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

ICES advice on fishing opportunities

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 2015–2017, catches in 2019 should be no more than 6588 tonnes (5990 tonnes for the Firth of Clyde and 598 tonnes for the Sound of Jura).

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

Stock development over time

The catches and harvest rate presented here are for the whole functional unit (Firth of Clyde and Sound of Jura combined), as catch data cannot be separated. The combined harvest rate is considered to be more representative for the Firth of Clyde than for the Sound of Jura; it has fluctuated around F_{MSY} (defined for the Firth of Clyde) since 2009. The abundance has been fluctuating above the MSY $B_{trigger}$ in both the Firth of Clyde and the Sound of Jura since 1996.

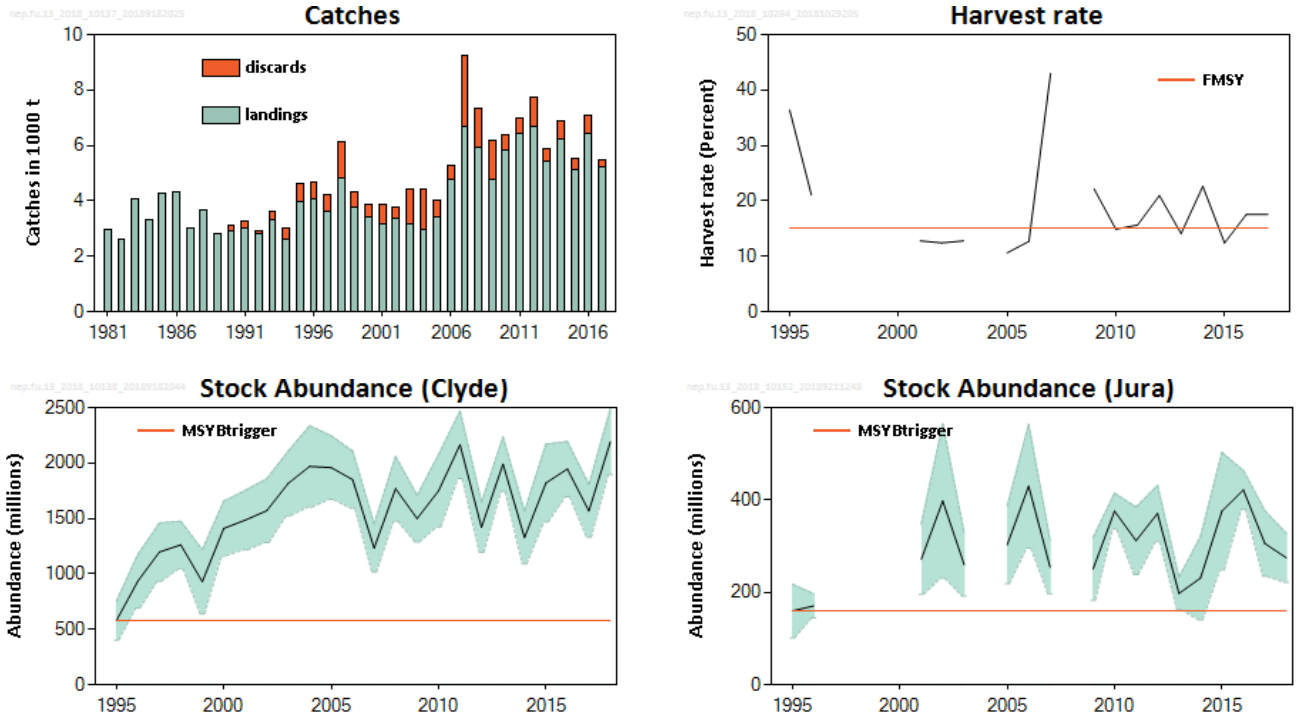

Figure 1 Norway lobster in Division 6.a, Functional Unit 13. Summary of the stock assessment. Catches (discard are data only available from 1990), harvest rate (sum of landings and dead discards in numbers, divided by total abundance), survey abundance (Underwater TV, millions; SSB proxy; 95% confidence intervals). Harvest rates before 2006 may be unreliable because of underreporting of landings. Historical harvest rates were calculated using the total catch divided by the total abundance for the two subareas combined. The orange lines represent the MSY $B_{trigger}$ and the F_{MSY} harvest rate proxy for the Firth of Clyde. The abundance is presented separately for the Firth of Clyde and for the Sound of Jura.

Stock and exploitation status

ICES assesses that fishing pressure on the stock is above F_{MSY}, while spawning stock size is above MSY $B_{trigger}$.

Table 1 Norway lobster in Division 6.a, Functional Unit 13. State of the stock and fishery relative to reference points. The combined harvest rate is considered to be more representative of fishing pressure in the Firth of Clyde than in the Sound of Jura. Therefore, in the tables below, the combined harvest rate is used for the Firth of Clyde, whereas question marks are considered to be more appropriate for the Sound of Jura.

Firth of Clyde

	Fishing pressure					Stock size				
		2015	2016	2017			2016	2017	2018	
Maximum sustainable yield	F_{MSY}	✓	✗	✗	Above	MSY $B_{trigger}$	✓	✓	✓	Above trigger
Precautionary approach	F_{pa},F_{lim}	✓	?	?	Unknown	B_{pa},B_{lim}	✓	✓	✓	Above potential reference points
Management plan	F_{MGT}	–	–	–	Not applicable	B_{MGT}	–	–	–	Not applicable

Sound of Jura

	Fishing pressure					Stock size				
		2015	2016	2017			2016	2017	2018	
Maximum sustainable yield	F_{MSY}	?	?	?	Unknown	MSY $B_{trigger}$	✓	✓	✓	Above trigger
Precautionary approach	F_{pa},F_{lim}	?	?	?	Unknown	B_{pa},B_{lim}	✓	✓	✓	Above potential reference points
Management plan	F_{MGT}	–	–	–	Not applicable	B_{MGT}	–	–	–	Not applicable

Catch scenarios

Table 2 Norway lobster in Division 6.a, Functional Unit 13. The basis for the catch scenarios.

Firth of Clyde

Variable	Value	Notes
Stock abundance (2019)	2193 million	UWTV survey 2018 (number of individuals)
Mean weight in wanted catch	18.98 g	Average 2015–2017 (combined for Firth of Clyde and Sound of Jura)
Mean weight in unwanted catch	8.4 g	Average 2015–2017 (combined for Firth of Clyde and Sound of Jura)
Unwanted catch	14.7%	Average 2015–2017 (proportion by number; combined for Firth of Clyde and Sound of Jura)
Discards survival	25%	Proportion by number
Dead unwanted catch	11.4%	Average 2015–2017 (proportion by number)

Sound of Jura

Variable	Value	Notes
Stock abundance (2019)	275 million	UWTV survey 2018 (number of individuals)
Mean weight in wanted catch	18.98 g	Average 2015–2017 (combined for Firth of Clyde and Sound of Jura)
Mean weight in unwanted catch	8.4 g	Average 2015–2017 (combined for Firth of Clyde and Sound of Jura)
Unwanted catch	14.7%	Average 2015–2017 (proportion by number; combined for Firth of Clyde and Sound of Jura)
Discards survival	25%	Proportion by number
Dead unwanted catch	11.4%	Average 2015–2017 (proportion by number)

Table 3 Norway lobster in Division 6.a, Functional Unit 13. Annual catch options. All weights are in tonnes.

Firth of Clyde – Catch scenarios for 2019 assuming discarding continues at the recent average rate.

Basis	Total catch	Dead removals	Wanted catch	Dead unwanted catch	Surviving unwanted catch	Harvest rate* %	% advice change **
	WC+DUC+ SUC	WC+DUC	WC	DUC	SUC	for WC+DUC	
ICES advice basis							
MSY approach	5990	5884	5566	318	106	15.1	33.6
Other options							
$F_{MSY\ lower}$	3928	3858	3649	209	70	9.9	−12.4
$F_{MSY\ upper}$***	5990	5884	5566	318	106	15.1	33.6
F_{2017}	6964	6841	6471	370	123	17.6	55.3

* By numbers.
**Advice value for 2019 relative to the advice value for 2018.
*** $F_{MSY\ upper} = F_{MSY}$ for this stock.

The change in advice is a result of the increase in stock abundance.

Sound of Jura – Catch scenarios for 2019 assuming discarding continues at the recent average rate.

Basis	Total catch	Dead removals	Wanted catch	Dead unwanted catch	Surviving unwanted catch	Harvest rate* %	% advice change **
	WC+DUC+ SUC	WC+DUC	WC	DUC	SUC	for WC+DUC	
ICES advice basis							
MSY approach	598	587	555	32	11	12	−14.0
Other options							
$F_{MSY\ lower}$	467	459	434	25	8	9.4	−32.8
$F_{MSY\ upper}$***	598	587	555	32	11	12	−14.0
F_{2017}	872	857	811	46	15	17.6	25.5

* By numbers.
**Advice value for 2019 relative to the advice value for 2018.
*** $F_{MSY\ upper} = F_{MSY}$ for this stock.

The change in advice is a result of the decrease in stock abundance and a decrease in the mean weight.

Basis of the advice

Table 4 Norway lobster in Division 6.a, Functional Unit 13. The basis of the advice.

Advice basis	MSY approach.
Management plan	The EU has proposed a multiannual management plan for the Western Waters, which is not yet finalised (EU, 2018).

Quality of the assessment

As previously, this year's assessment provides estimates of harvest rate for the two subareas of Firth of Clyde and Sound of Jura combined. This is because it is not possible to reliably disaggregate the landings (and catch) data for the two areas. As a result the estimated combined harvest rate does not provide an estimate of fishing pressure on either subarea separately. Given the relative stock sizes and likely magnitude of the landings from the two subareas, the combined harvest rate shown in Figure 1 is expected to be more representative of the harvest rate in the Firth of Clyde than in the Sound of Jura.

Annual UWTV surveys are carried out for both subareas. The time-series for the Firth of Clyde has been continuous since 1995 and for the Sound of Jura since 2009. The surveys have good coverage of the muddy sediment in each area and provide abundance estimates of each subarea with acceptable precision.

In 2017, observer sampling from the Scottish Industry–Science observer sampling scheme was extended to include sampling of Norway lobster catches in FU 13. As a result the sampling levels have increased and discard proportions are more precisely estimated.

Although the commercial catch-at-length samples are considered representative of the combined *Nephrops* fishery in Firth of Clyde and Sound of Jura, sampling levels remain insufficient to provide estimates of mean weights and discard rates for the Sound of Jura separately. The discard rates and mean weights used in the catch options are for the two subareas combined.

Issues relevant for the advice

From 2016 the EU landing obligation was applied to all catches of Norway lobster fisheries in ICES Subarea 6, with several exemptions. Observations from the 2016–2017 fishery indicate that some discarding above the minimum conservation reference size (MCRS) continues and has not changed markedly (Figure 3). Consequently, ICES is providing advice for 2019 assuming average discard rates as observed over the last three years, which is considered to be a more realistic assumption.

Nephrops in the Firth of Clyde occur at a very high density (average around 0.8 individuals m^{-2}), suggesting a relatively high productivity. The fishery in the Clyde area has been in existence since the 1960s and the population and biological parameters have been studied numerous times. Historical harvest rates in this FU have been generally high, at or above F_{max}. F_{max} is considered an appropriate F_{MSY} proxy, expected to deliver high long-term yield with a low probability of recruitment overfishing in the Firth of Clyde. For the Sound of Jura the density is also relatively high. However, the fishery here has been sporadic and sampling is at a relatively low level; therefore, a more cautious $F_{35\%SPR}$ is considered an appropriate F_{MSY} proxy in the Sound of Jura.

A single TAC covers the entire ICES Subarea 6. Management should be implemented at the functional unit level to ensure that fishing opportunities are in line with the scale of the resource for each of the stocks and the corresponding MSY approach. The two subareas in FU 13 imply that additional controls should be implemented to ensure landings taken in each subarea are in line with the advice.

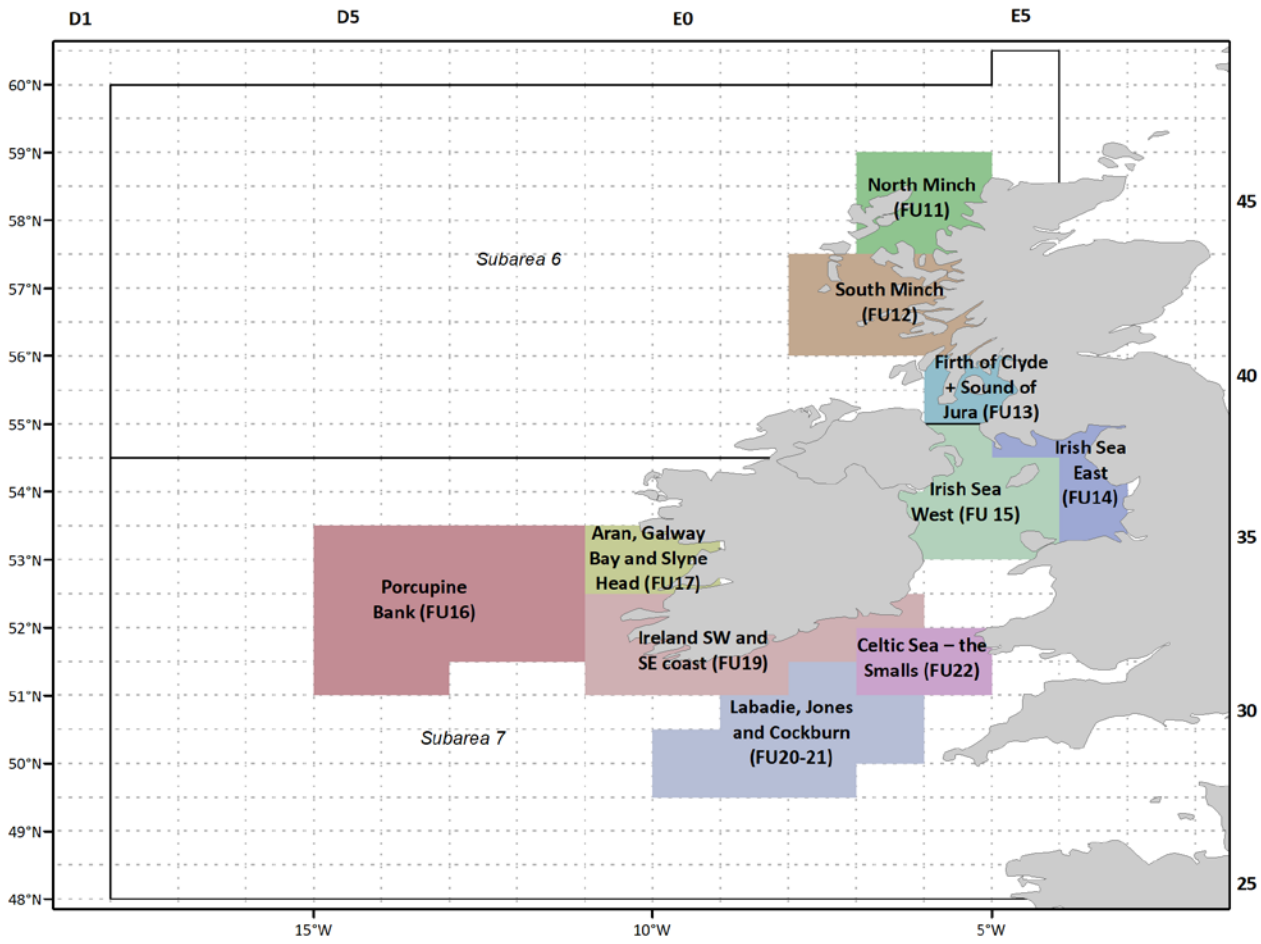

Figure 2 Norway lobster functional units in subareas 6 and 7.

Reference points

Table 5 Norway lobster in Division 6.a, Functional Unit 13. Reference points, values, and their technical basis.

Firth of Clyde

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	580 million individuals	Lowest observed abundance estimate (Firth of Clyde).	ICES (2016)
	F_{MSY}	15.1% harvest rate	F_{MSY} proxy equivalent to F_{max} for combined sexes derived from a length-based per recruit analysis.	ICES (2016)
Precautionary approach	B_{lim}	Not defined		
	B_{pa}	Not defined		
	F_{lim}	Not defined		
	F_{pa}	Not defined		
Management plan*	MAP MSY $B_{trigger}$	580 million individuals	MSY $B_{trigger}$	EU (2018)
	MAP B_{lim}	Not defined		
	MAP F_{MSY}	15.1% harvest rate	F_{MSY}	EU (2018)
	MAP range F_{lower}	9.9–15.1% harvest rate	Consistent with ranges provided by ICES (2016), resulting in no more than 5% reduction in long-term yield compared with MSY.	EU (2018)
	MAP range F_{upper}	15.1–15.1% harvest rate	$F_{MSY\ upper}$ value capped at F_{MSY} because it has not been possible to evaluate the probability of SSB < B_{lim} (ICES, 2016).	EU (2018)

*Proposed EU multiannual plan (MAP) for the Western Waters (EU, 2018).

Sound of Jura

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	160 million individuals	Lowest observed abundance estimate (Sound of Jura).	ICES (2016)
	F_{MSY}	12.0% harvest rate	F_{MSY} proxy equivalent to $F_{35\%SPR}$ for combined sexes, derived from a length-based per recruit analysis.	ICES (2016)
Precautionary approach	B_{lim}	Not defined		
	B_{pa}	Not defined		
	F_{lim}	Not defined		
	F_{pa}	Not defined		
Management plan*	MAP MSY $B_{trigger}$	160 million individuals	MSY $B_{trigger}$	EU (2018)
	MAP B_{lim}	Not defined		
	MAP F_{MSY}	12.0% harvest rate	F_{MSY}	EU (2018)
	MAP range F_{lower}	9.4–12.0% harvest rate	Consistent with ranges provided by ICES (2016), resulting in no more than 5% reduction in long-term yield compared with MSY.	EU (2018)
	MAP range F_{upper}	12.0–12.0% harvest rate	$F_{MSY\ upper}$ value capped at F_{MSY} because it has not been possible to evaluate the probability of SSB < B_{lim} (ICES, 2016).	EU (2018)

*Proposed EU multiannual plan (MAP) for the Western Waters (EU, 2018).

Basis of the assessment

Table 6 Norway lobster in Division 6.a, Functional Unit 13. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2018a).
Assessment type	Underwater TV survey.
Input data	One survey index (UWTV-FU13); commercial catches (international landings, length frequencies from Scottish and Northern Ireland catch sampling); fixed maturity parameters (from survey data); fixed natural mortalities. Discard survival rate.
Discards and bycatch	Included in the assessment since 1990; dataseries from the majority of the main fleets cover almost all landings.
Indicators	Size structure, mean size, and sex ratio of catches.
Other information	The latest benchmark (based on the UWTV survey) was performed in 2009 (ICES, 2009).
Working group	Working Group for the Celtic Seas Ecoregion (WGCSE).

Information from stakeholders

There is no additional available information for this stock.

History of the advice, catch, and management

Table 7 Norway lobster in Division 6.a, Functional Unit 13. ICES advice, landings and discards. All weights are in tonnes.

Year	ICES advice	Landings advice for Firth of Clyde (FU 13)	Landings advice for Sound of Jura (FU 13)	Catch advice for Firth of Clyde (FU 13)	Catch advice for Sound of Jura (FU 13)	ICES landings	Total discards*
1989						2812	
1990						2909	193
1991						3038	247
1992	Maintain current effort					2803	100
1993	Maintain current effort					3343	295
1994	Maintain current effort					2630	397
1995	Maintain current effort					3987	619
1996	Maintain current effort					4057	635
1997	As for 1996					3621	598
1998	Maintain current effort					4841	1292
1999	As for 1998					3752	566
2000	Maintain current effort					3417	470
2001	As for 2000					3182	677
2002	Maintain current effort					3384	406
2003	As for 2002					3173	1247
2004	Maintain current effort					2973	1435
2005	As for 2004					3395	611
2006	No increase in effort					4780	515
2007	No increase in effort and harvest rate of 15%	3765				6660	2566
2008	As for 2007	3765				5923	1433
2009	No increase effort and recent average catch	< 5700				4779	1390
2010	Harvest rate no greater than that equivalent to fishing at $F_{0.1}$	< 3900				5843	536
2011	MSY transition scheme	< 4100	< 500			6432	568
2012	MSY approach	< 4200	< 900			6687	1066
2013	MSY approach	< 5600	< 800			5435	454
2014	MSY approach	< 5744	< 521			6207	696
2015	MSY approach	< 3766	< 614			5147	401
2016	MSY approach			≤ 5554**	≤ 1014**	6447	636
2017	MSY approach			≤ 5755***	≤ 992***	5222	265
2018	MSY approach			≤ 4484***	≤ 695***		
2019	MSY approach			≤ 5990***	≤ 598***		

* Dead + surviving discards.
** Assumes all catches are landed.
*** Assuming recent discarding rates.

History of catch and landings

Table 8 Norway lobster in Division 6.a, Functional Unit 13. Catch distribution by fleet in 2017 as estimated by ICES.

Catch		Landings		Total discards	
98.8% dead	1.2% surviving	Directed *Nephrops* trawl fishery	*Nephrops* creel fishery	75% dead	25% surviving
5487 t		94% trawls (70–99 mm)	6% creels	265 t	
		5222 t			

Table 9 Norway lobster in Division 6.a, Functional Unit 13. History of ICES estimates of landings (for Scotland by gear) and total discards. All weights are in tonnes.

Year	UK Scotland				Other UK	Total	Total discards*
	Nephrops trawl	Other trawl	Creel	Subtotal			
1981	2498	404	66	2968	0	2968	
1982	2372	169	79	2620	0	2620	
1983	3889	121	52	4062	14	4076	
1984	3070	153	77	3300	10	3310	
1985	3921	293	65	4279	7	4286	
1986	4073	176	79	4328	13	4341	
1987	2860	82	64	3006	3	3009	
1988	3507	107	43	3657	7	3664	
1989	2577	184	35	2796	16	2812	
1990	2731	121	23	2875	34	2909	193
1991	2844	145	26	3015	23	3038	247
1992	2530	247	9	2786	17	2803	100
1993	3200	110	5	3315	28	3343	295
1994	2503	50	28	2581	49	2630	397
1995	3766	131	26	3923	64	3987	619
1996	3880	108	27	4015	42	4057	635
1997	3486	46	26	3558	63	3621	598
1998	4540	79	39	4658	183	4841	1292
1999	3476	29	37	3542	210	3752	566
2000	3142	63	75	3280	137	3417	470
2001	2890	65	95	3050	132	3182	677
2002	3075	53	105	3233	151	3384	406
2003	2954	20	119	3093	80	3173	1247
2004	2619	8	88	2715	258	2973	1435
2005	3148	5	94	3247	148	3395	611
2006	4356	1	179	4536	244	4780	515
2007	6069	4	221	6294	366	6660	2566
2008	5320	3	184	5507	416	5923	1433
2009	4304	1	191	4496	283	4779	1390
2010	5162	5	211	5378	465	5843	536
2011	5664	9	219	5892	540	6432	568
2012	5617	4	203	5824	863	6687	1066
2013	4708	4	212	4924	511	5435	454
2014	4770	1	258	5029	1178	6207	696
2015	4035	8	206	4249	898	5147	401
2016	4922	6	267	5195	1248	6447	636
2017	4021	3	256	4280	941	5222	265

*Dead + surviving discards.

Summary of the assessment

Table 10 Norway lobster in Division 6.a, Functional Unit 13. Assessment summary.

Year	Firth of Clyde UWTV abundance	Firth of Clyde 95% CI	Sound of Jura UWTV abundance	Sound of Jura 95% CI	Harvest rate (by number)**	Landings (in numbers)**	Total discards (in numbers)*	Removals (in numbers)	Landings**	Total discards*	Discard proportion (by numbers)	Mean weight in landings	Mean weight in discards	Dead discard proportion (by numbers)
	millions				%	millions			tonnes		%	grammes		%
1995	579	176	160	58	36.4	207	82	269	3987	619	28.4	19.24	7.54	22.9
1996	935	242	171	26	21.1	187	61	233	4057	635	24.7	21.68	10.35	19.7
1997	1198	262	NA	NA	NA	150	70	202	3621	598	32	24.21	8.5	26.1
1998	1262	213	NA	NA	NA	269	187	409	4841	1292	41	17.98	6.92	34.2
1999	930	289	NA	NA	NA	216	93	286	3752	566	30.2	17.39	6.05	24.5
2000	1411	246	NA	NA	NA	171	48	207	3417	470	22	19.96	9.75	17.4
2001	1486	268	272	76	12.8	164	82	225	3182	677	33.5	19.46	8.23	27.4
2002	1571	288	398	167	12.4	207	50	245	3384	406	19.5	16.35	8.12	15.4
2003	1817	292	260	68	12.8	166	134	266	3173	1247	44.7	19.13	9.31	37.7
2004	1970	367	NA	NA	NA	158	168	284	2973	1435	51.5	18.8	8.54	44.3
2005	1959	287	303	84	10.7	189	69	241	3395	611	26.8	17.96	8.81	21.6
2006	1851	257	430	134	12.7	248	55	290	4780	515	18.2	19.27	9.31	14.3
2007	1233	218	255	58	43	350	387	640	6660	2566	52.5	19.05	6.64	45.3
2008	1769	291	NA	NA	NA	357	207	512	5923	1433	36.6	16.59	6.94	30.3
2009	1499	210	251	68	22.2	261	169	388	4779	1390	39.3	18.31	8.23	32.7
2010	1750	327	376	38	14.9	276	55	317	5843	536	16.7	21.21	9.68	13.1
2011	2165	305	312	73	15.7	333	74	388	6432	568	18.2	19.34	7.65	14.3
2012	1421	227	371	61	21	306	93	376	6687	1066	23.4	21.83	11.42	18.6
2013	1990	246	198	35	14.1	262	62	309	5435	454	19	20.72	7.37	15
2014	1328	237	231	90	22.6	295	78	353	6207	696	20.9	20.79	8.92	16.6
2015	1820	351	376	127	12.4	232	54	273	5147	401	18.9	22.21	7.43	14.8
2016	1946	249	422	42	17.6	364	69	416	6447	636	15.9	17.7	9.21	12.4
2017	1568	239	306	71	17.6	305	31	329	5222	265	9.2	17.02	8.55	7.1
2018	2193	297	275	53										

* Dead + surviving discards.

** Values prior to 2006 may be underestimates because of underreporting of landings.

NA = not available.

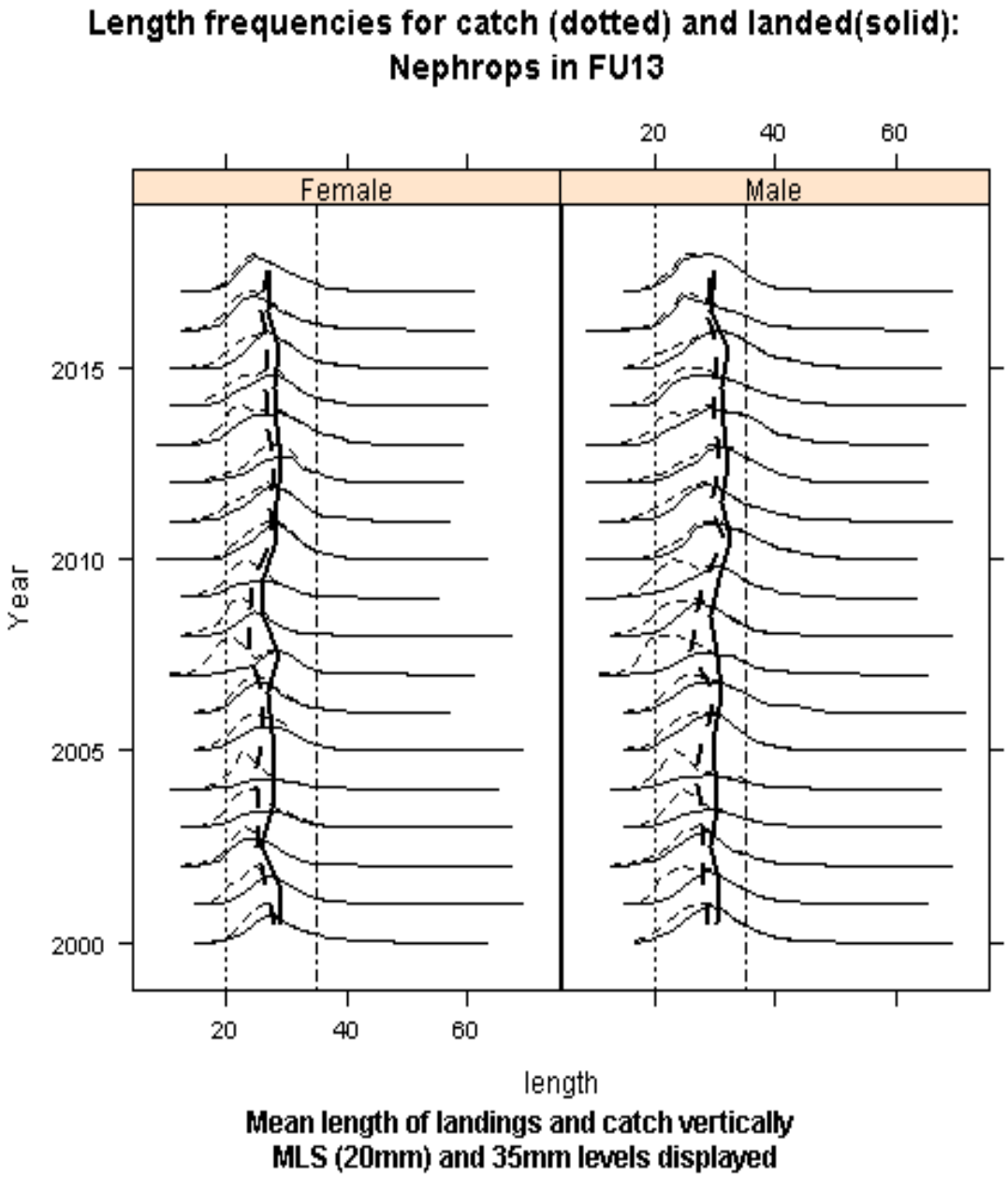

Figure 3 Norway lobster in Division 6.a, Functional Unit 13. Catch length–frequency distribution and mean size in catches and landings. Vertical lines are minimum landing size (20 mm) and 35 mm.

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