

Contents

14	Norway lobster (<i>Nephrops norvegicus</i>) in Division 6.a, Functional Unit 13 (West of Scotland, the Firth of Clyde and Sound of Jura)	480
	Type of assessment in 2022	480
	ICES advice applicable to 2021	480
	ICES advice applicable to 2022	480
14.1	General.....	480
	Stock description	480
	Management applicable to 2021 and 2022.....	481
	Ecosystem aspects.....	481
	Fishery description	481
14.2	Data available	481
	InterCatch.....	481
	Commercial catch.....	482
	Effort data	482
	Sampling levels	483
	Length compositions	483
	Sex ratio.....	483
	Mean weights.....	483
	Discarding.....	484
	Abundance indices from UWTV surveys	484
14.3	Assessment	485
	Comparison with previous assessments	485
	State of the stock.....	485
14.4	Catch option table.....	485
14.5	Reference points.....	486
14.6	Management strategies	487
14.7	Quality of assessment and forecast	487
14.8	Recommendation for next benchmark.....	488
14.9	Management considerations	488
14.10	References	489

14 Norway lobster (*Nephrops norvegicus*) in Division 6.a, Functional Unit 13 (West of Scotland, the Firth of Clyde and Sound of Jura)

Type of assessment in 2022

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the process defined by the benchmark WG (WKNEPH, 2009; WKNEPH, 2013). Full details are provided in the stock annex.

ICES advice applicable to 2021

‘ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, catches in 2021 that correspond to the F ranges in the MAP are between 3638 tonnes and 5425 tonnes (3142–4791 tonnes for the Firth of Clyde and 496–634 tonnes for the Sound of Jura), assuming recent discard rates. The entire range is considered precautionary when applying the ICES advice rule.

To ensure that Nephrops stocks are exploited sustainably, management of Nephrops should be implemented at the functional unit level. In this particular functional unit (FU), additional measures should be implemented to ensure that landings taken in each subarea (the Firth of Clyde and the Sound of Jura) are in line with the advice.’

ICES advice applicable to 2022

‘ICES advises that when the MSY approach is applied, and assuming that discard rates and fishery selection patterns do not change from the average of the years 2018–2020, catches in 2022 should be no more than 4235 tonnes (3607 tonnes for the Firth of Clyde and 628 tonnes for the Sound of Jura).

To ensure that the stock in Functional Unit (FU) 13 is exploited sustainably, management should be implemented at the FU level. In this particular FU, additional measures should be implemented to ensure that landings taken in each subarea (the Firth of Clyde and the Sound of Jura) are in line with the advice.

ICES notes the existence of a management plan, developed and adopted by one of the relevant management authorities for Subarea 6. ICES considers this plan to be precautionary when implemented at the FU level.’

14.1 General

Stock description

The Clyde functional unit (FU13) is located in the southern waters off the west coast of Scotland (see. Section 12 FU11 North Minch, Figure 12.1). It is comprised of two distinct patches in the Firth of Clyde and the Sound of Jura, to the east and west of the Mull of Kintyre respectively. The hydrography of the two subareas differs, with the Sound of Jura characterised by stronger tidal currents and the Firth of Clyde exhibiting features of a lower energy environment with a shallow entrance sill. Owing to its burrowing behaviour, the distribution of *Nephrops* is restricted to areas of mud, sandy mud and muddy sand. Within the two distinct patches, these substrates are distributed according to prevailing hydrographic and bathymetric conditions. The available

area of suitable sediment is smaller in the Sound of Jura, occupying only the deepest parts of the Sound, while in the Firth of Clyde these sediments predominate. Further details are provided in the stock annex.

Management applicable to 2021 and 2022

Management is at the ICES subarea level as described at the beginning of Section 12 FU11 North Minch.

Ecosystem aspects

Details of the ecosystem aspects for this functional unit are provided in the stock annex where available.

Fishery description

Information on developments in the fishery was provided by Marine Scotland fishery compliance officers.

There are 26 *Nephrops* vessels including 20 trawlers and six creelers fishing out of Ayr. Six boats left the fleet in 2021 due to crewing difficulties. All trawlers use 80 mm single or twin rigs with square mesh panels (SMP) of at least 160 mm, in accordance with The Sea Fishing (Licences and Notices) (Scotland) Regulations 2011. *Nephrops* trawling vessels with power >200 kW, or >12m, are required to use a 300 mm SMP.

The activity of Northern Irish vessels was not perceived to be high since 2017, when compared to previous years. Many vessels have moved to other areas where there was better fishing, some travelling as far away as Eyemouth, and vessels fishing in FU13 did not land locally instead going back to their home port because of better fuel and market prices.

Mobile gear is banned in the Inshore Clyde from Friday night to Sunday night as are vessels greater than 21 m in length. Most creel boats operating in the Clyde have two crew members and operate around 1000 creels. Creeling activity now takes place quite widely in the northern parts of the Firth operating on some of the same grounds but often taking place during the weekend trawling ban.

In terms of the influence of Marine Protected Area (MPA) management measures on the fishery, the South Arran Nature Conservation MPA (NCMPA) removed a large sea area for *Nephrops* trawlers to operate over. Trawlers which would have operated in this area were displaced to areas where they would not have targeted previously, or where they would have only operated in poor weather conditions. This allowed creelers to move into the areas where trawling was banned. There have been recent reports of increases in creel numbers in this area and this has resulted in gear conflict within the creel sector. The small area of the Upper Loch Fyne NCMPA closed to trawlers was reported to have had little impact.

Further general information on the fishery can be found in the stock annex.

14.2 Data available

InterCatch

Commercial data for 2021 were uploaded to InterCatch prior to the 2022 WG meeting. Uploaded data were worked up in InterCatch to generate 2021 raised international length–frequency

distributions. Allocation schemes for any unsampled fleets are described in the stock annex. Data exploration in InterCatch has previously shown that outputs of raised data were very close to those generated by the previous method applied internally with differences being <0.1%. As such, InterCatch length–frequency outputs have been used in the stock assessment since 2012.

The COVID-19 pandemic resulted in a reduced sampling effort of commercial catches for FU13 in 2021, as was also the case in 2020. There were no representative discards samples collected for FU13 in 2021, thus alternate methods of estimating discards were explored. It was agreed at WGCSE that estimates of discard rates and size distributions for 2021 would be based on an averaging of discard samples across all quarters from 2017–2019, the same procedure that was carried out for 2020 discards. Minimum and maximum discard rates over the same period were also examined to gain an appreciation of the plausible range of discarding that might have occurred in 2021. Assessment estimates affected by changes in discard rates are annotated hereafter to reflect this; i.e. “ x (y/z)”, where x is the estimate based on the average discard rate 2017–2019, y is based on minimum discard rate, and z on maximum discard rate over the same period.

Commercial catch

Official catch statistics (landings) reported to ICES are shown in Table 12.1.1 (see. Section 12 FU11 North Minch). These relate to the whole of area 6.a of which the FU13 is a part. Landings statistics for FU13 provided through national laboratories are presented in Table 14.1.1, broken down by country and by gear type. Landings from this fishery are predominantly reported from Scotland, although Northern Ireland contributed 904 tonnes in 2021. Total reported Scottish landings in 2021 were 4088 tonnes (plus 907 tonnes from other UK vessels i.e. Northern Ireland & England), consisting of 3805 tonnes landed by trawlers (93%) and 233 tonnes (5.7%) landed by Scottish creel vessels. Scottish creel landings have generally increased in the most recent years, from approximately 3% in 2012 to just below 6% of total landings in 2021.

Statistical rectangle 40E4 covers parts of both the Firth of Clyde and the Sound of Jura. Table 14.2.1 shows the split in landings between the two subareas comprising FU13. Historically the allocation of landings to the two components of FU13 was carried out by the fishery office and required them to have detailed knowledge of where vessels have been fishing within 40E4. The apparent sudden decline in landings from the Sound of Jura in 2001 is not considered to be associated with a sudden change in fishing practices and is thought more likely to be due to changes in fishery office recording practices. For this reason, the landings split is considered unreliable in recent years and the commercial landings data are now presented for the combined Firth of Clyde and Sound of Jura. Given the relative magnitudes of the fisheries (Clyde likely to be much bigger), the commercial data are likely to be more representative of the Clyde.

Effort data

In 2015, WGCSE agreed that effort should be reported in kW days, as this is likely to be more informative about changes in the actual fleet effort. Effort shows an overall decreasing trend but was stable through 2010 to 2012 (Figure 17.2.1). Effort increased in 2016 in comparison to 2015, but had been on a generally decreasing trend until 2021, when a slight increase in effort was observed following the extensive interruptions the fishery experienced in 2020 due to the COVID-19 pandemic. Note that the effort time-series range (2000–2021) does not match the more extensive year range available for landings due to a lack of confidence in the reliability of older effort data in the Marine Scotland Science database. The effort is also slightly inconsistent with the landings data because effort is provided for TR2 vessels only, while the ‘*Nephrops* trawl’ landings also includes landings by large mesh trawlers targeting *Nephrops*.

Sampling levels

Length compositions of landings and discards are obtained during market and on-board observer sampling respectively. These sampling levels are shown in Table 12.2.2 (see. Section 12 FU11 North Minch). Sampling of landings length compositions in the Sound of Jura is more infrequent but samples have been included in the FU13 raising procedure when available. Length compositions for the creel fishery are available for landings only. This is because survival in the animals that are discarded (although little quantitative information exists) is assumed to be high (ICES, 2013). Therefore, these animals are not considered to be removed from the population, and 100% survival is assumed (ICES, 2013).

Length compositions

Although assessments based on detailed catch analysis are not presently carried out, examination of length compositions can provide a preliminary indication of exploitation effects. Figure 14.2.2 shows a series of annual Clyde length–frequency distributions for the period 2002 to 2021. Catch and landings length compositions, and mean size are shown for each sex. The mean sizes of both sexes have fluctuated around relatively small ranges since 2015. The mean size of females in the catch has remained relatively stable over the past three to four years, whereas the mean size of males showed an increase until 2020, and then a slight decrease in 2021.

Sex ratio

Sex ratio in FU 13 shows some variation but males generally make the largest contribution to the annual landings (Figure 14.2.3(a)). This occurs because males are available throughout the year and the fishery takes place in all quarters, although effort is generally reduced during the winter months because of poor weather. Females on the other hand are mainly taken in the summer when they emerge after egg hatching. The seasonal change in proportion of males to females is evident in Figure 14.2.3(b) where males typically dominate in quarters one and four but the ratio is generally more even in quarters two and three. In 2016, males dominated in all quarters, but this was within the observed range of variation typically seen for this stock. The pattern was again fairly typical between 2017 and 2019, but in 2020 all quarterly sex ratios were majority male due to the decreased number of samples which were available for the year. Sampling was also reduced in 2021, but an increased proportion of females was observed in quarter 2. This metric is used as an indicator, whereby increasing proportions of females in the catch might signal an effect of acute overfishing. In this case, however, the atypical sex ratios observed in 2020 (and to some degree 2021) are known to be due to poor sampling, and not a cause for concern to management.

Mean weights

The mean weights in the landings have fluctuated in this FU over the time-series. Since 2015 there has been a variable but somewhat decreasing trend in this metric. Mean weight for FU13 is generally lower than other areas over the time-series (Table 12.2.3). There is a trend of increasing mean weights in the samples of landings for creel catches, noticeable for both sexes, but particularly for males in the early years of the time-series. However, this has declined in recent years, although sampling levels are low, particularly in the early and most recent years of the time-series. Given the seasonal variation present in other FUs it is not possible to state with any certainty that this trend is real (Figures 12.2.4 and 12.2.5; see. Section 12 FU11 North Minch).

Discarding

Discarding of undersized and unwanted *Nephrops* occurs in the Clyde fishery, and discard sampling has been conducted on the Scottish *Nephrops* trawler fleet since 1990. Discard rates have been high in this FU and have averaged around 25% by number in this FU since 1999. Since 2010, discard rates have been estimated to be substantially lower than the long term average, and in 2018 were at the lowest rate in the time-series at only 2.5% (Table 14.2.2). The discard rate in FU13 increased substantially in 2019 to 19.1%. Due to an absence of discard sampling in 2020 and 2021, a discard rate of 10.5% (1.8%/26.8%) was calculated based on a mean rate across all quarters 2017–2019, and allocated to all quarters in 2020 and 2021. The discard rate (adjusted to account for survival) which will be used in the forecast was estimated by taking a three-year average 2019–2021, amounting to 10.4% (8%/14.8%).

Studies (Charuau *et al.*, 1982; Sangster *et al.*, 1997; Wileman *et al.*, 1999) suggest that some *Nephrops* survive the discarding process. An estimate of 25% survival is assumed for this FU in order to calculate removals (landings + dead discards) from the population. The discard survival rate for creel caught *Nephrops* has been shown to be high (ICES, 2013) and a value of 100% is used.

Abundance indices from UWTV surveys

An underwater TV survey of the stock is conducted annually according to standards set out by the Manual for the *Nephrops* Underwater TV Surveys (Dobby *et al.*, 2021). Surveys have been carried out in both subareas since 1995 although the Sound of Jura has been surveyed more infrequently. Underwater television surveys of *Nephrops* burrow distributions avoid the problems associated with traditional trawl surveys that arise from variability in burrow emergence of *Nephrops*. TV surveys are targeted at known areas of mud, sandy mud and muddy sand in which *Nephrops* construct burrows. Full details of the UWTV approach can be found in the stock annex and the report of WKNEPH in 2009 (ICES, 2009). On average, 37 stations have been considered valid each year for the Firth of Clyde and 11 for the Sound of Jura. These are raised to the estimated ground area available for *Nephrops*; 2080 km² based on contoured superficial sediment information (British Geological Surveys).

In 2022, 30 valid stations were used in the final survey analysis for the Firth of Clyde (Table 17.2.3) and 12 stations for the Sound of Jura (Table 14.2.4). Table 14.2.5 shows a detailed breakdown of information from the most recent TV surveys conducted in the Firth of Clyde. This includes estimates of abundance and variability in each of the strata adopted in the stratified random approach. Details for the Sound of Jura are shown in Table 14.2.6. A CV (coefficient of variation, or relative standard deviation) of <20% is considered an acceptable precision level for UWTV survey estimates of abundance (SGNEPS, ICES, 2012). CVs for the three most recent TV surveys in Firth of Clyde and Sound of Jura are lower than the precision level agreed.

Figure 14.2.4 shows the distribution of stations in recent TV surveys (2011–2022) across FU13 (the two distinct subareas can be clearly seen) with the size of the symbols proportional to the *Nephrops* burrow density. Table 14.2.3 and Figure 14.2.5 show the time-series estimated abundance for the TV surveys in the Firth of Clyde, with 95% confidence intervals on annual estimates. Similar information for the Sound of Jura is shown in Table 14.2.4 and Figure 17.2.6. Most surveys have detected generally higher densities in the southern part of the Clyde.

The TV survey estimates of abundance for *Nephrops* in the Firth of Clyde suggest that the population increased until the mid-2000s implying a sustained period of increased recruitment. Following this, abundance has fluctuated around the values previously observed in the early 2000s.

In 2022, the overall abundance increased slightly but remained within recently observed ranges (Figure 14.2.5).

There is not a continuous time-series of abundance in the Sound of Jura and in some years (particularly 2002 and 2006) estimates are associated with large confidence intervals. Abundance has fluctuated with no obvious trend. In 2013, the abundance was at the second lowest point in the time-series. The abundance appeared relatively stable from 2017 until 2021, but in 2022 it dropped below the 15% quantile of estimated values (Figure 14.2.6).

The use of the UWTV surveys for *Nephrops* in the provision of advice was extensively reviewed by WKNEPH (ICES, 2009; ICES, 2013). A number of potential biases were highlighted including those due to edge effects, species burrow misidentification and burrow occupancy. The cumulative relative to absolute conversion factor estimated for FU13 was 1.19 meaning that the TV survey is likely to overestimate *Nephrops* abundance by 19%.

14.3 Assessment

Comparison with previous assessments

The assessment in 2022 is based on a combination of examining trends in fishery indicators and underwater TV survey data, using an extensive data series for the Firth of Clyde component of FU13 and a more limited time-series of UWTV data from the Sound of Jura subarea. The assessment in 2022 follows that of previous years (since 2015) in that the commercial data for Clyde and Sound of Jura have been combined, because of concerns regarding the accuracy of the landings data. There are also no discard samples and limited market samples available for the Sound of Jura. Therefore, the harvest rate and catches for the two areas are presented as a combined total. *Nephrops* abundance will continue to be monitored separately, with a TV survey being conducted in both subareas where logistically possible.

State of the stock

The underwater TV surveys are presented as the best available information on the stocks of *Nephrops* in the two subareas of FU13. The surveys provide fishery-independent estimates of *Nephrops* abundance. At present, it is not possible to extract any length or age-structure information from the survey and it therefore only provides information on abundance over the area of the survey.

TV survey estimated stock abundance for the Firth of Clyde in 2022 was 1665 million individuals, a 17.7% increase from the 2021 estimate, well above the B_{trigger} value of 580 million. The abundance estimate for the Sound of Jura in 2022 was 241 million individuals, a 22.3% decrease from the 2021 estimate, but again above the B_{trigger} value of 160 million.

The harvest rate for the FU13 in 2021 (dead removals for both subareas/ Firth of Clyde and Sound of Jura TV abundance = 21%) was above the F_{MSY} proxy value (the value associated with high long-term yield and low risk depletion) for the Clyde (15.1%), and the Sound of Jura (12.0%). Note the F_{MSY} proxy values for this stock were revised in October 2015 at WKMSYRef4 (ICES, 2016b).

14.4 Catch option table

Landings predictions and catch options at various harvest rates (based on principles established at WKNEPH (ICES, 2009)), will be made for Firth of Clyde and Sound of Jura on the basis of the

2022 UWTV survey conducted in June. These will be presented in October 2022 for the provision of advice.

Catch scenario table inputs and historical estimates of mean weight in landings and harvest rates are presented in Table 17.2.2 and summarised below. The calculation of catch options for the Firth of Clyde follows the procedure outlined in the stock annex.

The table below shows the agreed inputs to the catch scenarios table for FU13.

Input	Data	2022 assessment
Survey abundance (millions)	UWTV 2022	1 665 Clyde; 241 SoJ
Mean weight in projected landings (g)	2019–2021	17.16
Mean weight in projected discards (g)	2019–2021	7.33
Projected discards	Average 2019–2021 (proportion by number; combined for Firth of Clyde and Sound of Jura)	13.4%
Discards survival	Proportion by number (assumed)	25%
Dead projected discards	2019–2021	10.4%*

* Based on mean discard rate (2017-2019) allocated to all Quarters of 2020 & 2021. Estimates of 14.8% and 8% were derived based on the maximum and minimum observed discard rates, respectively, for the same period

14.5 Reference points

F_{MSY} proxy for this stock was revised in October 2015 at WKMSYRef4 (ICES, 2016a; ICES, 2016b). These were updated on the basis of an average of estimated F_{MSY} proxy harvest rates over a period of years, which corresponds more closely to the methodology for finfish. In cases where there is a clear trend in the values a five-year average was chosen. Similarly, the five-year average of the F at 95% of the YPR obtained at the F_{MSY} proxy reference point was proposed as the F_{MSY} lower bound and the five year average of the F above F_{MAX} that leads to YPR of 95% of the maximum as the upper bound. Using an average value also has the advantage of reducing the effect of any unusually high or low estimates of the F_{MSY} proxy, which occasionally appear. For this functional unit the F_{MSY} proxy has been revised to 15.1% for the Clyde and 12.0% for the Sound of Jura respectively.

For *Nephrops* stocks, $MSY B_{trigger}$ has been defined as the lowest stock size from which the abundance has increased and is calculated as 579 million individuals for the Firth of Clyde. The advice from WKMSYRef4 (ICES, 2016b) rounded this value to give an $MSY B_{trigger}$ of 580 million.

$MSY B_{trigger}$ was not previously proposed for FU13 (SJ) as there were few points in the survey series (due to missing years). WKMSYRef4 stated that the survey series is now considered to be of sufficient length to allow the B_{loss} (abundance in 1995) to be proposed as the $MSY B_{trigger}$. This results in a value of 160 million (ICES, 2016b). Full details are contained in the stock annex.

These should remain under review by WGCSE and may be revised should improved data become available.

Table 17.2.2 and Figure 17.4.1 show the estimated harvest rates over this period. The harvest rate was calculated from the total dead removals for both subareas divided by the combined abundance for the Firth of Clyde TV survey and the Sound of Jura. This does result in some years

were the harvest rate is not calculable as we do not have a full time-series of TV surveys for the Sound of Jura. The combined harvest rate peaked in 2007 at 43.0% before declining to around the F_{MSY} level for the Clyde in 2010–2011. The harvest rate has fluctuated since then, and increased in 2021 to 19.3% from 9.4% in 2020. It is unlikely that prior to 2006, the estimated harvest rates are representative of actual harvest rates due to under-reporting of landings.

14.6 Management strategies

Scotland has recently established a network of regional Inshore Fisheries Groups (rIFGs), non-statutory bodies that aim to improve the management of Scotland's inshore fisheries out to six nautical miles, and to give commercial inshore fishermen a strong voice in wider marine management developments. The rIFGs will contribute to regional policies and initiatives relating to management and conservation of inshore fisheries, including impacts on the marine environment and the maintenance of sustainable fishing communities and measures designed to better conserve and sustainably exploit stocks of shellfish and sea fish (including salmon) in their local waters. Although no IFG proposals specific to the management of *Nephrops* fisheries have yet been adopted, some of the IFG management plans for the Scottish West Coast include spatial management of *Nephrops* fisheries and the introduction of creel limits.

A weekend ban on mobile gear was introduced in the Clyde in 1986 under a Scottish Statutory Instrument. Mobile gear is banned in the Inshore Clyde from Friday night to Sunday night, as are vessels greater than 21 m in length.

On the 8th of February 2016, phase 1 of the fisheries management measures for inshore MPAs in Scottish waters came into force (SG, 2016). These measures relate to both NCMPA (Marine (Scotland) Act and the UK Marine and Coastal Access Act) and Special Areas of Conservation (EC Habitats Directives – Council Directive 92/43/EEC) both of which have the aim of conserving biological diversity in Scottish waters and along with other protected sites make up Scotland's MPA network (SG, 2017a). Although not specific to the management of the *Nephrops* fishery they will influence spatial patterns of fishing for *Nephrops* where controls on the two main gear types, demersal trawls and creels, are implemented on *Nephrops* habitat. There are three NCMPAs within the Clyde functional unit. The MPA, which extends onto the main patch of *Nephrops* habitat, is the South Arran NCMPA, within the Firth of Clyde subarea, where a complete ban on demersal vessels greater than 120 gross tonnage has been implemented. Partial closures (i.e. zoned management) for demersal trawlers smaller than this size and creelers are also in place. For Loch Sween, north of the main habitat area in the Sound of Jura subarea, demersal trawling by vessels is banned. However, for trawlers smaller than 75 gross tonnage, temporal closures are in place over some of the area. For the Upper Loch Fyne and Loch Goil NCMPA, just north of the main habitat area in Firth of Clyde subarea, demersal trawling by vessels greater than 75 gross tones is banned and the activity of vessels below this is zoned. Creeling activity is also zoned (SG, 2016). The areas of the NCMPAs relative to the estimated *Nephrops* habitat within the Clyde functional unit are presented in Figure 17.6.1.

14.7 Quality of assessment and forecast

There are concerns over the accuracy of historical landings and effort data and because of this the final assessment adopted is independent of official statistics. Harvest rates since 2006 are also considered more reliable due to more accurate landings data reported under new legislation.

One of the main issues for this FU is the problem of not being able to split the landings between the Sound of Jura and Firth of Clyde. This means that we are unable to provide harvest rates for the two subareas separately. What is currently provided is not actually a harvest rate for either

sub area; but is likely more representative of the Firth of Clyde. This has an impact on the quality of the assessment but not on the forecast.

In recent years, the length and sex composition of the landings data is considered to be well sampled. However, in 2018 sampling levels fell below this normal standard. Discard sampling has been conducted on a quarterly basis for Scottish *Nephrops* trawlers in the Firth of Clyde sub-area fishery since 1990, and is considered to represent the fishery adequately. There are few samples available from the Sound of Jura and these have been included in the FU13 raising procedure.

Discard sampling in 2021 was impacted by the COVID-19 pandemic, with no valid samples collected in Functional Unit 13. Estimates of discard rates for all quarters in the assessment were based on mean discard rates across all quarters from 2017–2019 (see “InterCatch”, above). This change is considered to have had minimal impact on the quality of the assessment because discard rates have been consistently low in recent years.

Underwater TV surveys have been conducted for this stock every year since 1995. The number of valid stations in the survey has remained relatively stable throughout the time period. Confidence intervals around the abundance estimates are stable throughout the series and relatively low compared with other FUs in area 6.a. In the provision of catch scenarios based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. A three-year average (2019–2021) of discard rate (adjusted to account for some survival of discarded animals) has been used in the calculation of catch advice.

The cumulative relative to absolute conversion factor estimates for FU13 component is largely based on expert opinion (see stock annex). The precision of these bias corrections cannot yet be characterised. The method to derive landings for the catch options is sensitive to the input dead discard rate and mean weight in landings and this introduces uncertainties in the catch forecasts. Precision estimates are needed for these forecast inputs.

The overall area of the ground is estimated from the available BGS contoured sediment data and at present is considered to be a minimum estimate. VMS data, recently made available and linked to landings (from queries of the Scottish FIN database) suggest no major differences between areas fished and the mud sediment maps. The inclusion of vessels smaller than 15 m would likely increase the fished area in some of the inshore locations, while in the Clyde the non-estimated sea loch areas are relatively small.

14.8 Recommendation for next benchmark

This stock was last benchmarked in 2009 (ICES, 2009). WGCSE recommends that the issue concerning the split of landings between Sound of Jura and the Firth of Clyde be examined when this stock is next proposed for benchmark process.

14.9 Management considerations

ICES and STECF have repeatedly advised that management should be at a smaller scale than the ICES division level. Management at the Functional Unit level could provide controls to ensure effort and catch were in line with resources available. In this FU, the two subareas imply that additional controls may be required to ensure that the landings taken in each subarea are in line with the landings advice.

Creel fishing takes place in part of this area although the relative scale of the fishery is smaller than in the Minches. Overall effort in terms of creel numbers is not known, and measures to

control numbers are not in place. There is a need to ensure that the combined effort from all forms of fishing is taken into account when managing this stock.

There is a bycatch of other species in the area of the Firth of Clyde and estimated discards of whiting and haddock by the TR2 fleet are generally high in area 6.a. It is important that efforts continue to ensure that unwanted bycatch is kept to a minimum in this fishery. Current efforts to reduce discards and unwanted bycatches of cod include the implementation of large square meshed panels (SMPs) of 120 mm under the west coast emergency measures, and SMPs of 200 mm implemented as part of the previous Scottish Conservation Credits scheme. A seasonal closure (early spring) in the southwest part of the Firth of Clyde is in place to protect spawning cod although *Nephrops* vessels are derogated to fish in those parts where mud sediments are distributed.

14.10 References

- Bailey, N. and Chapman, C. J. 1983. A comparison of density, length composition and growth of two populations off the West coast of Scotland. ICES C. M. 1983/K:42.
- BGS. 2011. Marine SeaBed Sediment Map - UK Waters - 250k (DigSBS250). British Geological Survey, Nottingham. Available at: <<http://www.bgs.ac.uk/discoverymetadata/13605549.html>> [Accessed: unknown date].
- Charuau A., Morizur Y., Rivoalen J.J. 1982. Survival of discarded *Nephrops norvegicus* in the Bay of Biscay and in the Celtic Sea, ICES-CM-1982/B:13.
- Council Reg. (EU) 43/2009.
- Dobby, H., Doyle, J., Jónasson, J., Jonsson, P., Leocádio, A., Lordan, C., Weetman, A., and Wieland, K. 2021. ICES Survey Protocols – Manual for *Nephrops* underwater TV surveys, coordinated under ICES Working Group on *Nephrops* Surveys (WGNEPS). ICES Techniques in Marine Environmental Sciences Vol. 65. 44 pp. <https://doi.org/10.17895/ices.pub.8014>.
- ESRI. 2014. ArcGIS. Version 10.2.1. Environmental Systems Research Institute, Inc.: Redlands, CA.
- EU. 2019. Regulation (EU) 2019/472 of the European Parliament and of the Council of 19 March 2019 establishing a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks, amending Regulations (EU) 2016/1139 and (EU) 2018/973, and repealing Council Regulations (EC) No 811/2004, (EC) No 2166/2005, (EC) No 388/2006, (EC) No 509/2007 and (EC) No 1300/2008. Official Journal of the European Union, L 83: 1–17. <http://data.europa.eu/eli/reg/2019/472/oj>
- ICES. 2010. Report of the Study Group on *Nephrops* Surveys (SGNEPS), 9–11 November 2010, Lisbon, Portugal. ICES CM 2010/SSGESST:22. 95 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. 2013. Report of the Benchmark Workshop on *Nephrops* assessment (WKNEPH). ICES CM 2013/ACOM:45. 230 pp.
- ICES. 2016a. EU request to ICES to provide FMSY ranges for selected stocks in ICES subareas 5 to 10. In Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 5, Section 5.2.3.1.
- ICES. 2016b. Report of the Workshop to consider FMSY ranges for stocks in ICES categories 1 and 2 in Western Waters (WKMSYREF4), 13–16 October 2015, Brest, France. ICES CM 2015/ACOM:58. 187 pp.
- ICES. 2017. ICES Statistical Rectangles. International Council for the Exploration of the Sea: Copenhagen, Denmark. Available at: <<http://geo.ices.dk/index.phpSource>> [Accessed: 16/03/2017].
- Sangster, G.I., Breen, M., Bova, D.J., Kynoch, R., O'Neill, F.G., Lowry, N., Moth-Poulsen, T. Hansen, U.J., Ulmestrand, M., Valentinsson, D., Hallback, H., Soldal, A.V., and Hoddevik, B. 1997. *Nephrops*

- survival after escape and discard from commercial fishing gear. Presented at ICES FTFB Working Group, Hamburg, Germany 14–17 April, 1997, ICES CM 1997 CM/B.
- SG. 2016. Simple guide to fisheries management measures in Marine Protected Areas. Marine Scotland (The Scottish Government): Edinburgh. Available at: <<http://www.gov.scot/Resource/0049/00498320.pdf>> [Accessed: 16/05/2017].
- SG. 2017a. Marine Protected Areas in Scotland's Seas - Guidelines on the selection of MPAs and development of the MPA network. Marine Scotland (The Scottish Government): Edinburgh. Available at: <<http://www.gov.scot/Topics/marine/marine-environment/mpanetwork/mpaguidelines>> [Accessed: 16/05/2017].
- SG. 2017b. Marine conservation orders (MCOs) and fisheries management measures (MPAs and SACs) - with effect May 2017. Marine Scotland (The Scottish Government): Edinburgh. Available at: <<https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?availablelayers=838>> [Accessed: 31/05/2017].
- SNH. 2015. Nature Conservation Marine Protected Areas. Scottish Natural Heritage (Scottish Government): Inverness. Available at: <<https://gateway.snh.gov.uk/natural-spaces/index.jsp>> [Accessed: 03/04/2017].
- SNH. 2016. Special Areas of Conservation. Scottish Natural Heritage (Scottish Government): Inverness. Available at: <<https://gateway.snh.gov.uk/natural-spaces/index.jsp>> [Accessed: 03/04/2017].
- Tuck, I.D., Chapman C.J. and Atkinson, R.J.A. 1997. Population biology of the Norway lobster, *Nephrops norvegicus* (L.) in the Firth of Clyde, Scotland. I: Growth and density. ICES J. Mar.Sci 54, 125–135.
- Tuck, I.D., Bailey, N., Atkinson, R.J.A. and Marrs, S.J. 1999. Changes in *Nephrops* density in the Clyde Sea area from UWTV survey data. ICES, Doc. Living Resources Comm., CM 1999/G:13 (mimeo).
- Wessel, P. and Smith, W.H.F. 2016. GSHHG version 2.3.6 - A Global Self-consistent, Hierarchical, High-resolution Geography Database. National Centers for Environmental Information, National Oceanic and Atmospheric Administration: Boulder, CO. <<https://www.ngdc.noaa.gov/mgg/shorelines/gshhs.html>> [Accessed: 31/05/2017].
- Wileman, D.A., Sangster, G.I., Breen, M., Ulmestrand, M., Soldal, A.V. and Harris, R.R. 1999. Roundfish and *Nephrops* survival after escape from commercial fishing gear. EU Contract Final Report. EC Contract No: FAIR-CT95-0753.

Table 14.1.1. *Nephrops*, Clyde and Sound of Jura (FU13), ICES estimates of landings of *Nephrops*, 1981–2021.

UK SCOTLAND						OTHER UK	IRELAND	TO- TAL**
YEAR	NEPHROPS TRAWL	OTHER	CREEL	BELOW MINIMUM SIZE	SUB TO- TAL			
1981	2498	404	66	0	2968	0	0	2968
1982	2372	169	79	0	2620	0	0	2620
1983	3889	121	52	0	4062	14	0	4076
1984	3070	153	77	0	3300	10	0	3310
1985	3921	293	65	0	4279	7	0	4286
1986	4073	176	79	0	4328	13	0	4341
1987	2860	82	64	0	3006	3	0	3009
1988	3507	107	43	0	3657	7	0	3664

UK SCOTLAND						OTHER UK	IRELAND	TO- TAL**
YEAR	NEPHROPS TRAWL	OTHER	CREEL	BELOW MINIMUM SIZE	SUB TO- TAL			
1989	2577	184	35	0	2796	16	0	2812
1990	2731	121	23	0	2875	34	0	2909
1991	2844	145	26	0	3015	23	0	3038
1992	2530	247	9	0	2786	17	0	2803
1993	3200	110	5	0	3315	28	0	3343
1994	2503	50	28	0	2581	49	0	2630
1995	3766	131	26	0	3923	64	0	3987
1996	3880	108	27	0	4015	42	0	4057
1997	3486	46	26	0	3558	63	0	3621
1998	4540	79	39	0	4658	183	0	4841
1999	3476	29	37	0	3542	210	0	3752
2000	3142	63	75	0	3280	137	0	3417
2001	2890	65	95	0	3050	132	0	3182
2002	3075	53	105	0	3233	151	0	3384
2003	2954	20	119	0	3093	80	0	3173
2004	2619	8	88	0	2715	258	0	2973
2005	3148	5	94	0	3247	148	0	3395
2006	4356	1	179	0	4536	244	0	4780
2007	6069	4	221	0	6294	366	0	6660
2008	5320	3	184	0	5507	416	0	5923
2009	4304	1	191	0	4496	283	0	4779
2010	5162	5	211	0	5378	465	0	5843
2011	5664	9	219	0	5892	540	0	6432
2012	5617	4	203	0	5824	863	0	6687
2013	4708	4	212	0	4924	511	0	5435
2014	4770	1	258	0	5029	1178	0	6207
2015	4035	8	206	0	4249	898	0	5147

UK SCOTLAND						OTHER UK	IRELAND	TO- TAL**
YEAR	NEPHROPS TRAWL	OTHER	CREEL	BELOW MINIMUM SIZE	SUB TO- TAL			
2016	4922	6	267	0	5195	1252	4	6447
2017	4195	3	263	0	4461	942	1	5403
2018	3574	13	253	0	3840	303	0	4143
2019	3834	3	265	0	4102	581	0	4683
2020	2869	10	225	0	3104	532		3636
2021	3805	50	233	0	4088	907		4995

Table 14.2.1. *Nephrops*, Clyde (FU13), ICES estimated landings of *Nephrops*, in each of the subareas (Firth of Clyde and Sound of Jura 1981–2021).

YEAR	UK LANDINGS		
	FIRTH OF CLYDE	SOUND OF JURA	ALL SUBAREAS
1981	2277	691	2968
1982	1983	637	2620
1983	3395	681	4076
1984	2600	710	3310
1985	3561	725	4286
1986	3228	1113	4341
1987	2408	601	3009
1988	3509	155	3664
1989	2595	217	2812
1990	2592	317	2909
1991	2654	384	3038
1992	2383	420	2803
1993	2766	577	3343
1994	2095	535	2630
1995	3692	295	3987
1996	3671	386	4057
1997	3135	486	3621
1998	4373	468	4841

YEAR	UK LANDINGS		
	FIRTH OF CLYDE	SOUND OF JURA	ALL SUBAREAS
1999	3423	329	3752
2000	3229	188	3417
2001	2979	203	3182
2002	3350	34	3384
2003	3154	19	3173
2004	2965	8	2973
2005	3388	7	3395
2006	4768	12	4780
2007	6580	80	6660
2008	5845	78	5923
2009	4688	91	4779
2010	5782	61	5843
2011	6363	69	6432
2012	6634	53	6687
2013	NA	NA	5435
2014	NA	NA	6207
2015	NA	NA	5147
2016	NA	NA	6447
2017	NA	NA	5403
2018	NA	NA	4143
2019	NA	NA	4683
2020	NA	NA	3636
2021	NA	NA	4995

Table 14.2.2. *Nephrops*, Clyde (FU13): Firth of Clyde and Sound of Jura combined. Adjusted TV survey abundance (Firth of Clyde subarea), landings, discard rate (proportion by number) and estimated harvest rate. The harvest rate was calculated from the total (dead) removals in number for both subareas divided by the combined abundance from both TV surveys.

YEAR	LANDINGS IN NUM- BERS (MIL- LIONS)	DISCARD IN NUM- BERS (MIL- LIONS)	REMOVALS IN NUMBERS (MIL- LIONS)**	ADJUSTED SURVEY CLYDE (MIL- LIONS)	ADJUSTED SURVEY JURA (MIL- LIONS)	COM- BINED HARVEST RATE*	LANDINGS (TONNES)	DISCARDS (TONNES)	DEAD DIS- CARDS (TONNES)	DIS- CARD RATE (%)	DEAD DIS- CARD RATE (%)	MEAN WEIGHT IN LANDINGS (gr)	MEAN WEIGHT IN DISCARDS (gr)
1995	207	82	269	579	160	36.40	3987	619	464	28.4	22.90	19.24	7.54
1996	187	61	233	935	171	21.07	4057	635	476	24.7	19.70	21.68	10.35
1997	150	70	202	1198	NA	NA	3621	598	448	32	26.10	24.21	8.50
1998	269	187	409	1262	NA	NA	4841	1292	969	41	34.20	17.98	6.92
1999	216	93	286	930	NA	NA	3752	566	424	30.2	24.50	17.39	6.05
2000	171	48	207	1411	NA	NA	3417	470	352	22	17.40	19.96	9.75
2001	164	82	225	1486	272	12.80	3182	677	508	33.5	27.40	19.46	8.23
2002	207	50	245	1571	398	12.44	3384	406	305	19.5	15.40	16.35	8.12
2003	166	134	266	1817	260	12.81	3173	1247	935	44.7	37.70	19.13	9.31
2004	158	168	284	1970	NA	NA	2973	1435	1076	51.5	44.30	18.80	8.54
2005	189	69	241	1959	303	10.65	3395	611	458	26.8	21.60	17.96	8.81
2006	248	55	290	1851	430	12.71	4780	515	386	18.2	14.30	19.27	9.31
2007	350	387	640	1233	255	43.01	6660	2566	1924	52.5	45.30	19.05	6.64
2008	357	207	512	1769	NA	NA	5923	1433	1075	36.6	30.30	16.59	6.94

YEAR	LANDINGS IN NUM- BERS (MIL- LIONS)	DISCARD IN NUM- BERS (MIL- LIONS)	REMOVALS IN NUMBERS (MIL- LIONS)**	ADJUSTED SURVEY CLYDE (MIL- LIONS)	ADJUSTED SURVEY JURA (MIL- LIONS)	COM- BINED HARVEST RATE*	LANDINGS (TONNES)	DISCARDS (TONNES)	DEAD DIS- CARDS (TONNES)	DIS- CARD RATE (%)	DEAD DIS- CARD RATE (%)	MEAN WEIGHT IN LANDINGS (gr)	MEAN WEIGHT IN DISCARDS (gr)
2009	261	169	388	1499	251	22.17	4779	1390	1043	39.3	32.70	18.31	8.23
2010	276	55	317	1750	376	14.91	5843	536	402	16.7	13.10	21.21	9.68
2011	333	74	388	2165	312	15.66	6432	568	426	18.2	14.30	19.34	7.65
2012	306	93	376	1421	371	20.98	6687	1066	800	23.4	18.60	21.83	11.42
2013	262	62	309	1990	198	14.12	5435	454	341	19	15.00	20.72	7.37
2014	295	78	353	1328	231	22.64	6207	696	522	20.9	16.60	20.79	8.92
2015	232	54	273	1820	376	12.43	5147	401	301	18.9	14.80	22.21	7.43
2016	364	69	416	1946	422	17.57	6447	636	477	15.9	12.40	17.70	9.21
2017	316	32	340	1568	306	18.1	5403	275	199	9.5	7.1	17.02	8.55
2018	268	7	273	2193	275	11.1	4143	68	51	2.5	1.9	16.14	9.79
2019	271	64	319	2083	318	13.3	4683	435	326	19.1	15	17.26	6.81
2020	195	23	212	1941	NA	9.4	3636	174	130	10.5	8.1	18.96	7.59
2021	328	38	356	1414	310	20.6	4995	292	219	10.5	8.1	15.27	7.59
2022	-	-	-	1665	241	-	-	-	-	-	-	-	-
Average***											10.4	17.16	7.33

* Harvest rates previous to 2006 are unreliable.

** Removals numbers take the dead discard rate into account.

*** Dead discard average: 2019–2021; Mean weight in landings and discard average: 2019–2021.

Table 14.2.3. *Nephrops*, Clyde (FU13): Firth of Clyde subarea. Results of the 1995–2022 TV surveys (values adjusted for bias).

YEAR	NUMBER OF VALID STATIONS	MEAN DENSITY (BURROWS / m ²)	ABUNDANCE (MILLIONS)	95% CONFIDENCE INTERVAL (MILLIONS)
1995	29	0.277	579	176
1996	38	0.454	935	242
1997	31	0.571	1198	262
1998	38	0.605	1262	213
1999	39	0.445	930	289
2000	40	0.681	1411	246
2001	39	0.714	1486	268
2002	36	0.756	1571	288
2003	37	0.874	1817	292
2004	32	0.95	1970	367
2005	44	0.941	1959	287
2006	43	0.882	1851	257
2007	40	0.597	1233	218
2008	38	0.849	1769	291
2009	39	0.723	1499	210
2010	37	0.84	1750	327
2011	40	1.041	2165	305
2012	37	0.681	1421	227
2013	34	0.956	1990	246
2014	35	0.639	1328	237
2015	37	0.875	1820	351
2016	37	0.935	1946	249
2017	38	0.754	1568	239
2018	40	1.055	2193	297
2019	38	1.002	2083	381
2020	28	0.933	1941	297
2021	41	0.68	1414	211
2022	30	0.8	1665	316

Table 14.2.4. *Nephrops*, Clyde (FU13): Sound of Jura subarea. Results of the 1995–2022 TV surveys (values adjusted for bias).

YEAR	NUMBER OF VALID STA- TIONS	MEAN DENSITY (BUR- ROWS / m ²)	ABUNDANCE (mil- lions)	95% CONFIDENCE INTERVAL (millions)
1995	7	0.42	160	58
1996	10	0.45	171	26
1997	no surveys			
1998				
1999				
2000				
2001	13	0.71	272	76
2002	9	1.04	398	167
2003	12	0.68	260	68
2004	no survey			
2005	11	0.79	303	84
2006	10	1.13	430	134
2007	10	0.67	255	58
2008	no survey			
2009	12	0.66	251	68
2010	12	0.98	376	39
2011	12	0.82	312	73
2012	12	0.98	371	61
2013	9	0.52	198	35
2014	9	0.61	231	90
2015	12	0.98	376	127
2016	12	1.11	422	42
2017	12	0.80	306	71
2018	12	0.72	275	53
2019	12	0.832	318	61
2020	no survey			
2021	12	0.812	310	98
2022	12	0.632	241	71

Table 14.2.5. *Nephrops*, Clyde (FU13): Firth of Clyde subarea. Results by stratum of the 2020–2022 TV surveys. Note that stratification was based on a series of sediment strata (M – Mud, SM – Sandy mud, MS – Muddy sand).

STRATUM	AREA (km ²)	NUM- BER OF STA- TIONS	MEAN BUR- ROW DENSITY (no./m ²)	OB- SERVED VARI- ANCE	ABUN- DANCE (MIL- LIONS)	STRATUM VARI- ANCE	PRO- POR- TION OF TOTAL VARI- ANCE	SURVEY PRECI- SION LEVEL (CV)
2020 TV survey								
M	716.8	10	1.084	0.058	777	2983	0.095	
SM	698.6	9	1.294	0.246	904.3	13364	0.428	
MS	664.6	9	0.946	0.304	628.4	14895	0.477	
Total	2080	28			2309.7	31242	1	0.076
2021 TV survey								
M	716.8	16	0.718	0.078	514.3	2486	0.223	
SM	698.6	13	0.843	0.089	588.8	3354	0.301	
MS	664.6	12	0.469	0.144	311.3	5309	0.476	
Total	2080	41			1414.4	11149	1	0.072
2022 TV survey								
M	716.8	13	0.84	0.094	602.4	3711	0.149	
SM	698.6	9	1.072	0.243	748.8	13169	0.527	
MS	664.6	8	0.471	0.147	313.4	8098	0.324	
Total	2080	30			1664.6	24978	1	0.088

Table 14.2.6. *Nephrops*, Clyde (FU13): Sound of Jura subarea. Results by stratum of the 2019, 2021, and 2022 TV surveys. Note that stratification was based on a series of sediment strata.

STRATUM	AREA (km ²)	NUMBER OF STATIONS	MEAN BUR-ROW DENSITY (no./m ²)	OBSERVED VARIANCE	ABUNDANCE (MILLIONS)	STRATUM VARIANCE	PROPORTION OF TOTAL VARIANCE	SURVEY PRECISION LEVEL SURVEY (CV)
2019 TV survey								
M	90	2	0.689	0.088	62	357	0.389	
SM	150	4	0.878	0.023	131.8	128	0.139	
MS	142	6	0.874	0.129	124.1	434	0.472	
Total	382	12			317.9	919	1	0.101
2021 TV survey								
M	90	1	0.387	0.044	34.8	355	0.148	
SM	150	5	0.845	0.254	126.8	1140	0.474	
MS	142	6	1.046	0.27	148.6	909	0.378	
Total	382	12			310.2	2404	1	0.157
2022 TV survey								
M	90	2	0.626	0.01	56.3	42	0.033	
SM	150	5	0.676	0.011	101.3	47	0.037	
MS	142	5	0.59	0.287	83.8	1159	0.93	
Total	382	12			241.4	1247	1	0.162

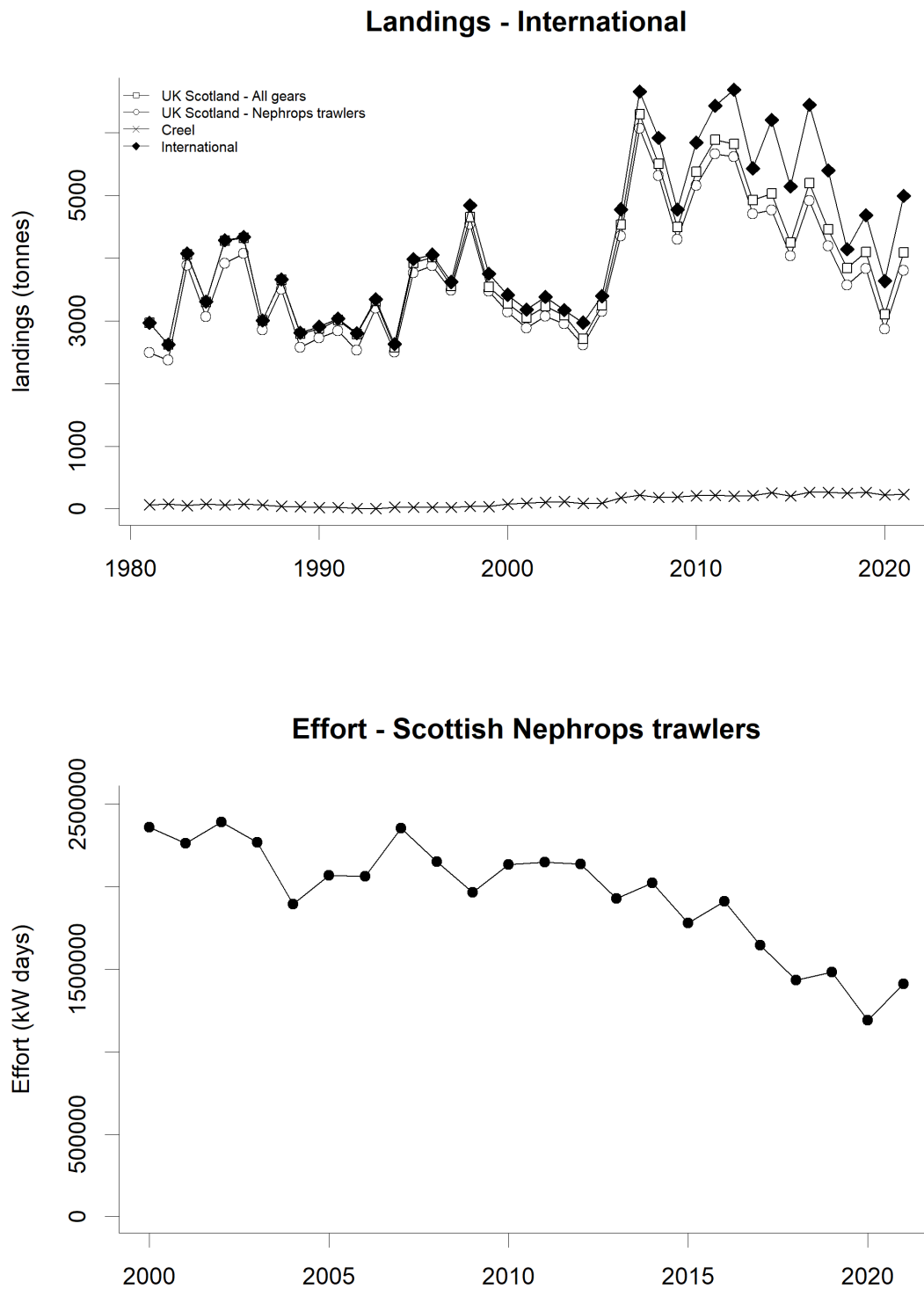


Figure 14.2.1. *Nephrops*, Clyde (FU13). Long-term landings and effort.

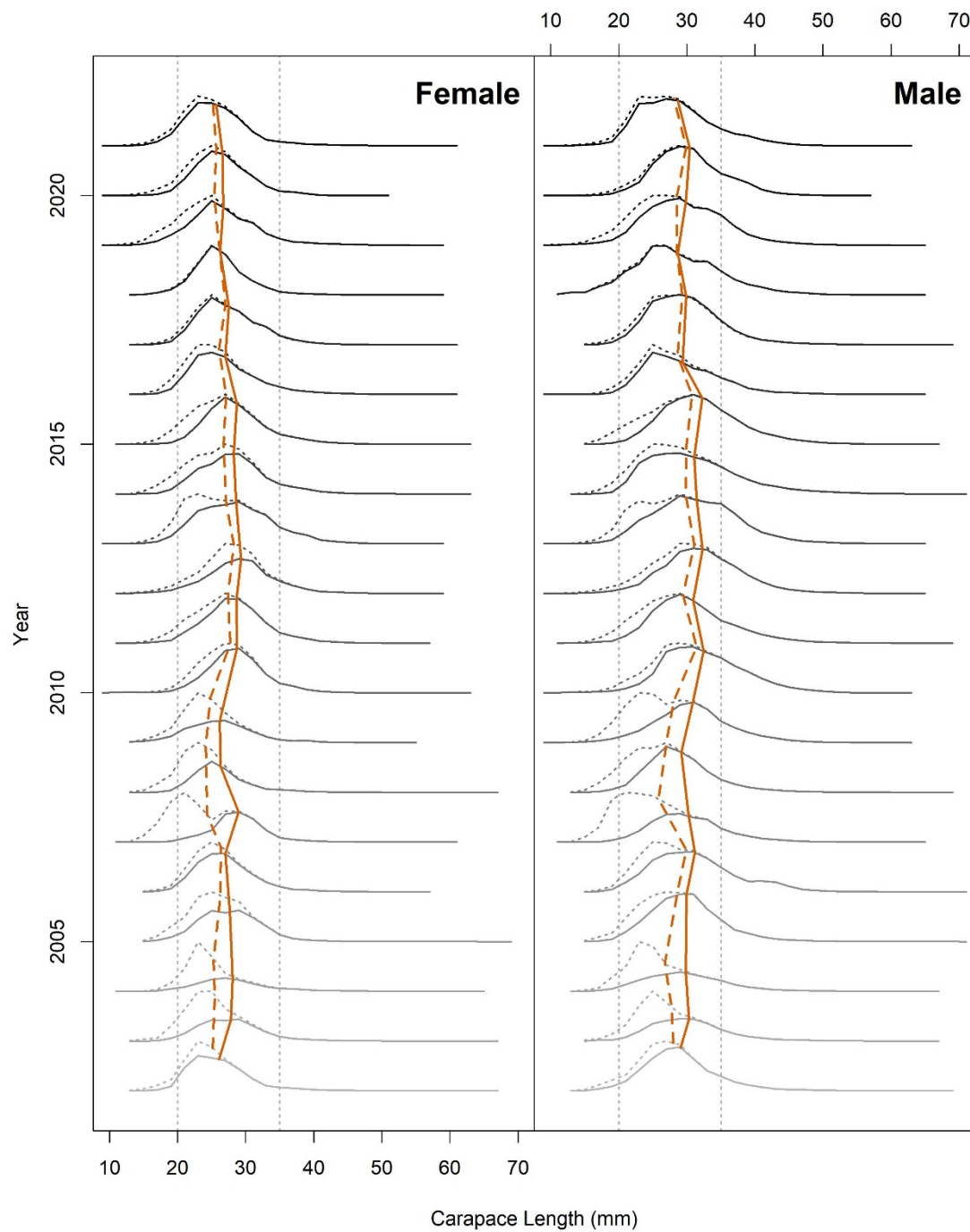


Figure 14.2.2. *Nephrops*, Clyde (FU13). Catch length–frequency distribution (dotted) and landings (solid) for *Nephrops*, 2002–2021. Mean size in catches and landings are represented by solid and dashed orange lines, respectively. Vertical dotted lines are minimum conservation reference size (25 mm) and 35 mm.

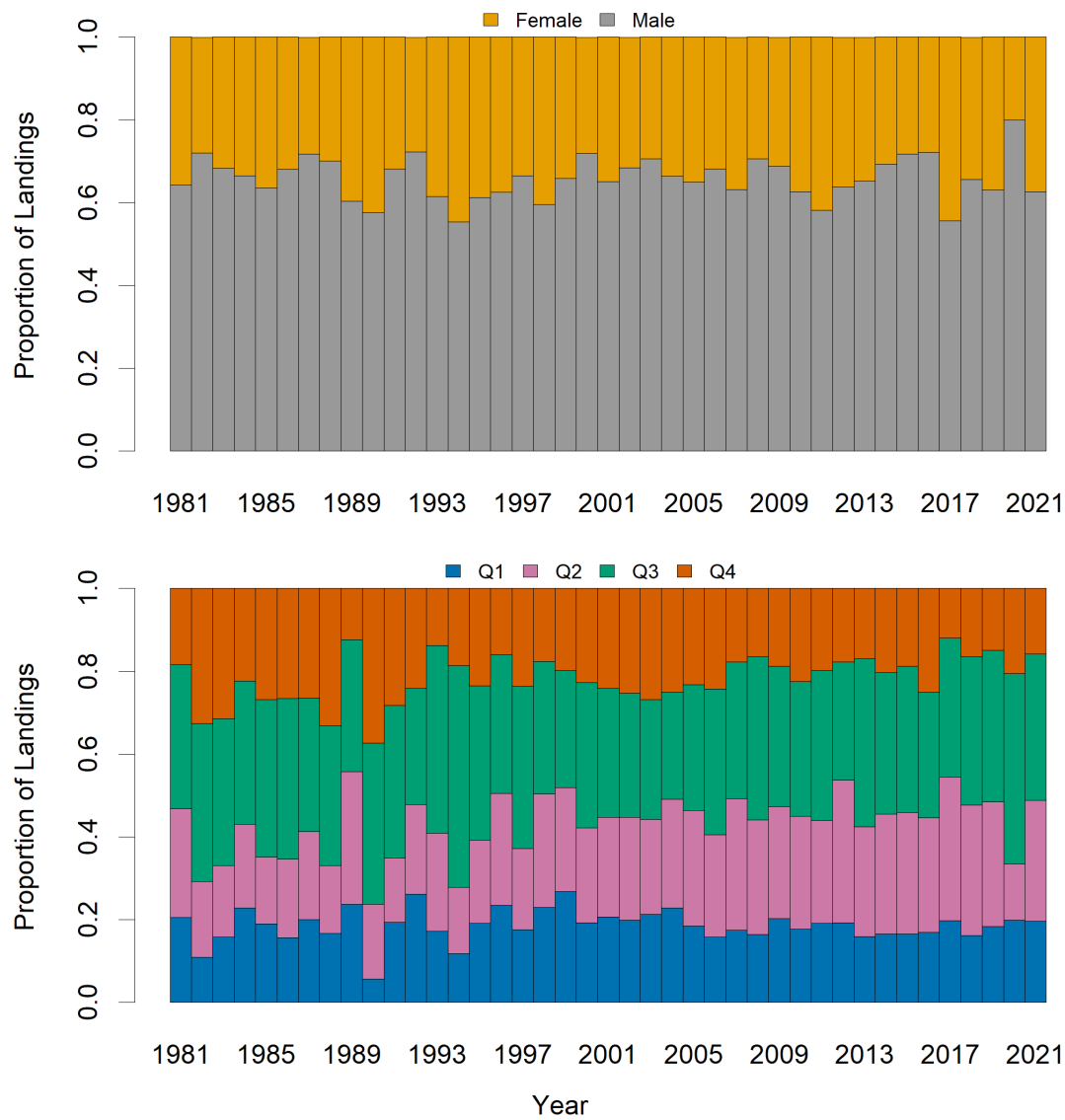


Figure 14.2.3. (a) *Nephrops*, Clyde (FU13). Proportion of landed weight by sex (*top*), by quarter (*bottom*) from Scottish trawlers.

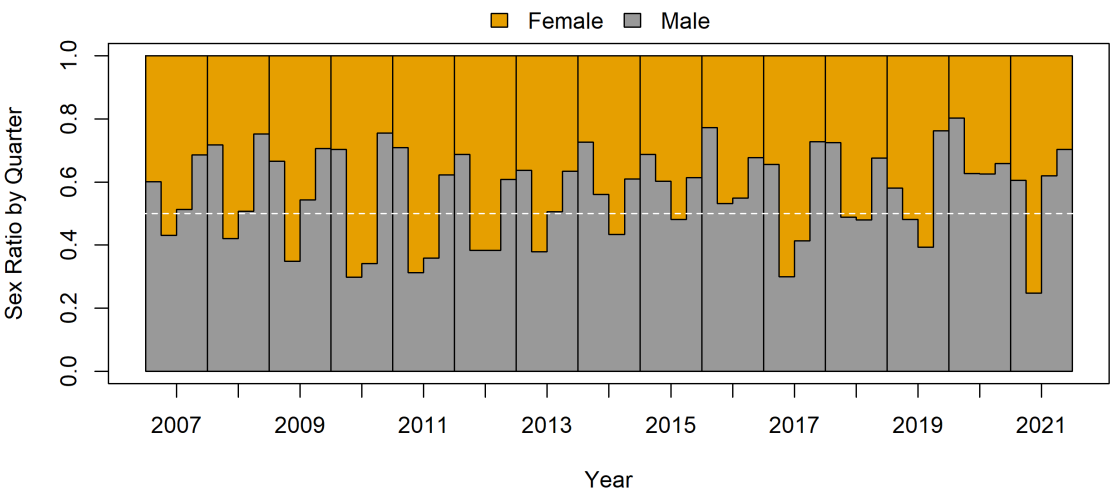


Figure 14.2.3. (b) *Nephrops*, Clyde (FU13), quarterly numeric proportions by sex (2007–2021).

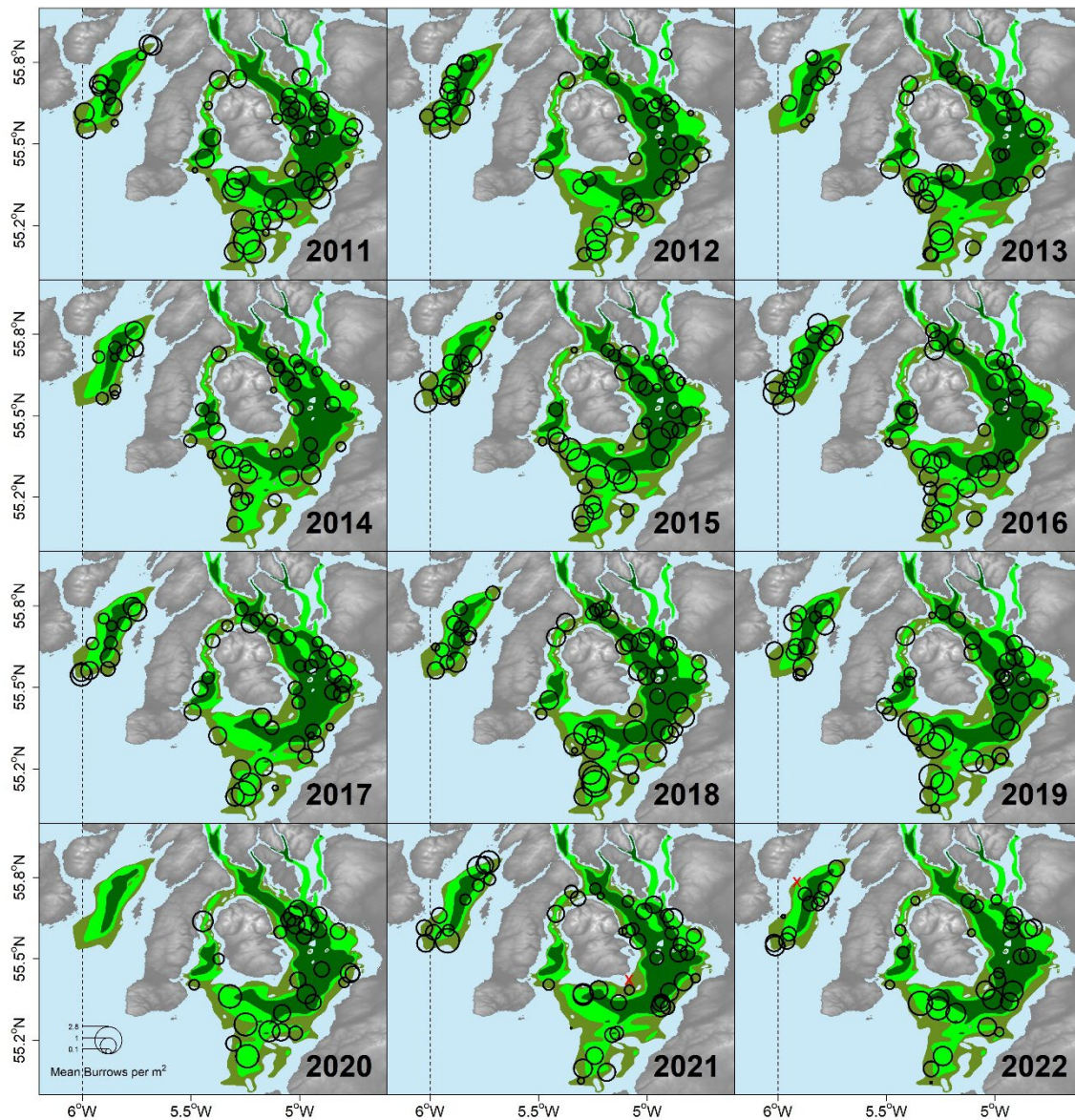


Figure 14.2.4. *Nephrops*, Clyde (FU13), TV survey station distribution and density (mean burrows/m²) for Firth of Clyde and Sound of Jura subareas, 2011–2022. Sound of Jura located to the east. Shaded green and brown areas represent areas of suitable sediment for *Nephrops*. Bubbles scaled the same. Red crosses represent zero observations.

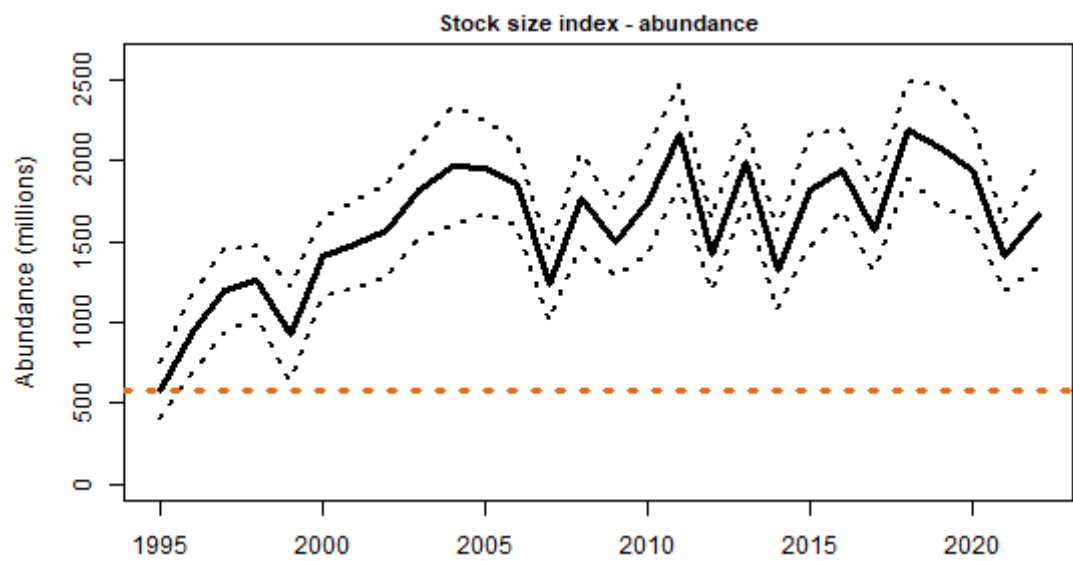


Figure 14.2.5. *Nephrops*, Clyde (FU13): Firth of Clyde subarea. Time-series of revised TV survey abundance estimates (adjusted for bias, *solid black line*), with 95% confidence intervals (*dotted black lines*), 1995–2022. The dashed red line is the rounded B_{trigger} value of 580 million individuals.

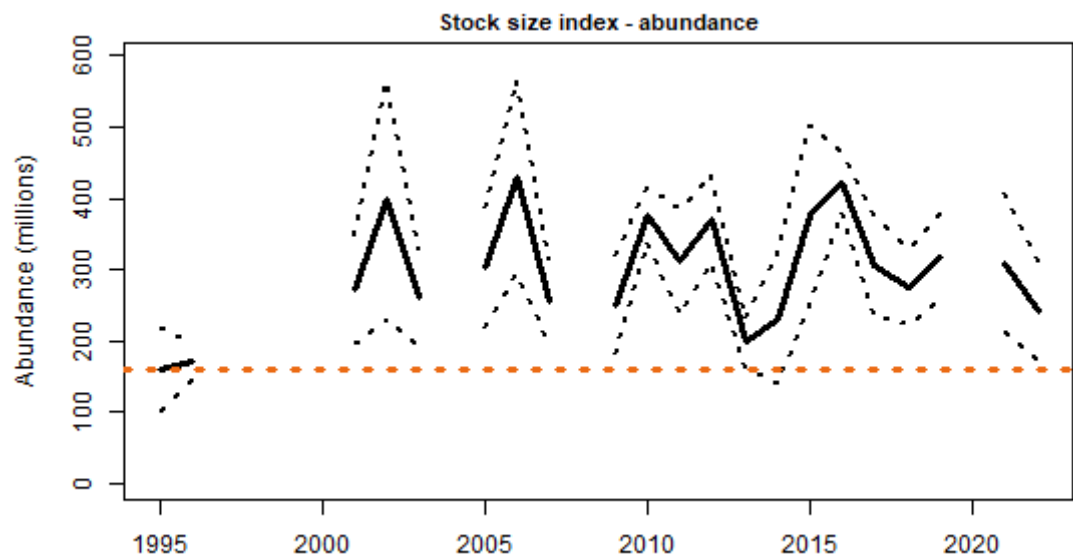


Figure 14.2.6. *Nephrops*, Clyde (FU13): Sound of Jura subarea. Time-series of TV survey abundance estimates (adjusted for bias, *solid black line*) with 95% confidence intervals (*dotted black lines*), 1995–2022. The dashed orange line is the rounded B_{trigger} value of 160 million individuals.

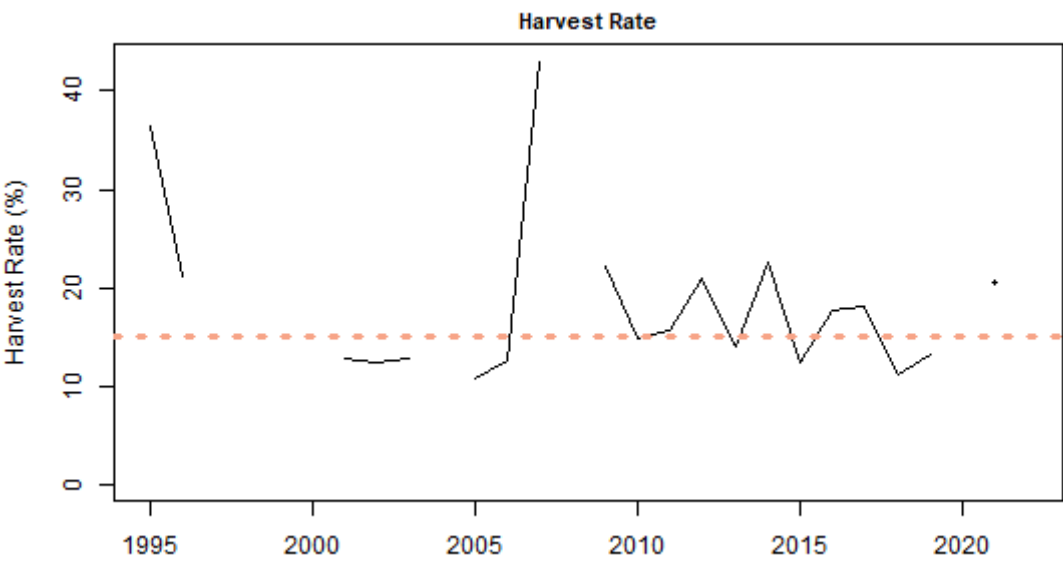


Figure 14.4.1. Clyde (FU13) *Nephrops* harvest rate, 1995–2021. The harvest rate is calculated by dead removals (both subareas combined)/TV abundances (both sub-areas combined). The dashed and solid lines are the F_{MSY} proxy harvest

rate (for the Firth of Clyde 15.1%) and the time-series of estimated harvest rates, respectively. Harvest rates prior to 2006 are considered unreliable.

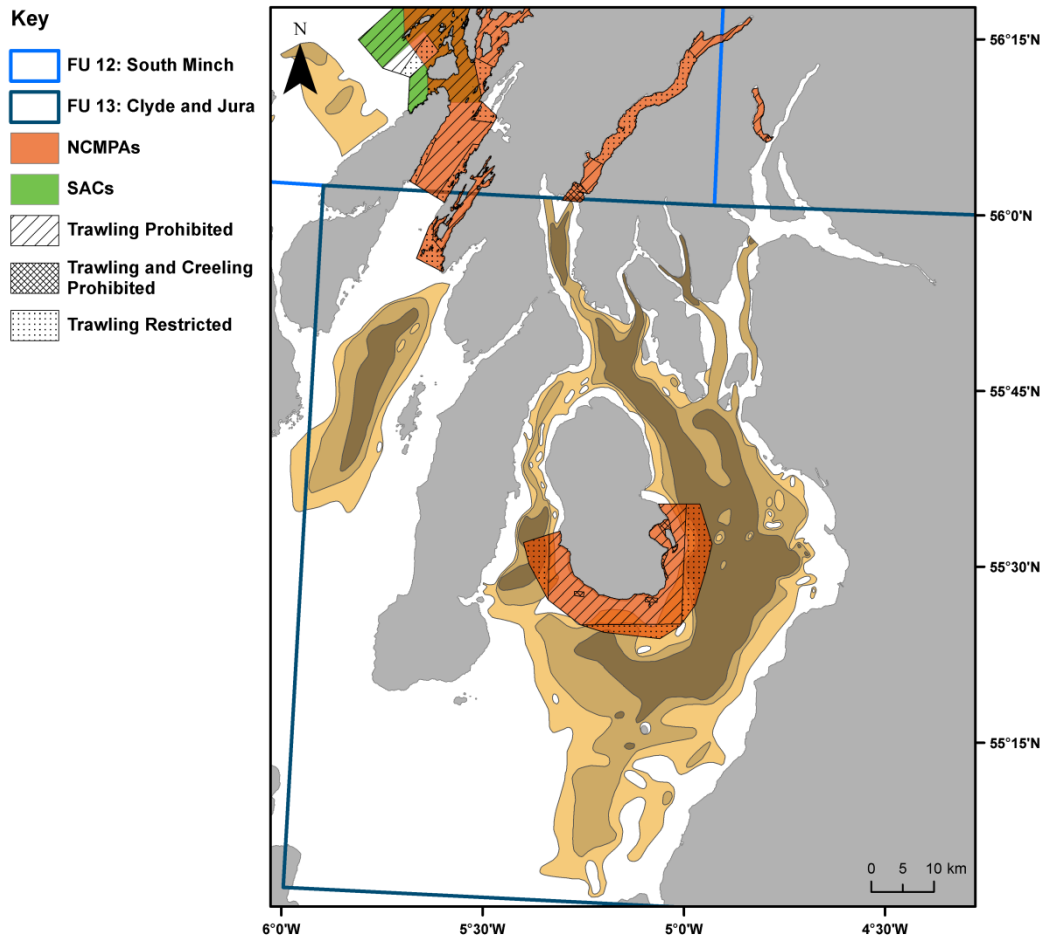


Figure 17.6.1. The area of *Nephrops* habitat (Mud, Muddy Sand and Sandy Mud) within the Clyde functional unit (FU13) relative to the areas of the Nature Conservation MPAs (NCMPAs) which fisheries management measures. Areas where demersal trawling is prohibited, restricted (i.e. vessel size restrictions or seasonal closures) and where creeling is prohibited are displayed. For more detailed information see SG (2016). Geographic Coordinate System: OSGB 1936, Datum: OSGB 1936, Projected Coordinate System: British National Grid. Coastline by Wessel and Smith (2016), MPA sites subsetted from NCMPA (SNH, 2015) and SAC (SNH, 2016) layers, management areas by SG (2017b) and functional units generated from merged ICES rectangles (ICES, 2017). Map and modified layers created using ArcGIS (ESRI, 2014).