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16 Norway lobster (*Nephrops norvegicus*) in Division 7.a, Functional Unit 15 (Irish Sea, West)

Type of assessment

The assessment and provision of advice through the use of the UWTV survey data and other commercial fishery data follows the general process defined by WKNEPH (2009) described in the stock annex. The TV survey is due to be repeated in the summer of 2021 and forms the basis of advice for this stock in the autumn.

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 11 785 tonnes.

To ensure that the stock in Functional Unit (FU) 15 is exploited sustainably, management should be implemented at the FU level.

ICES notes the existence of a management plan, developed and adopted by one of the relevant management authorities for Subarea 7. ICES considers this plan to be precautionary when implemented at the FU level.”

16.1 General

Stock description and management units

The Irish Sea West (FU15) is comprised of ICES rectangles 35E3–E5, 36E3–E5, 37E3–E5 and 38E4 within 7a. It is included in ICES Area 7 together with the Irish Sea East (FU14), Porcupine Bank (FU16), Aran Grounds (FU17) northwest Irish Coast (FU18), southeast and southwest Irish Coast (FU19), NW Labadie, Baltimore and Galley, and Jones and Cockburn (FU20–21) and the Smalls (FU22).

A TAC is in place for ICES Area 7 which does not correspond to the assessment units. As *Nephrops* are limited to muddy habitats the distribution of suitable sediment defines the species distribution and the stocks are therefore assessed as seven separate Functional Units. The TAC for Area 7 is shown in the tables below.

Fishery description

The FU 15 *Nephrops* fishery first developed in the late 1950s. The environment in the Western Irish Sea is very suitable for *Nephrops*, with a large mud patch and a gyre that retains the larvae over the mud patch, thus ensuring good recruitment. The ground can be characterized as an area of very high densities of small *Nephrops* compared to other functional units. The UK (Northern Ireland) and Ireland are the main countries involved in the FU15 *Nephrops* fishery.

The fishery in 2021

The *Nephrops* fishery in the Irish Sea west is economically one of the most important in ICES Area 7 and is mainly prosecuted by vessels from UK (Northern Ireland) and Ireland. Working Group landings from FU15 are presented in Table 16.1 and Figure 16.1. The total declared international

Nephrops landings reported from FU15 in 2021 was 6779 t, which was a decrease increase from 2019. The low levels of landings in 2019 (6115 t) are considered to reflect behavioural changes due to the COVID-19 pandemic (Table 16.1). There has been a trend for Irish, since 2012, and more recently Northern Irish vessels to switch to multi (quad) rig trawls and in general a reduction of single-rig vessel effort. Since March 2012, it is mandatory for all Irish vessels to use specified species selective gears. Similar conditions have been introduced in October 2012 for the UK (Northern Ireland) vessels. The introduction of highly selective gears suggests a reduction in bycatch rates of non-target fish species of around 30%. Quad-rig vessels are thought to increase *Nephrops* catch rates by around 30% whilst further reducing fish bycatch of ~30% due to the lower headline height. In 2021 there was small increase in LPUE in 2021 for Northern Irish vessels whilst the LPUE for Irish vessels remained stable (Table 16.2).s

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

Information from stakeholders

No information from stakeholders.

16.2 Data

Commercial size composition data for landings and discards were provided by Northern Ireland and Ireland. Other biological data used in the assessment were as listed in the stock annex compiled by the Benchmark meeting WKNEPH (2009).

InterCatch

Data were available in InterCatch and used to derive assessment input data.

Landings

Working Group landings from FU15 are presented in Table 16.1 and Figure 19.1. The total declared international *Nephrops* landings reported from FU15 in 2021 was 6779 t. Landings are derived primarily from Ireland and Northern Ireland. In 2021 there was significant impact of COVID-19 on the behaviour of fishers due to movement and social restrictions as well as market changes due to changing levels of demand.

Effort

Effort by the UK fleet remained relatively stable since 2002 following a steady decline from the early 1990s. There was a further marginal reduction in effort and lpue time-series for Ireland (Table 16.3) compared to 2016, with effort at the lowest reported value in the series. In previous years these interannual fluctuations have been attributed to the high mobility and flexibility, in terms of fishing in other areas within the TAC area, whereas the Northern Irish effort is mostly concentrated on FU15. Fishing activity from the Irish fleet in FU15 increasingly concentrates on good fishing periods during the year, resulting in a larger and increasing lpue. The lpue and effort lpue series for Northern Ireland are updated to provide kW days (kWd) and lpue as kg/kWd. A change to e-logbooks and recording of fishing hours after 2013 means that the recent data are not comparable with the historic series. Recent lpue and effort after 2013 has remained stable. The lpue for the Northern Irish and Irish fleets in 2021 were similar 2.71 kg/kWd and 2.84 kg/kWd but both increases since 2018 from 2.56 kg/kWd and 2.7 kg/kWd.

Sampling levels

Sampling of catches was impacted by COVID-19 in 2020 with cessation of sampling in the second quarter. Sampling resumed fully in 2021 and comparable levels to pre-2020 levels. Fisher self-sampling for Northern Irish vessels achieved 256 samples collected from the reference fleet, with 134, 66, 48 and 8 samples in quarters 1–4 respectively. The number of discard and catch samples collected from the Irish fleet was 0, 10, 22 and 2 samples collected in quarters 1–4 respectively. These rates correspond to one sample per 20.3 t landed by the Northern Irish fleet and one sample for every 44.4 t landed by the Irish fleet. Sampling levels due to changes in the schemes to adapted to COVID-19 impacts on working and social distancing requirements.

Commercial length–frequency distributions

Length and sex compositions of *Nephrops* landed from the Irish Sea West are estimated from port sampling by Ireland and Northern Ireland. Sampling of Northern Ireland catches was not possible during 2003–2007, with the Irish length frequencies raised to the international catch for these years. Northern Ireland sampling resumed in 2008 and these data are combined with those from Ireland for that year.

This Northern Irish fisher self-sampling scheme uses a reference fleet of vessels selected vessels from the main Northern Irish ports. The reference vessels selection is designed to be representative of the entire fleet with systematic rota sampling. The mean sizes of *Nephrops* in the catches of both the Northern Ireland and Ireland fisheries have fluctuated for the last decade (Tables 19.4–19.5; Figure 16.1). There is little evidence to suggest a long-term trend in the mean size of males and females in the landings and catches which continues to fluctuate around the series mean (Figure 16.2).

Sex ratio

The sex ratio by year is shown in Figure 16.3. This shows some fluctuations over time. In general, the sex ratio in landings and catches are biased toward males, with a geomean of 56.2% males in landings (1986–2020) and 52.4% in catches (1986–2020). There was little bias toward males in catches was observed in 2021 comprising 58% in landings and 52%. Historically the stronger bias of males in landings relates to the average larger size of male *Nephrops*.

Mean weights

Explorations of the mean weight in the catch samples by sex shows a strong seasonal pattern in the females (Figure 16.4). This corresponds with the emergence of mature females from the burrows to mate in summer. There is no evidence of a recent trend toward decreasing mean weights (Figure 16.5), however compared to the early part of the time-series mean weights have decreased. The mean weights in landings (2016–2021) and mean weights in discards (2016–2020) are used in the basis for calculating catch options (Section 19.4).

Discards

Annual discard rates are estimated using unsorted catch and discards sampling. Unsorted catches and samples of retained catch are provided by vessels. The catch sample is partitioned into landings and discards using a discard selection ogive. This selection ogive can be derived per sample or as aggregation of samples within a quarter or year when sampling rates are low. Sampling effort is stratified weekly, but quarterly aggregations are used for quarterly length

frequencies and discard estimates. The length–weight regression parameters given in the stock annex are used to calculate sampled weights and appropriate raising factors. Discarding practice is highly variable, mainly driven by market demand, and was 26.5% of the catch by number in 2021 (Table 16.6). A discard survival rate of 10% is assumed for *Nephrops* from this FU (WKNEPH 2009).

Surveys

Abundance indices from UWTV surveys

Since 2003, Ireland and Northern Ireland have jointly carried out underwater television surveys of the main *Nephrops* grounds in the western Irish Sea. These surveys were based on a randomised fixed-grid design. The methods used during the surveys were similar to those employed for UWTV surveys of other *Nephrops* stocks and were as agreed by WKNEPHTV (ICES, 2007), WKNEPBID (ICES, 2008), SGNEPS (ICES, 2009; 2010; 2012), WKNEPH (ICES, 2009) and WGNEPS (ICES, 2013; 2014; 2015; 2016). From 2003 to 2011 year an average of 146 valid stations was covered by the two surveys combined, and the data were raised to a stock area of around $5290 \times 10^{-6} \text{ km}^2$ as detailed in Table 16.7. The number of stations were significantly reduced in 2012 following a recommendation from SGNEPS 2012 that a CV (or relative standard error) of <20% is an acceptable precision level for UWTV survey estimates of abundance. This allowed sampling intensity to be reduced and survey effort allocated to other areas and FUs in area 7. Details of the survey methodology are available in WGNEPS (ICES, 2016). Figure 16.6 shows the distribution of stations sampled in 2022. In 2022 the survey was completed on both the RV Corystes (82 stations) and Celtic Explorer (13 stations). In 2021 there was change to using High Definition ‘still’ image cameras to collect footage onboard the RV Corystes, this was used again in 2022. This change provides significantly improved image quality. A similar change has also taken place in other functional units in ICES area 7. A trial in FU 16 showed no significant difference in the burrow estimates derived from standard video imagery and high definition still imagery. In 2022 97 stations were completed, footage from 3 stations was not collected because of the presence of static fishing gear preventing the deployment of the camera. Figures 16.7–16.10 are contour plot of the krigged-density estimates for FU15 over the period 2003–2022. The resulting krigged burrow abundance estimate was 4498 million burrows. This was a similar result of that obtained in 2019 of 4775 million burrows. A violin plot of the burrow densities observed in the survey (2003–2022) is shown in Figure 16.11. The character of the burrow densities encountered has remained consistent over time; characterised by a relatively high occurrence of low density stations and a normal distribution densities around 0.74 burrow/m^2 . Confidence in the survey estimates and design are assured through the maintained low coefficient of variation on the burrow estimates. This low coefficient of variation, despite the loss of three survey stations supports that the survey provides high quality information

The use of the UWTV surveys for the provision of *Nephrops* management advice was extensively reviewed by WKNEPH (ICES, 2009) and potential biases were highlighted including those due to edge effects; species burrow misidentification and burrow occupancy. A cumulative bias correction factor estimated for FU15 was 1.14 which means the TV survey is likely to overestimate *Nephrops* abundance by 14%.

Nephrops trawl surveys

In addition to UWTV surveys Northern Ireland have completed spring (April) and summer (August) *Nephrops* trawl surveys since 1994 and provide data on catch rates, size composition and biological data from fixed stations in the western Irish Sea as detailed in the Stock Annex (Stock Annex Figure 1). Survey cpue has remained stable over time. Mean carapace length-by-sex (from

the trawl survey) shows inter-annual variation fluctuating around mean with no apparent trend over time (Figure 16.12).

Due to reduced resources, the spring survey series was terminated in 2010 as part of a national rationalisation of the survey programme after considering benefits to management and stock assessment. Due to a major ship break-down, no data are available for the 2013 summer survey. The summer trawl survey catch rates correlate somewhat with UWTV survey abundance estimates (Figure 16.13), but showed a deviating trend, especially in 2010. The longer time-series of the trawl survey shows that catch rates in the last few years (2005–2009, 2011) are close to the mean of the series when UWTV burrow abundances were in the range of 5–6 billion burrows. The reduction in the 2010 trawl estimate, that showed a conflicting trend to the UWTV abundance, is most likely associated with the survey taking place in suboptimal tidal conditions. Usually the trawl survey coincides with slack tides, but this was not optimal in 2010 due to availability of the ship and synchronisation with the UWTV survey.

16.3 Assessment

Comparison with previous assessments

The assessment approach used by WGCSE 2022 is consistent with that set out in the stock annex and *WKNEPH* (*WKNEPH*, 2009). Since the most recent three years of sampling data were available, three-year averages of mean weights in the landings and proportions retained in the fishery have been used. This is in line with the procedure used for other stocks in areas 6 and 7 by WGCSE.

State of the stock

The stock size is estimated to show a decrease, but within the limits previously observed for the stock. The harvest ratio in 2021 (15.4%) and remains below F_{MSY} (18.1) (Figure 16.14). This stock has previously sustained landings at around 9000 t for many years. The stock increased until 2003, with a general decrease until 2014 and has increased since then. The most recent UWTV abundance estimate of 4498 million in 2022 follows a period (2016–2017) of above average size. The geometric mean of current series is 4908 million. Figure 16.14 is the stock summary plot for FU15. Recent harvest rates have fluctuated around F_{MSY} , but is estimated as 15.4 in 2021, having decreased from 19.9 in 2015 (Table 16.6). The stock is estimated to be above $MSYB_{trigger}$ (3000 million).

16.4 Catch option table

Catch option table inputs are presented in Table 16.6 and summarised below. A three year average (2019–2021) of mean weight in the landings and proportion of removals retained was used.

A stock abundance prediction for 2023 was made for FU15 using the approach agreed at the Benchmark Workshop (*WKNEPH*, 2009) and outlined in the stock annex made on the basis of the 2021 UWTV survey.

The basis for the catch options.

Variable	Value	Notes
Stock abundance (2023)	4498	UWTV survey 2022; numbers of individuals in millions
Mean weight in projected landings	15.0	Average 2019–2021; in grammes
Mean weight in projected discards	8.07	Average 2019–2021; in grammes
Projected discard rate	26.5	Average 2019–2021; percentage by number of the total catch
Discard survival rate	10.0	Percentage by number of the discards

16.5 Reference points

A decision-making framework for the choice of F_{MSY} proxy reference points is available in the introduction to the *Nephrops* ICES advice sheets. The current F_{MSY} proxy reference points for FU15 *Nephrops* was evaluated at WKMSYRef4. The MSY reference point for FU15 *Nephrops* is the F_{max} for combined sexes. No precautionary reference points have been defined for *Nephrops* stocks. Whereas the F_{MSY} proxy reference points were chosen with the intent that they should lead to a low probability of stock overfishing.

Previously the cpue data from the trawl surveys were scaled to the UWTV index to provide a $B_{trigger}$ approximation based on the mean of the five lowest survey catch rates in the time-series (Figure 16.8), this is still accepted as an appropriate $B_{trigger}$ for FU15.

Stock code	MSY Flower	F_{MSY}	MSY Fupper with AR	MSY $B_{trigger}$	MSY Fupper with no AR
nep-15	12.4	18.2	18.2	3000*	18.2

*Abundance in millions.

16.6 Management strategy

As yet there are no explicit management strategies for this stock.

16.7 Quality of assessment and forecast

Uncertainties in the survey, mean weight in the landings and discard rates are not taken into account in the deterministic catch option. There is some variability in these over time.

There are several key uncertainties and bias sources in the method used here (these are discussed further in WKNEPH 2009). Various agreed procedures have been put in place to ensure the quality and consistency of the survey estimates following the recommendations of several ICES groups (WKNEPTV 2007; WKNEPHBID 2008; SGNEPS 2009). These have led to a revision in the historical time-series of survey abundance estimates for FU15, which was presented to last year's Working Group. Ultimately there still remains a degree of subjectivity in the production of UWTV abundance estimates (Marrs *et al.*, 1996).

Taking explicit note of the likely biases in the surveys may at least provide an estimate of absolute abundance that was more accurate but no more precise (WKNEPH 2009). The survey estimates themselves are very precisely estimated (CVs 2–5%) given the homogeneous distribution of burrow density and the modelling of spatial structuring. The cumulative bias estimates for FU15 are largely based on expert opinion (see Stock Annex). The precision of these bias corrections cannot yet be characterised but is likely to be higher than that observed in the survey.

In the provision of catch options based on the absolute survey estimates additional uncertainties related to mean weight in the landings and the discard rates also arise. These parameters are quite variable, in future years the uncertainty in these key parameters should be estimated.

The quality of landings data has improved since 2007 with the implementation of sales notes and buyers and sellers legislation. Prior to that there were concerns that landings were underreported. The harvest ratio may be under estimated prior to 2007.

16.8 Recommendations for next benchmark

WGCSE will keep the stock under review and recommend future benchmark as required.

16.9 Management considerations

The FU15 *Nephrops* fishery first developed in the late 1950s. Since then it has sustained landings of around 8500 t for more than 30 years. Fishing effort in the past has been very high but has declined somewhat in recent years. The environment in the Western Irish Sea is very suitable for *Nephrops* with a large mud patch and gyre, which retains the larvae over the mud patch thus ensuring good recruitment. The ground can be characterised as an area of very high densities of small *Nephrops*. All available information indicates that size structure of catches appears to have changed little since the fishery first began.

The *Nephrops* trawl fisheries take bycatches of other species, especially juvenile whiting, but also cod. Catches of these species should be reduced to as low as possible because of the poor status of these stocks. A conditional national licence has been introduced by Ireland since March 2012, making the use of grids or separator panels mandatory for all TR2 boats fishing in the Irish Sea. Around 55% of the Irish vessels use separator trawls and while 45% have opted to use Swedish grids to reduce bycatch. Additionally, there has been a trend for Irish vessels to switch to multi (quad) rig trawls. Provisional data suggest a ~30% increase in *Nephrops* catch rates and a reduction in fish bycatch of ~30% due to the lower headline height.

Since October 2012, all TR2 vessels in the UK (Northern Ireland) fleet are required to use a highly selective fishing gear. In the Irish Sea these currently include Seltra 300 mm box trawl, 270 mm diamond mesh panel Seltra box trawl and 300 mm square mesh panel. All these gears are being developed with the aim of achieving exemption from the cod recovery plan under Article 11 (less than 1.5% cod catch). Enforcement is through the issue cod recovery zone fishing authorisations, where no authorisation is given to a vessel that is not using a highly selective gear.

ICES has repeatedly advised that management should be at a smaller scale than the ICES Subarea 7. Management at the Functional Unit level could provide the controls to ensure that catch opportunities and effort are at the same scale as the resource.

A number of cod recovery measures have been introduced since 2000 to promote recovery of Irish Sea cod stocks. These include a closure of the western Irish Sea cod spawning grounds from mid-February to end of April since 2000, with a later extension to the eastern Irish Sea closure. Despite a partial derogation for *Nephrops* vessels during the closed period the distribution of effort on *Nephrops* has been affected by this management plan. There have also been

decommissioning schemes to reduce fishing effort. During 2016–2020 the EU landing obligation was applied to all catches of Norway lobster fisheries in ICES Subarea 7 with exemptions for high survival. From 2020, this stock is still under a landing obligation and there are still exemptions in place. Observations from the 2016–2020 fishery indicate that discarding above the minimum conservation reference size (MCRS) continues and has not changed markedly (Figure 3). ICES is providing advice for 2022 assuming average discard rates as observed over the last three years. This is considered to be the most realistic assumption.

16.10 References

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Table 16.1. Irish Sea West (FU15): Landings (tonnes) by country, 2000–2018.

Year	Ireland	Isle of Man	UK	Other countries	Total
2000	3433	0	4937	0	8370
2001	2689	3	4749	0	7441
2002	2291	1	4501	0	6793
2003	2709	4	4352	0	7065
2004	2786	13	4470	1	7270
2005	2133	0	4420	0	6554
2006	2051	1	5508	1	7561
2007	2767	0	5724	0	8491
2008	3132	50	7323	2	10508
2009	2343	1	6855	0	9198
2010	2578	0	6384	0	8963
2011	3575	2	6584	0	10162
2012	3794	3	6732	0.2	10529
2013	2465	31	6175	0.2	8672
2014	2938	0**	5676	0.0	8613
2015	2199	0**	6433	0.3	8632
2016	1609	0**	5715	3	7327
2017	1253	0**	4896	0	6150
2018	1387		4369	0	5756
2019*	1859		5731	0	7590
2020	1555		4560		6115
2021	1512		5267		6779

* provisional. **included in UK landings.

Table 16.2. Irish Sea West (FU15): Catches and landings (tonnes), effort ('000 hours trawling), cpue and lpue (kg/hour trawling) Republic of Ireland *Nephrops* Directed Trawlers 2000–2019.

Year	Landings (Kg)	Effort (Hours)	Effort (days)	Effort (kwdays)	lpue
1995	1706969	44459	3516	835977	2.041885
1996	1406140	31409	2326	607785	2.313549
1997	2801501	60502	4518	1124379	2.491599
1998	2696979	52277	4051	1053491	2.560039
1999	4031508	73786	5260	1367903	2.947217
2000	3227565	61936	4396	1199896	2.68987
2001	2428587	51111	3435	939387	2.585289
2002	2015965	46072	2900	873563	2.307749
2003	1620391	47704	3120	878568	1.844355
2004	2586760	52673	3500	1033073	2.503946
2005	2111185	50825	3414	1003901	2.102981
2006	2031881	53461	3535	1084251	1.873995
2007	2728841	52550	3575	1056291	2.583419
2008	3165781	49218	3401	1027919	3.079796
2009	2333433	34651	2368	706178	3.304312
2010	2505061	36504	2546	739345	3.388218
2011	3554343	47640	3229	921298	3.857972
2012	3725318	49313	3560	966006	3.856413
2013	2269336	33818	2571	682793	3.323608
2014	2449612	40371	3007	852740	2.872635
2015	2119880	35898	2733	756719	2.80141
2016	1529418	28249	2301	556452	2.748516
2017	1120690	22516	1749	410628	2.729208
2018	1363911	27084	1919	535002	2.549353
2019	1803134	33981	2304	700132	2.57542
2020	1517909	25717	2250	570314	2.661534
2021	1517909	25717	2250	570314	2.661534

Table 16.3. Irish Sea West (FU15): Landings (tonnes), effort ('000 hours trawling), lpue (kg/hour trawling), effort ('000 kW days) and lpue (kg/kWd) of Northern Ireland *Nephrops* trawlers, 2000–2019.

Year	Landings	Effort ('000 hours)	lpue ('000 hrs)	kW days ('000)	lpue kWd
2000	4758	168.7	28.2		
2001	4587	163.7	28.0		
2002	4495	130.8	34.4		
2003	4146	136.1	29.0		
2004	4273	144.3	29.6		
2005	4235	138.4	30.6		
2006	5356	144.1	37.2		
2007	5512	126.9	43.4		
2008	7056	141.4	49.9		
2009	6487	134.7	48.2		
2010	5888	141.1	41.7		
2011	5952	132.7	44.9		
2012	5865	137.8	42.6		
2013	5605	135.7	41.3	2151.9	2.60
2014	5190	114.6	45.3	2111.2	2.46
2015	6396			1962.6	3.26
2016	5638			2107.3	2.68
2017	4789			1904.3	2.51
2018	4293			2079.3	2.06
2019	5539			2166.5	2.56
2020	4550			1852.0	2.46
2021	5201				

* provisional.

Table 16.4. Irish Sea West (FU15): Mean sizes (mm CL) of male and female *Nephrops* in Northern Ireland catches, landings and discards, 2000–2018.

Year	Catches		Landings		Discards	
	Males	Females	Males	Females	Males	Females
2000	27.7	24.5	29.4	26.3	22.5	22.6
2001	25.7	23.6	26.1	24.4	21.7	21.2
2002	26.7	24.1	26.7	24.9	21.8	21.7
2003	na	na	na	na	na	na
2004	na	na	na	na	na	na
2005	na	na	na	na	na	na
2006	na	na	na	na	na	na
2007	na	na	na	na	na	na
2008	25.9	24.6	26.9	25.5	21.4	21.5
2009	27.7	25.1	29.3	26.5	23.6	23.2
2010	28.3	25.6	29.5	26.3	23.2	22.8
2011	27.6	26.0	29.3	27.7	22.6	22.8
2012	26.8	24.3	27.7	25.4	21.7	21.1
2013	26.2	24.2	27.2	25.4	21.5	21.3
2014	26.3	23.9	27.1	24.9	21.1	20.6
2015	25.3	23.4	26.8	24.7	21.6	21.3
2016	25.9	24.3	26.9	25.5	22.3	21.8
2017	27.0	24.8	28.0	26.1	22.9	22.5
2018	27.6	25.1	28.8	26.6	23.3	22.5
2019	27.1	24.1	27.9	24.8	22.6	21.7
2020	27.5	26.5	29.1	28.1	22.6	22.5
2021	27.4	26.3	29.0	27.9	22.3	22.4

na = not available.

Table 16.5. Irish Sea West (FU15): Mean sizes (mm CL) of male and female *Nephrops* in Republic of Ireland catches, landings and discards, 2000–2018.

Year	Catches		Landings		Discards	
	Males	Females	Males	Females	Males	Females
2000	29.1	27.1	32.2	29.7	24.3	24.0
2001	26.7	24.8	28.6	27.0	23.0	22.2
2002	28.9	25.4	30.2	27.8	24.6	23.6
2003	27.7	24.9	29.7	26.9	24.0	23.1
2004	28.1	26.1	29.7	27.8	23.9	23.7
2005	28.5	26.8	30.1	29.1	23.9	23.2
2006	27.7	25.5	29.5	27.1	23.8	23.1
2007	27.7	25.4	29.8	27.9	24.0	23.3
2008	27.4	24.6	28.9	26.6	22.0	21.4
2009	28.5	26.3	30.5	29.2	24.3	23.4
2010	28.0	25.9	29.6	27.6	23.8	23.3
2011	27.0	25.7	28.8	27.3	23.7	23.5
2012	26.8	25.6	28.3	27.0	23.2	23.0
2013	26.3	25.1	27.4	26.5	23.1	22.6
2014	27.7	24.9	29.2	26.3	23.6	23.3
2015	27.7	25.7	29.5	27.4	24.4	24.0
2016	26.0	25.0	27.3	26.4	23.5	23.3
2017	27.2	25.0	28.1	26.2	23.4	22.6
2018	27.4	24.9	29.8	22.8	24.6	22.8
2019	27.9	25.0	29.5	27.0	22.8	22.3
2020	28.0	26.3	29.7	27.9	24.1	24.1
2021	27.9	25.8	29.6	28.4	23.2	23.9

Table 16.6. Irish Sea West (FU15): Proportion discarded by weight and number from FU15. (Note a 10% survivorship of discards is assumed in HR and forecast calculations).

Year	UWTV abundance estimate Millions	95% Confidence Interval millions	Landings in number	Total discards in number*	Removals in number	Harvest rate (by number) %	Landings tonnes	Total discards* tonnes	Discard rate (by number) %	Dead discard rate (by number)	Mean weight in landings grammes	Mean weight in discards
2003	5485	0.027	404	291	666	12.1	7065	2659	41.9	39.3	17.5	9.14
2004	5547	0.03	416	218	612	11.0	7270	1993	34.4	32.0	17.5	9.14
2005	5673	0.044	346	157	488	8.6	6554	1412	31.2	29.1	18.9	8.99
2006	5402	0.041	467	261	701	13.0	7561	2285	35.9	33.4	16.2	8.75
2007	5150	0.034	511	375	848	16.5	8491	3246	42.3	39.7	16.6	8.66
2008	4288	0.025	755	191	927	21.6	10508	1421	20.2	18.6	13.9	7.44
2009	4623	0.026	567	335	868	18.8	9198	2934	37.1	34.7	16.2	8.76
2010	4990	0.031	572	180	733	14.7	8963	1539	23.9	22.0	15.7	8.55
2011	4871	0.023	644	332	943	19.4	10162	2683	34.0	31.7	15.8	8.08
2012	5062	0.029	771	258	1003	19.8	10529	1871	25.1	23.1	13.7	7.25
2013	4310	0.027	662	229	867	20.1	8672	1590	25.7	23.6	13.1	6.94
2014	4593	0.025	641	198	819	17.8	8613	1418	23.6	21.7	13.4	7.16
2015	4373	0.029	620	280	872	19.9	8643	2228	31.1	28.9	13.9	7.96

[illegible]

Table 16.7. Irish Sea West (FU15): Results from NI/ROI collaborative UWTV surveys of *Nephrops* grounds in 2003–2020.

Ground	Year	Number of stations	Mean Density (No./M ²)	Domain Area (km ²)	Estimate (billions)	CV on Burrow estimate
Western Irish Sea	2003	160	0.99	5295	5.5	3%
	2004	147	1.00	5310	5.5	3%
	2005	141	1.02	5281	5.7	4%
	2006	138	0.97	5194	5.4	4%
	2007	148	0.93	5285	5.1	3%
	2008	141	0.77	5287	4.3	3%
	2009	142	0.83	5267	4.6	3%
	2010	149	0.90	5307	5.0	3%
	2011	156	0.88	5289	4.9	2%
	2012	99	0.91	5291	5.1	3%
	2013	80	0.78	5278	4.3	3%
	2014	99	0.83	5272	4.6	3%
	2015	100	0.79	5279	4.4	3%
	2016	100	0.84	5260	5.1	3%

Ground	Year	Number of stations	Mean Density (No./M ²)	Domain Area (km ²)	Estimate (billions)	CV on Burrow estimate
	2017	101	0.90	5304	5.3	3%
	2018	100	0.85	5791	4.9	3%
	2019	100	0.76	5370	4.4	3%
	2020	99	0.82	5791	4.8	3%
	2021	95	0.78	5790	4.7	4%

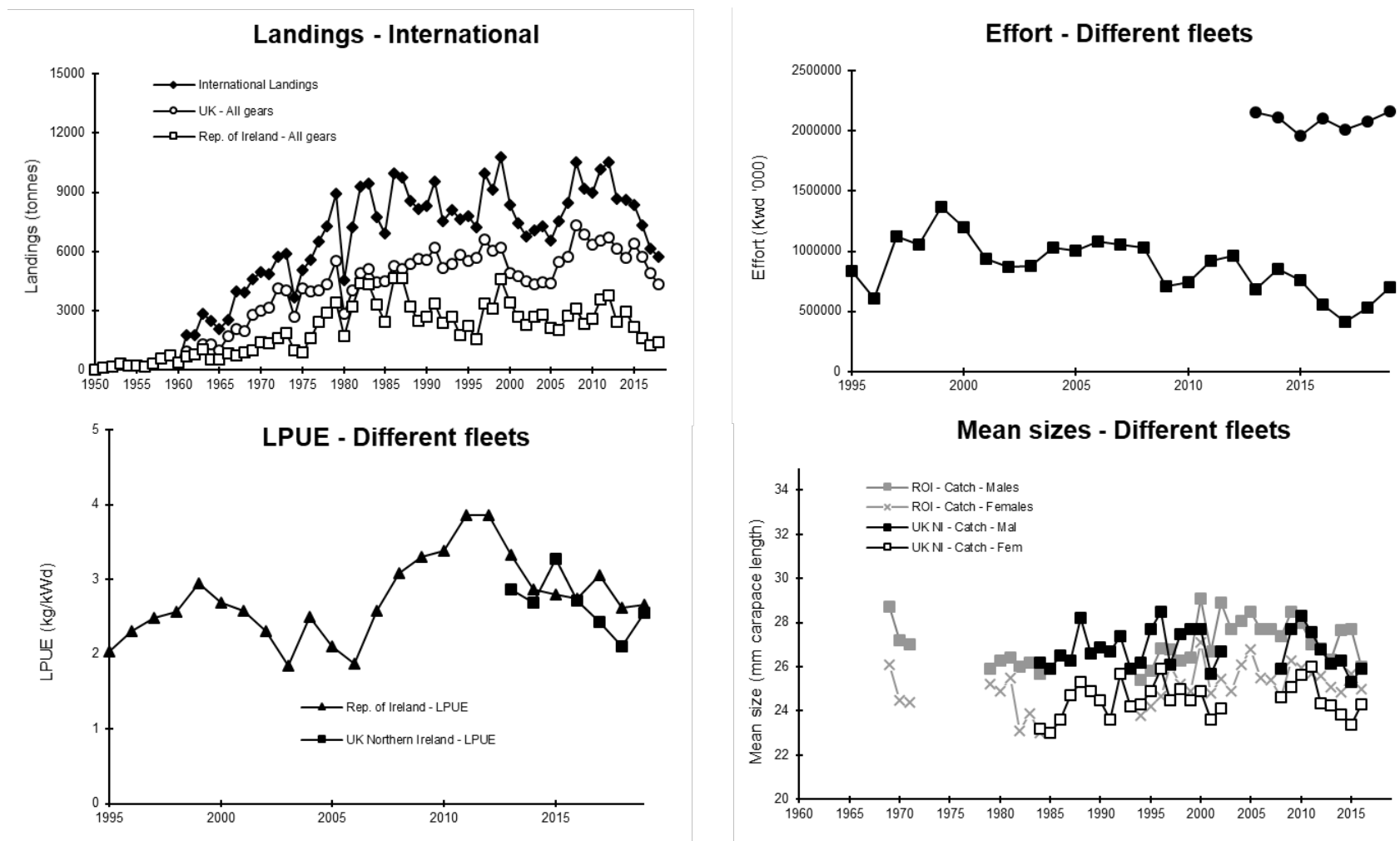


Figure 16.1. Irish Sea West (FU15): Long-term trends in landings, effort, lpue, and mean sizes of *Nephrops*. [The quality of landings data has improved since 2007 with the implementation of sales notes and buyers and sellers legislation, which result in misleading lpue trend plots pre- and post-2007].

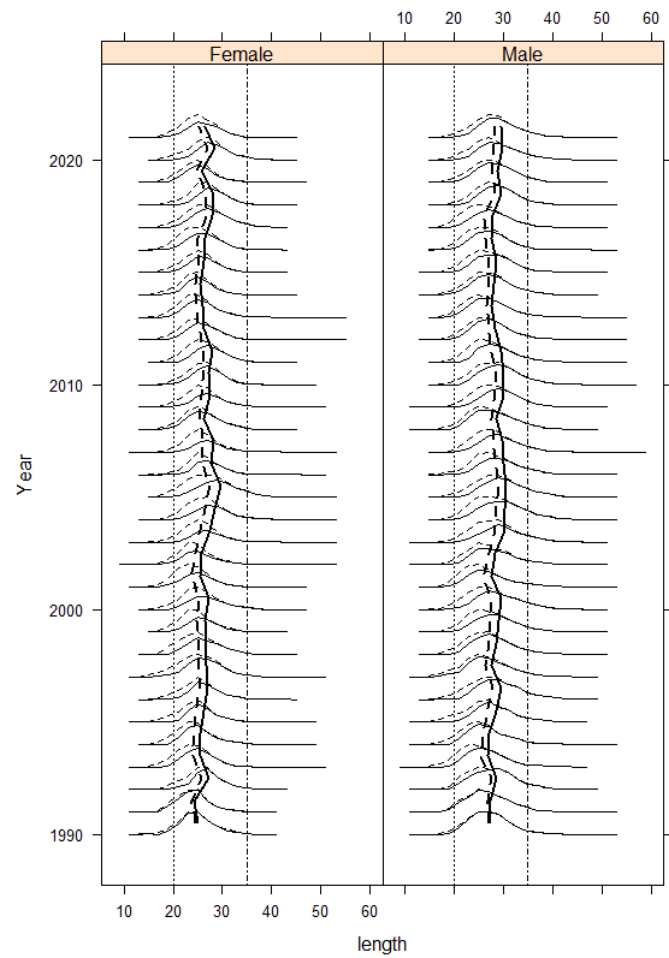
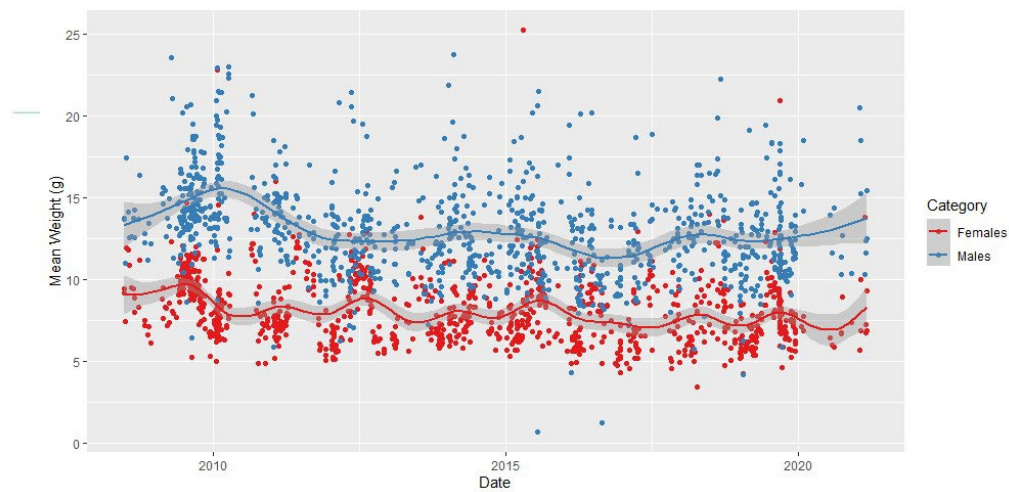


Figure 16.2. Irish Sea West (FU15): Length distributions in the landings (solid) and catches (dotted) 1986–2022.



Figure 16.3 *Nephrops* in FU15 (Irish Sea West). Sex ratio (percentage of males) of landings and discards (1986–2020).



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Figure 16.4 *Nephrops* in FU15 (Irish Sea West). Mean weight in catch samples by sex with GAM loess smoother (k=20).

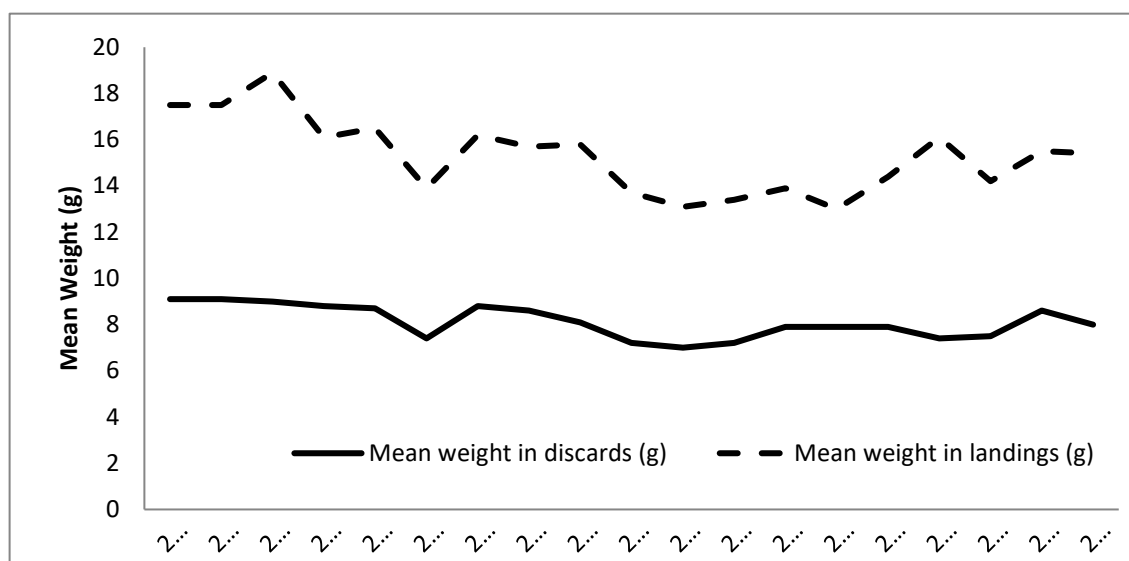


Figure 16.5 *Nephrops* in FU15 (Irish Sea West). Mean weight in landings and discards.

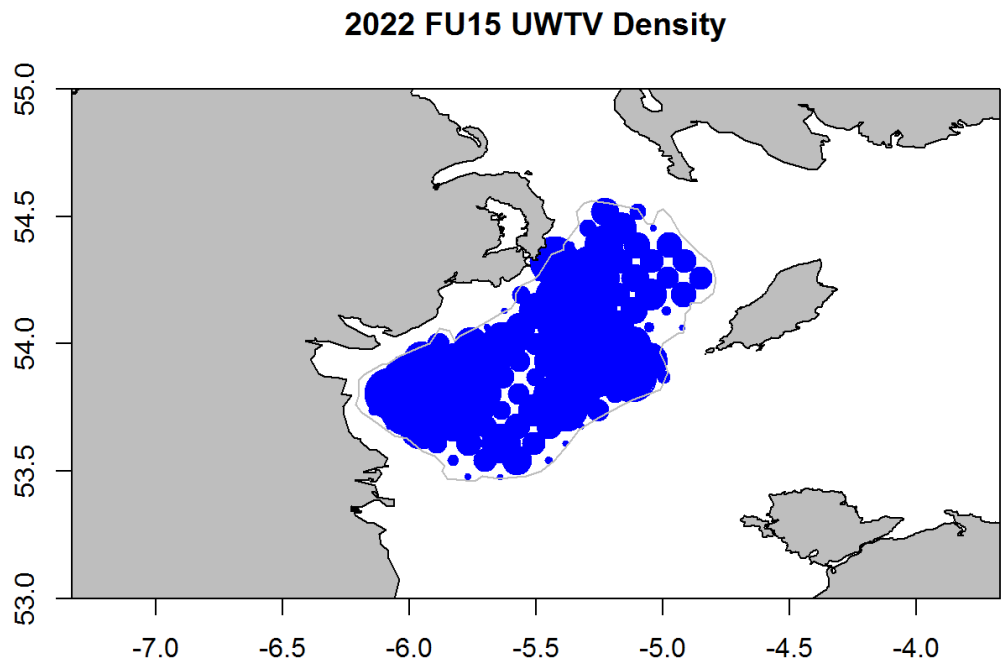


Figure 16.6. Irish Sea West (FU15): 2022 UWTV survey stations, symbol size reflects the burrow density.

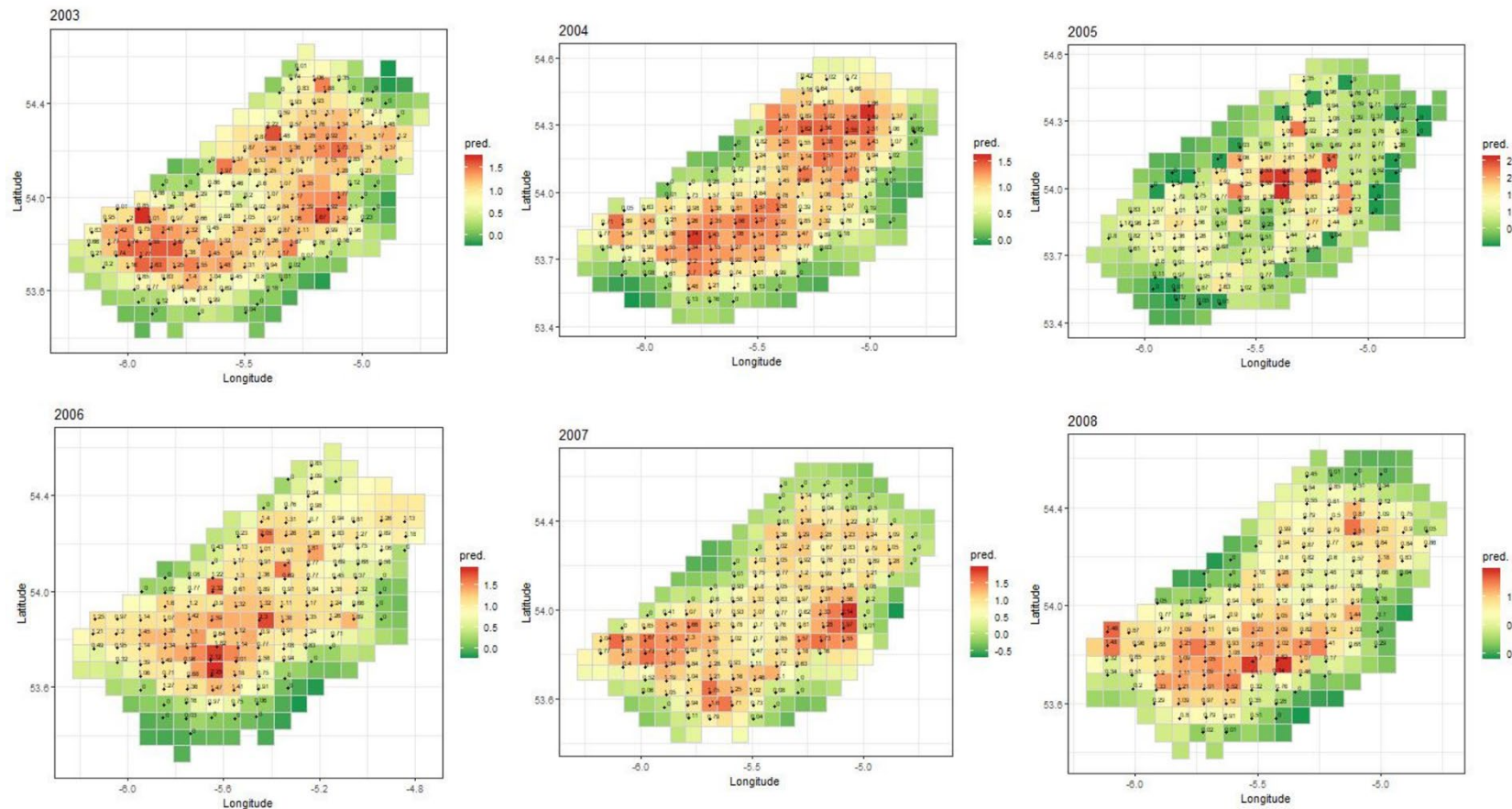


Figure 16.7. Irish Sea West (FU15): Contour plots of the krigger density estimates for the Irish Sea from 2003–2008.

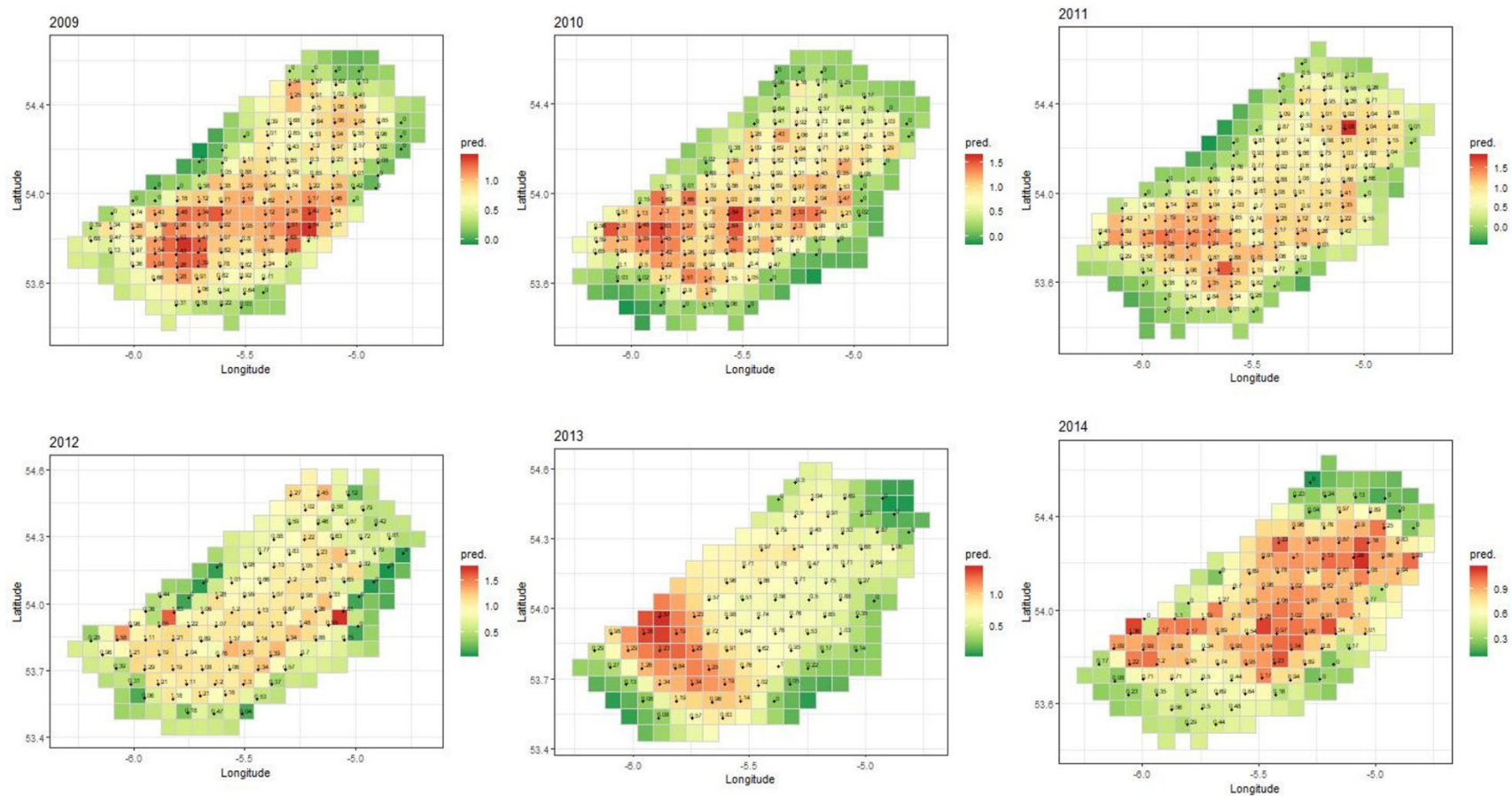


Figure 16.8. Irish Sea West (FU15): Contour plots of the krigger density estimates for the Irish Sea from 2009–2014.

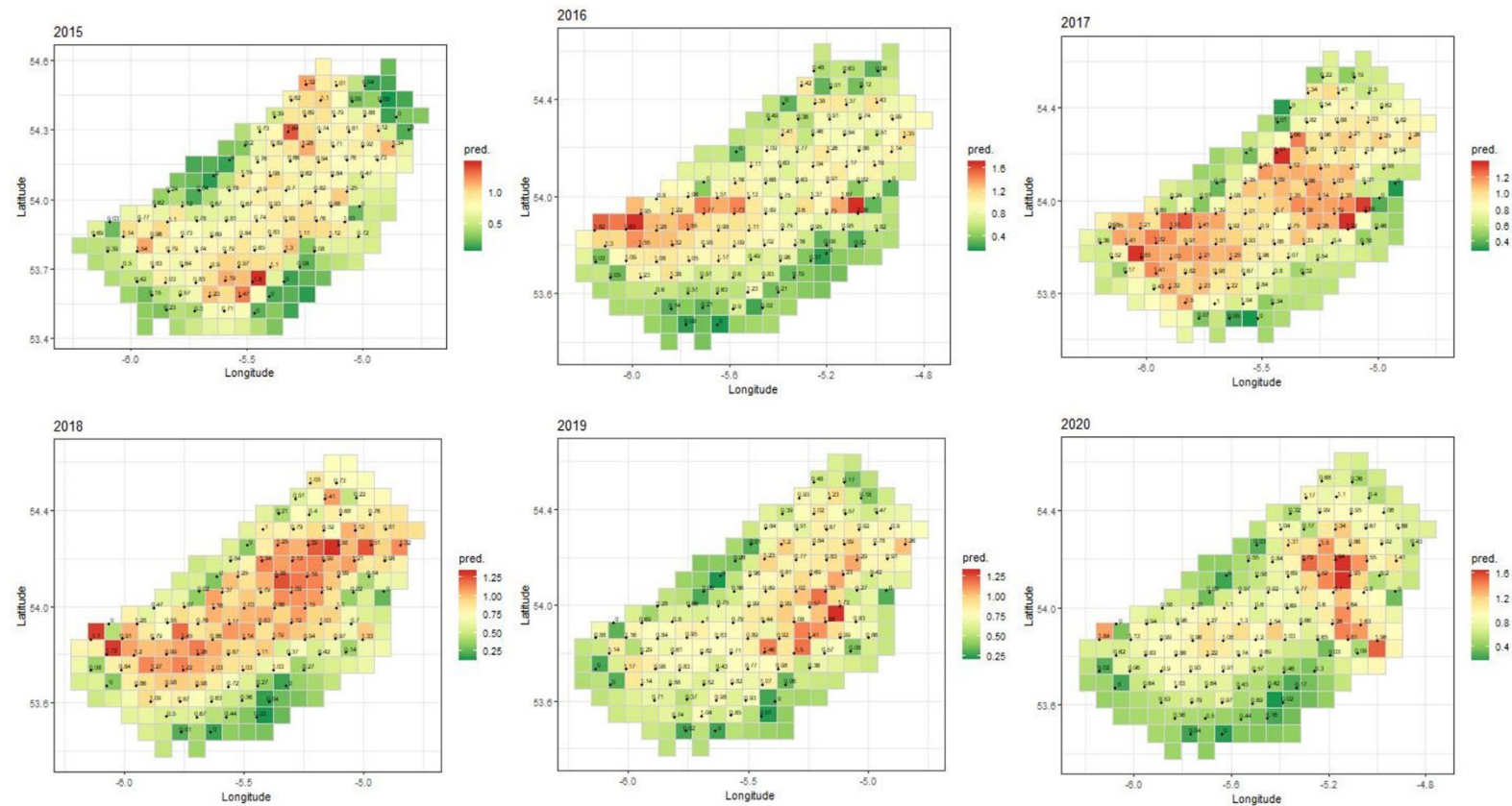


Figure 16.9. Irish Sea West (FU15): Contour plots of the krige density estimates for the Irish Sea from 2009–2020.

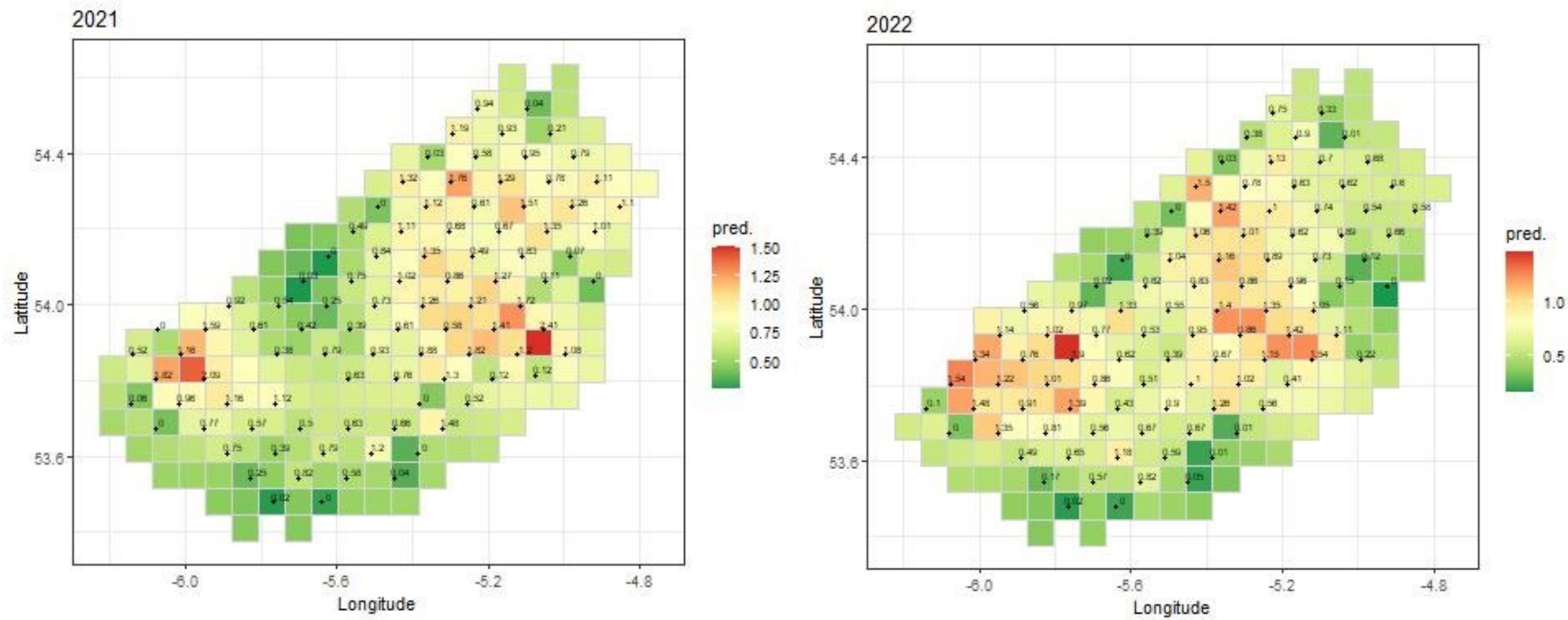


Figure 16.10. Irish Sea West (FU15): Contour plots of the krigger density estimates for the Irish Sea for 2021 and 2022

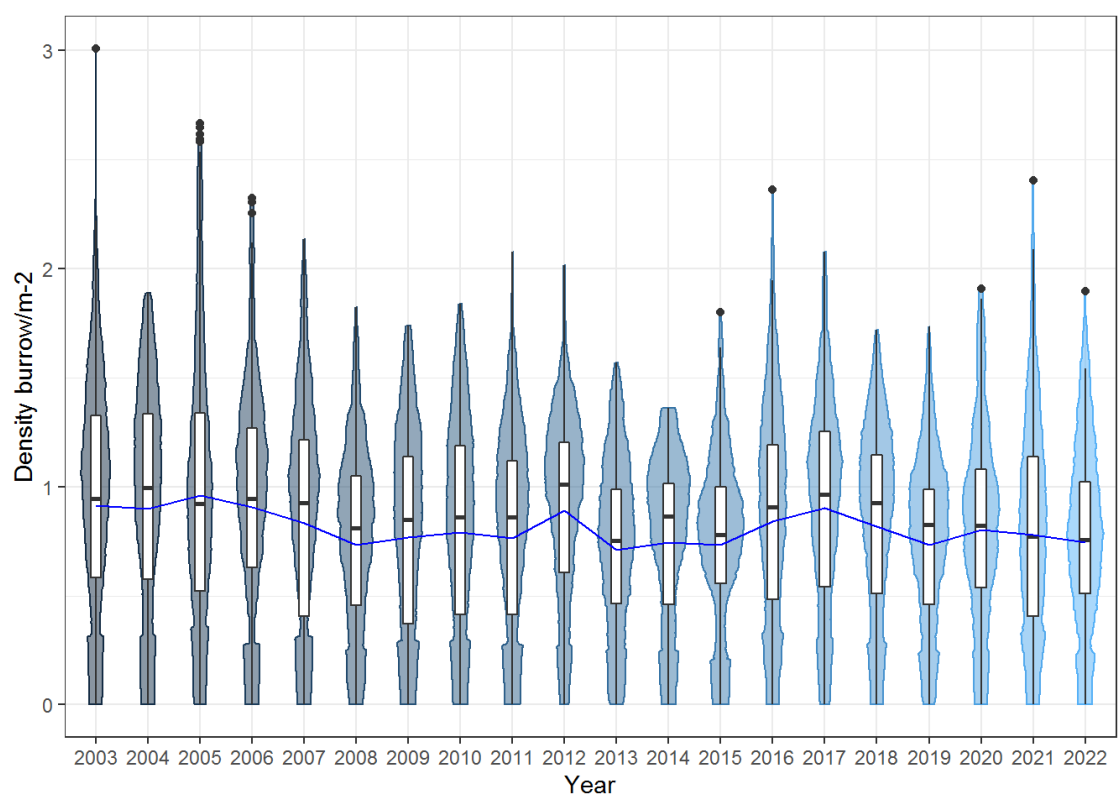


Figure 16.11. Irish Sea West (FU15): Box and kite plot of burrow density observed during UWTV survey 2003–2022.

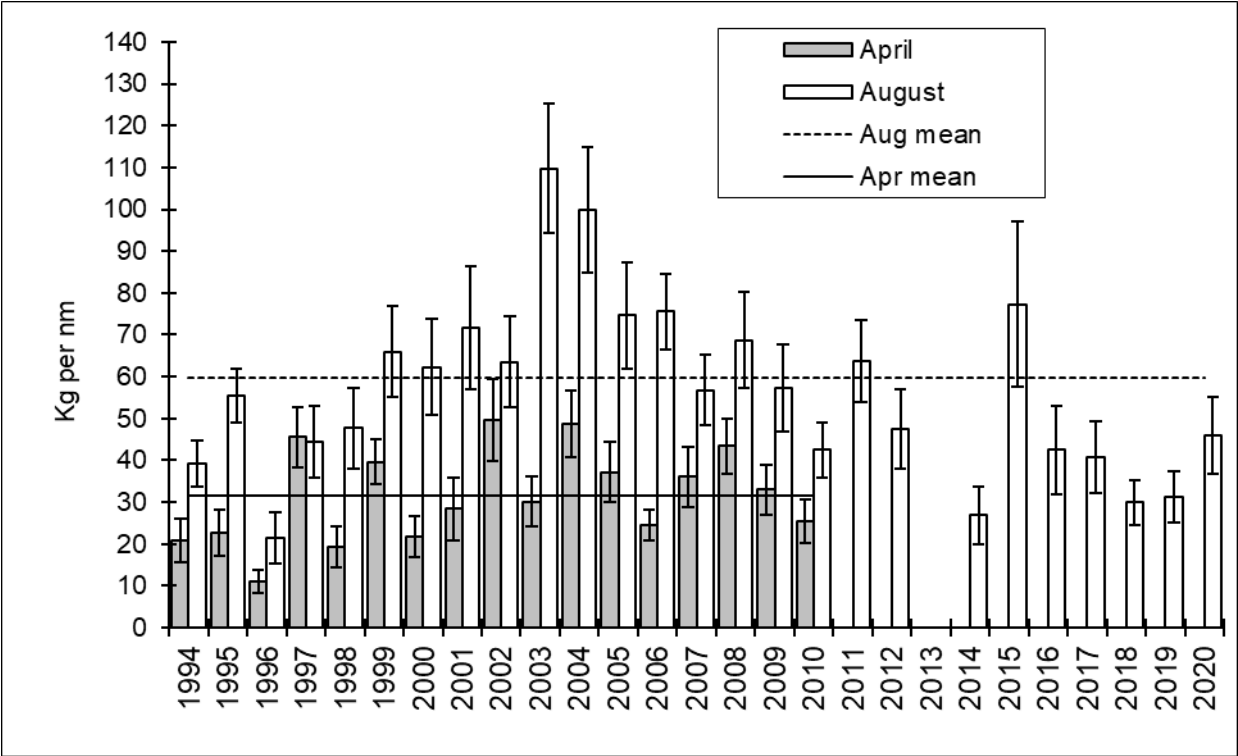


Figure 16.12 Irish Sea West (FU15): *Nephrops* catches (kg per nm) from NI trawl surveys. No data available in 2013 due to ship breakdown.

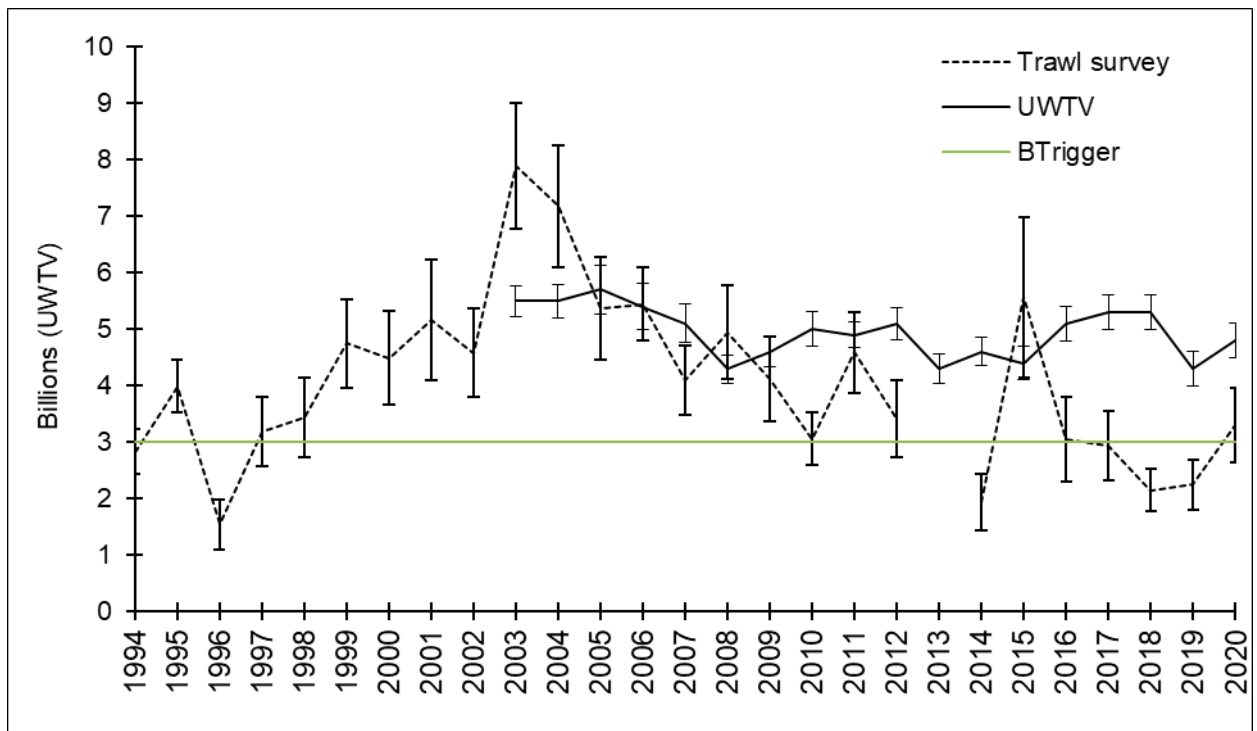


Figure 16.13. Irish Sea West (FU15): Revised UWTv index and scaled trawl survey. Cpue along with B_{trigger} based upon mean of five lowest trawl survey values. Abundance figures have not been bias corrected.

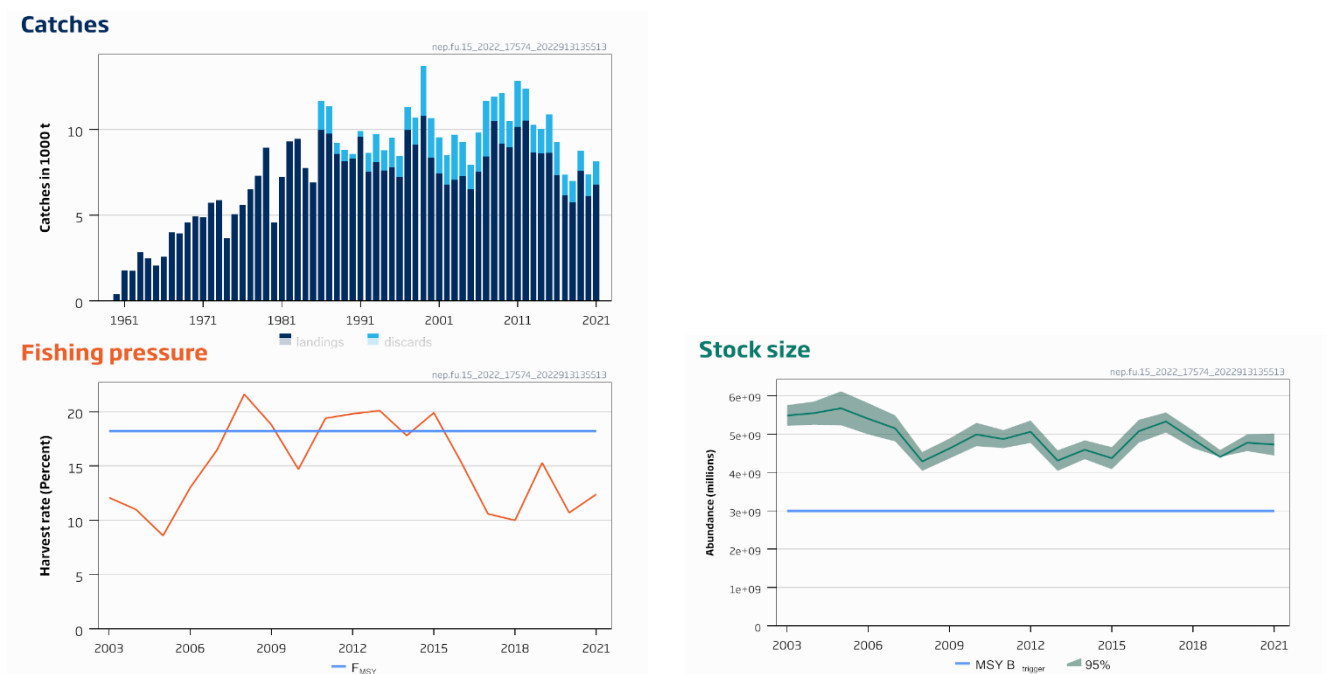


Figure 16.14 Norway lobster in Division 7.a, Functional Unit 15. Summary of the stock assessment. Catches (discard data are only available from 1986), harvest rate (sum of landings and dead discards in numbers, divided by total abundance), survey abundance (Underwater TV, billions; SSB proxy; 95% confidence intervals). Harvest rates between 2003 and 2006 may be underestimated because of underreporting of landings. Orange lines represent MSY B_{trigger} and the F_{MSY} harvest rate.