	22	10	18	7	12	6	1	3	1	23
58	22	27	43	134	45	40	48	47	105	52	3	8	5	7	12	11	3	3	2	27
59	10	32	41	85	33	19	23	48	79	33	12	3	3	8	6	1	2	1	1	14
60	8	10	19	115	33	23	14	42	48	22	3	2	3	5	7	3		3	2	21
61	5	5	28	40	23	7	8	30	39	15	8	1		3	2	1	1		22	13
62	4	3	16	21	9	9	9	16	55	18	1	1	7	3	6	3		2	1	10
63	1	5	9	19	9	7	10	7	23	11	2	1			1	1		3		6
64		8	8	18	10	6	3	16	12	8			1	1	2	72		22		3
65		1	14	11	9	1	3	9	11	7			1	1	3			1		11
66	1	1	6	10	1		2	3	11	3				1	1					3
67		1	5	8	1		2	3	6	1										3
68		2	4	7	3			4	7											6
69	1		1	6	2		1	1	2	2										7
70			2	4				1	2					1	1					7
71	1		1	5				1	1											6
72			1	5								1								6
73				2	1															1
74				4					1			1								2
75			1	4					1	1				2	5				2	8
Total	163771	154405	179758	128777	112723	115274	123804	138120	108011	101424	114853	121594	138920	161371	143502	83463	96919	100704	130114	116190
Weights	3886	3571	3991	3447	3176	3030	2987	3398	3559	2520	2380	2807	3569	4091	3412	2125	2154	2273	3006	2694

Table 11.6.b. *Nephrops* in FUs 23-24 Bay of Biscay (8a,b) discards length distributions in 2003-2022.

Total Discards CL mm ⁺	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
10	28				22		82								26			55		31
11			94		171	38	135	2								23	8		25	136
12	70	363	413	70	202	98	79		237								8		78	216
13	294	1722	1085	234	122	235	177	97	596	532		28	184	76	111	47	110	83	431	554
14	636	3152	3190	1138	900	389	291	83	834	665	229	101	606	327	384	31	428	249	391	1061
15	1198	5548	7287	3102	1288	189	1157	155	941	1425	870	281	1476	578	1228	533	583	457	435	921
16	3386	6784	13528	7810	2959	1027	2315	822	1230	4544	1313	1300	2354	569	1668	1029	606	75	803	2974
17	5927	8836	15094	11655	3636	1832	3059	1333	2430	4737	4179	1647	3242	2717	3697	3499	741	506	1584	3235
18	8078	10161	19795	16139	4590	2626	4843	2309	3630	8066	3372	2808	5073	5207	4175	6531	1456	1598	3169	3122
19	11506	17361	19522	25891	5244	6473	6485	3532	4546	8024	8730	3822	8084	9685	8517	7534	1951	3456	5963	6964
20	12142	19250	22265	39742	8735	11444	12766	5692	7227	10125	9682	6457	9246	9420	13805	9555	3042	5479	9789	6688
21	18597	25898	32409	54230	11585	15630	16772	7699	10393	12145	15281	9195	10952	12022	16601	13562	4330	8770	10652	7911
22	21416	25210	35523	69870	17930	24730	18701	11689	15161	14034	20618	11384	11324	15704	16245	17648	6379	11969	9220	8871
23	28429	26756	40041	70094	24086	27560	21693	13672	13837	12904	26287	15130	14109	18312	20400	20617	6817	17291	11897	9057
24	26501	21343	36279	55408	30615	29638	24105	16963	15551	14889	21750	14000	16820	19435	21961	16825	8875	20577	11417	9293
25	23211	20085	30222	52660	32917	28007	20736	14670	16545	10873	17823	18051	18746	22159	21886	18966	8383	22133	11259	8468
26	17357	12006	19003	38812	27376	23127	14205	11852	10047	7747	10188	11947	15874	24994	21474	12621	6065	21676	8490	7682
27	9680	6436	8498	20124	20567	10129	9188	8558	8127	4304	5439	8155	11931	17139	13660	8548	3506	14931	7107	3642
28	6187	3487	4603	10263	10365	5893	5927	5986	3201	919	2824	5026	8056	11441	11398	5719	2625	8239	5407	1637
29	2537	2115	1201	4188	4464	3225	3163	3360	2086	588	2146	2316	5771	10887	5361	3151	913	5056	2871	1215
30	1605	1901	1600	2578	2868	1923	3261	1876	2011	680	945	1672	4714	5283	5464	1457	885	3741	1345	878
31	1326	1115	1417	1109	1316	925	1824	1274	1246	125	922	1263	2033	4343	3766	1135	517	2567	907	529
32	574	735	526	592	737	454	839	716	492	200	684	1482	1745	2458	2470	513	181	1657	183	99
33	313	503	296	544	484	421	671	350	265	13	365	384	812	3193	814	1014	183	2332	1274	168
34	261	385	553	411	537	1025	830	274	272	145	494	433	1108	1071	1132	744	146	439	547	110
35	176	424	260	230	265	206	332	242	174	24	233	125	147	874	1540	296	163	186	163	68
36	113	108	46	73	336	78	197	55	59	3	260	391	243	774	503	140	74	10	75	147
37	83	74	246	25	299	153	188	162	149	146	130	45	298	573	681	11	8	333	357	14
38	93	31	116	99	40	93	269	16	97	68	81	71	246	576	320	18	8	115	31	14
39	15	139	147		3	369	55	33	24		33	230	65	598	409	60	35		41	30
40	37	73	37	169	47		66	38	25	3		122	175	72	235	39	64	261		52
41	34	60	20		40		8	4				7	46	148	126	40				1
42	4	12	31		20	53		4	157				508	186	139		8	161		15
43	14	13			11		38		4	4		152	199		202	20				15
44		13					14	6					12		164				13	
45	13			36					5					56	38					
46								6						44	77					7
47									6			7			23					1
48						8				36										
49													23							
50					11															14
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75																				
Total	201841	222102	315346	487288	214788	198031	174480	113530	121603	117935	154914	117930	156400	200973	200600	151926	59102	154401	105925	85841
Weights	1977	1932	2698	4544	2411	2123	1833	1275	1263	1012	1521	1326	1822	2531	2387	1571	634	1908	1126	791

Table 11.6.c. *Nephrops* in FUs 23-24 Bay of Biscay (8a,b) catches length distributions in 2003-2022.

Total catches CL mm ³	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
10	28				22		82								26			55		31
11			94		171	38	135	2								23	8		25	136
12		363	413		202	98	79										8		78	216
13	294	1722	1085	234	122	235	177	97	237			28	184	76	111	47	110	83	431	554
14	636	3152	3190	1138	900	389	291	83	834	665		101	606	327	384	31	428	249	391	1061
15	1198	5548	7287	3102	1288	189	1157	155	941	1425	229	281	1476	578	1228	533	583	457	435	921
16	3386	6784	13528	7810	2959	1027	2315	822	1230	4544	1313	1300	2354	569	1668	1029	606	75	803	2974
17	5947	8843	15094	11655	3636	1832	3059	1333	2430	4737	4179	1647	3242	2717	3697	3499	741	506	1584	3235
18	8092	10161	19820	16144	4593	2638	4843	2309	3630	8066	3372	2808	5073	5207	4181	6531	1456	1598	3169	3132
19	11506	17376	19549	25891	5244	6473	6485	3532	4546	8024	8735	3822	8084	9685	8535	7534	1951	3456	5963	7015
20	12229	19297	22348	39747	8738	11521	12803	5706	7249	10160	9713	6458	9262	9441	13829	9573	3042	5560	9889	6905
21	18877	26146	32679	54289	11598	15820	16845	7775	10398	12170	15433	9249	11082	12160	16921	13668	4346	9001	10962	8434
22	22077	26109	36293	70001	17948	24938	18989	11941	15171	14269	21300	11464	11899	16237	16613	17738	6531	12199	9862	9531
23	30042	28950	42629	70322	24134	27882	22167	14058	13948	13238	27289	15894	15231	19084	21554	20802	7148	17771	13355	10456
24	30467	27006	42790	56230	30803	30359	26034	18202	16065	16288	24913	15836	19343	20775	23747	17236	10041	22055	13696	11562
25	31376	31015	43900	55504	34119	30750	24406	18610	18348	14716	25696	22470	22223	26001	25731	20789	12708	25635	16928	13257
26	30654	26004	36814	45189	33060	29446	22463	14820	15622	23430	19857	22526	32279	30738	16983	14338	28863	18026	16493	
27	27294	22530	30504	32134	30006	21020	21948	22730	15647	15383	20365	21024	21633	29705	28073	15453	15317	26056	21174	14811
28	24759	18837	26482	24909	23613	18533	21659	21375	12191	12838	16084	18814	22487	28058	25844	13471	14869	20909	19875	14397
29	19381	16923	19228	18779	16980	16115	16687	18700	11687	11708	15543	16876	19498	29156	22570	12337	12322	15476	16551	14083
30	18868	16044	17170	16268	15087	12649	16531	17612	10832	10315	11241	14334	18403	21879	22159	10269	10961	15061	15702	11139
31	14672	13469	14051	12923	12014	10697	12682	14024	9500	8518	10059	12314	14489	21163	16745	9442	7893	12964	11193	10684
32	11849	11057	10433	10286	10011	9299	10150	12082	7447	7614	7801	11836	13766	15554	15419	6930	6533	9317	9885	11846
33	8566	8523	8095	8965	8343	7857	7757	9201	6440	6082	5923	6892	10695	15712	8566	8093	5362	8530	9044	6563
34	6456	6684	7090	7524	7076	7449	6815	7414	5739	4649	4617	7091	8990	9487	8770	5735	5028	4350	6748	5629
35	4829	5097	5361	5366	6793	5573	4900	6094	4715	3531	3016	5087	6270	7683	6592	3972	4586	3989	4775	4749
36	3931	3416	3415	4177	5071	3945	3894	3681	4319	2652	2237	3654	5462	7247	5332	3677	2366	3136	3577	3209
37	3158	2949	2844	3221	4138	3273	2753	3186	3797	2122	1602	2727	4809	5358	3302	2274	1758	2052	3042	1630
38	2752	2129	2496	2760	2679	2491	2139	2263	4007	1632	1079	1854	3556	3918	2325	1908	1197	1799	2235	1172
39	2189	1822	1797	1956	2247	2412	1546	1662	3496	1314	968	2075	2791	3448	2585	1835	981	696	1639	1523
40	1973	1628	1665	1768	1758	1633	1257	1318	3321	1107	518	965	2851	2048	1529	1271	1006	1049	1157	732
41	1457	1248	1174	1171	1267	1190	886	971	2740	878	438	676	1681	1542	1146	691	530	441	896	979
42	1407	901	984	990	1130	1069	742	746	2654	635	351	412	1792	1370	918	329	337	535	626	709
43	1068	787	842	741	722	805	578	560	2161	563	320	495	1082	749	787	407	330	317	479	531
44	810	719	640	633	746	706	487	515	1762	536	249	234	649	658	636	319	129	192	363	304
45	821	613	605	631	518	536	396	442	1182	478	177	206	523	708	480	296	107	151	360	367
46	535	485	415	479	373	405	307	312	1024	441	181	159	280	445	271	153	79	118	205	227
47	456	388	353	440	311	361	262	290	865	378	88	158	216	332	284	86	80	113	238	173
48	339	313	339	382	257	294	254	237	656	381	134	87	149	230	143	80	46	77	159	90
49	206	318	288	319	237	262	196	204	557	212	74	72	223	195	100	51	30	66	146	66
50	253	306	276	287	201	228	156	160	501	160	46	63	108	123	126	68	36	53	107	116
51	170	214	176	246	163	201	115	135	383	132	37	58	68	83	53	32	27	26	78	47
52	150	152	184	201	138	116	110	120	296	128	32	24	46	88	96	36	24	26	56	42
53	120	111	142	137	140	121	98	97	198	96	24	42	33	56	37	21	13	12	33	33
54	80	90	104	156	115	95	63	95	271	93	17	18	29	59	49	18	11	6	31	35
55	57	47	109	137	79	73	75	79	152	58	15	11	26	23	61	10	5	8	8	40
56	23	86	69	117	60	67	54	75	132	46	8	5	15	21	24	8	2	2	3	16
57	47	49	58	134	70	41	31	67	98	48	22	10	18	7	12	6	1	3	1	23
58	22	27	43	134	45	80	48	47	105	52	3	8	5	7	12	11	3	3	2	27
59	10	32	41	85	33	19	23	48	79	33	12	3	3	8	6	1	2	1		14
60	8	10	19	115	33	23	14	42	48	22	3	2	3	5	7	3		3	2	21
61	5	5	28	40	23	7	8	30	39	15	8	1		3	2	1	1		22	13
62	4	3	16	21	9	9	9	16	55	18	1	1	7	3	6	3		2	1	10
63	1	5	9	19	9	7	10	7	23	11	2	1			1	1			3	6
64		8	8	18	10	6	3	16	12	8			1	1	2	72			22	3
65		1	14	11	9	1	3	9	11	7			1	1	3			1		11
66	1	1	6	10	1		2	3	11	3				1	1					3
67		1	5	8	1		2	3	6	1										3
68		2	4	7	3			4	7											6
69	1		1	6	2		1	1	2	2										7
70			2	4				1	2					1	1					7
71	1		1	5				1	1											6
72			1	5													3			6
73				2	1															6
74				4																2
75			1						1			1		2				2		8
Total	365612	376507	495103	616065	332060	313304	297984	251649	229614	219358	269766	239522	295318	362344	344101	235388	156020	255104	236037	202032
Weights	5863	5503	6689	7990	5587	5154	4820	4673	4822	3532	3900	4133	5391	6622	5799	3696	2789	4181	4132	3485

Table 11.7. Total number of burrows (10⁶) and CVs by spatial stratum and for the whole Bay of Biscay. Years 2016-2022 after including rough sea bottom (noted RO) contained in the outline of the Central Mud Bank (WK benchmark 2016). The area S_h involves in the revised total surface of the stock (WD9, WGBIE 2022 ; 14 640 km² instead of 16 164 km² previously validated by the WK benchmark 2016).

2016													
h	S _h	n _h	Σ S _h ²	Σ S _h	Σ X _h ²	Σ X _h	Σ S _h ·X _h	Cov[S _h ,X _h]	V[S _h]	V[X _h]	Y _h	σ[Y _h]	CV
CB	2571.6	35	898958	5441.9	138084	1404.5	237404	559.65	1553.94	2403.64	535.25	106.19	19.84
CL	1152.9	22	617859	3599.5	66462	851.5	149838	501.07	1378.38	1595.47	219.95	45.90	20.87
LI	4603.6	61	1643332	9857.0	293757	2850.0	487251	445.32	842.36	2676.69	1073.44	146.78	13.67
RO	2987.0	20	602733	3381.9	79735	755.5	128976	64.43	1624.66	2694.54	538.13	166.95	31.02
VS	633.1	9	270183	1510.1	227625	1267.0	221684	1136.82	2100.35	6157.44	428.34	76.76	17.92
VV	2691.7	32	732177	4706.0	505117	3021.5	483206	1253.39	1293.45	7091.00	1393.69	202.36	14.52
total	14639.9	179	4765242	28496.4	1310780	10150.0	1708358				4188.80	331.12	7.90
2017													
h	S _h	n _h	Σ S _h ²	Σ S _h	Σ X _h ²	Σ X _h	Σ S _h ·X _h	Cov[S _h ,X _h]	V[S _h]	V[X _h]	Y _h	σ[Y _h]	CV
CB	2571.6	22	813364	4177.8	33043	633.5	119573	-34.66	952.63	704.83	314.48	63.22	20.10
CL	1152.9	12	328243	1946.7	29080	510.0	88578	531.28	1131.34	673.14	243.58	35.96	14.76
LI	4603.6	38	1330924	7042.1	102075	1477.5	272743	-28.77	700.09	1206.14	778.94	114.86	14.75
RO	2987.0	19	714364	3591.6	91529	748.0	121830	-1086.90	1969.73	3448.94	501.69	184.60	36.80
VS	633.1	3	59051	416.6	86866	478.0	66548	86.68	602.31	5352.08	585.80	163.68	27.94
VV	2691.7	19	576761	3239.7	163766	1375.5	232348	-121.58	1353.53	3565.93	921.63	182.70	19.82
total	14639.9	113	3822707	20414.4	506357	5222.5	901620				3346.12	335.75	10.03
2018													
h	S _h	n _h	Σ S _h ²	Σ S _h	Σ X _h ²	Σ X _h	Σ S _h ·X _h	Cov[S _h ,X _h]	V[S _h]	V[X _h]	Y _h	σ[Y _h]	CV
CB	2571.6	31	723778	4616.3	97276	1196.0	179278	39.21	1211.35	1704.45	537.30	105.10	19.56
CL	1152.9	16	359325	2353.7	172468	1216.0	184779	393.37	872.64	5336.80	480.35	113.54	23.64
LI	4603.6	60	1397621	8809.1	136681	2046.0	302892	42.37	1767.30	1134.11	862.28	113.55	13.17
RO	2987.0	28	1483862	5412.3	83889	842.0	172404	357.34	16210.44	2169.22	374.75	116.58	31.11
VS	633.1	10	177252	1312.2	177370	1103.5	144600	-21.77	564.18	6177.67	429.35	100.06	23.30
VV	2691.7	30	924623	4973.3	326602	2446.0	383413	-761.35	3453.72	4385.22	1067.60	184.71	17.30
total	14639.9	175	5066461	27476.9	994286	8849.5	1367366				3751.64	307.49	8.20
2019													
h	S _h	n _h	Σ S _h ²	Σ S _h	Σ X _h ²	Σ X _h	Σ S _h ·X _h	Cov[S _h ,X _h]	V[S _h]	V[X _h]	Y _h	σ[Y _h]	CV
CB	2571.6	23	728947	3929.5	46206	697.0	110158	-405.63	2617.78	1140.18	367.86	93.56	25.43
CL	1152.9	8	184678	1189.3	58643	479.5	63229	-1150.31	1126.24	4271.89	374.87	162.23	43.28
LI	4603.6	44	872771	6051.3	128852	1769.5	240385	-69.15	942.77	1341.62	1085.63	155.64	14.34
RO	2987.0	24	551433	3514.6	49144	683.5	100068	-1.09	1597.79	1290.36	468.47	123.43	26.35
VS	633.1	10	268032	1592.4	110618	933.0	142124	-716.34	1606.36	2618.79	299.12	64.20	21.46
VV	2691.7	30	621094	4163.6	385452	2750.5	415613	1168.37	1491.35	4595.77	1433.98	173.77	12.12
total	14639.9	139	3226955	20440.7	778915	7313.0	1071577				4029.92	329.92	8.19
2020													
h	S _h	n _h	Σ S _h ²	Σ S _h	Σ X _h ²	Σ X _h	Σ S _h ·X _h	Cov[S _h ,X _h]	V[S _h]	V[X _h]	Y _h	σ[Y _h]	CV
CB	2571.6	26	706682	4252.2	10224	370.0	61679	46.66	449.65	198.34	180.46	34.61	19.18
CL	1152.9	9	236908	1455.7	33468	344.0	57593	244.30	183.47	2539.94	219.72	94.55	43.03
LI	4603.6	47	1295960	7724.4	126323	1572.0	251552	-147.93	575.20	1603.13	755.55	135.34	17.91
RO	2987.0	15	454630	2581.4	93880	651.5	109358	-197.25	741.68	4684.53	607.95	251.21	41.32
VS	633.1	8	245351	1392.0	263808	1291.5	227853	447.02	448.20	7901.60	473.67	89.58	18.91
VV	2691.7	27	774428	4514.5	363262	2415.0	403498	-11.52	753.23	5663.58	1161.19	191.77	16.51
total	14639.9	132	3713960	21920.2	890964	6644.0	1111534				3398.54	369.27	10.87
2021													
h	S _h	n _h	Σ S _h ²	Σ S _h	Σ X _h ²	Σ X _h	Σ S _h ·X _h	Cov[S _h ,X _h]	V[S _h]	V[X _h]	Y _h	σ[Y _h]	CV
CB	2571.6	30	483080	3757.7	23560	522.0	62692	-92.82	427.59	499.20	288.09	69.80	24.23
CL	1152.9	14	254977	1872.7	28203	468.5	63060	29.97	343.41	963.44	232.60	57.85	24.87
LI	4603.6	60	1035986	7828.6	119160	1732.0	230389	74.64	246.43	1172.25	821.38	124.64	15.17
RO	2987.0	29	463880	3624.4	44107	565.0	70080	-19.03	389.60	1182.10	375.52	123.86	32.98
VS	633.1	9	139495	1108.0	128651	847.0	109535	656.96	384.60	6117.36	390.26	100.99	25.88
VV	2691.7	33	554490	4197.3	227645	2181.0	282939	172.96	644.56	2609.38	1127.93	151.59	13.44
total	14639.9	175	2931907	22388.8	571324	6315.5	818695				3235.76	268.84	8.31
2022													
h	S _h	n _h	Σ S _h ²	Σ S _h	Σ X _h ²	Σ X _h	Σ S _h ·X _h	Cov[S _h ,X _h]	V[S _h]	V[X _h]	Y _h	σ[Y _h]	CV
CB	2571.6	30	435027	3580.7	24310	455.5	55423	36.41	263.53	599.78	263.82	77.37	29.33
CL	1152.9	14	195082	1624.8	35864	494.0	59988	204.38	501.43	1417.91	282.69	78.38	27.73
LI	4603.6	59	908225	7236.4	112704	1746.5	212911	-22.40	356.39	1051.80	896.03	129.71	14.48
RO	2987.0	29	459594	3601.3	32365	543.0	66471	-34.27	442.04	792.78	363.21	102.72	28.28
VS	633.1	10	141224	1171.8	302708	1333.0	142560	-1515.53	435.08	13891.01	580.77	184.34	31.74
VV	2691.7	32	475803	3848.9	447118	2634.5	325319	272.46	415.02	7426.59	1485.80	271.61	18.28
total	14639.9	174	2614955	21063.9	955068	7206.5	862672				3872.31	383.74	9.91

Table 11.8. Estimation of the abundance of *Nephrops* burrows (10⁶) by UWTV. Example of years 2014 and 2015 (rough numbers of burrows with no correction by cumulative bias factor equal to 1.24; WKNEP (ICES, 2017a)).

Year	2014		2015	
Number of data	204	204	114	114
Method of estimate for average (A=arithmetic; KO=ordinary kriging)	A	KO	A	KO
Estimation	0.415930	0.425463	0.410321	0.414796
	0.052829	0.046598	0.180002	0.183475
CV geo				
CV iid	0.072647	-	0.082643	-
Surface (km ²)	11 676	11 676	11 676	11 676
Abundance (Estimation * Surface)	4 856	4 968	4 791	4 843

Table 11.9. *Nephrops* in FUs 23-24 Bay of Biscay (8a,b). Effort and LPUE values of commercial fleets.

Year	Le Guilvinec District Quarter 2		
	Landings(t)	Effort(100h)	LPUE(Kg/h)
1987	603	437	13.81
1988	777	471	16.52
1989	862	664	12.99
1990	801	708	11.31
1991	717	728	9.84
1992	841	757	11.12
1993	805	735	10.96
1994	690	671	10.30
1995	609	627	9.72
1996	715	598	11.97
1997	638	539	11.83
1998	622	489	12.72
1999	505	423	11.93
2000	438	405	10.82
2001	697	417	16.71
2002	527	371	14.20
2003	487	356	13.68
2004	410	321	12.74
2005	455	336	13.57
2006	414	306	13.50
2007	401	291	13.76
2008	410	271	15.15
2009	384	279	13.78
2010	471	253	18.61
2011	422	279	15.13
2012	348	229	15.17
2013	288	224	12.83
2014	252	198	12.73
2015	451	231	19.52
2016	475	241	19.74
2017	520	238	21.88
2018	374	220	16.98
2019	338	216	15.66
2020	296	190	15.61
2021	338	212	15.94
2022	312	188	16.60

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