

ECOREGION North Sea
STOCK *Nephrops* in Division IIIa (Skagerrak–Kattegat)

Advice 2015

ICES advises on the basis of the MSY approach that catches in 2015 should be no more than 10 290 tonnes in 2015. If total discard rates do not change from the average of the last three years (2011–2013), this implies total landings of no more than 5 318 tonnes. Note that catches include discards expected to survive the discarding process – assumed to be 25% of the total number discarded for this stock.

Stock status

Fishing pressure			
	2011	2012	2013
MSY (F_{MSY})	✓	✗	✓ Appropriate
Precautionary approach (F_{pa}, F_{lim})	?	?	? Undefined
Stock size			
	2011	2012	2013
MSY ($B_{trigger}$)	?	?	? Unknown
Precautionary approach (B_{pa}, B_{lim})	?	?	? Unknown
Qualitative evaluation	→	→	→ Stable

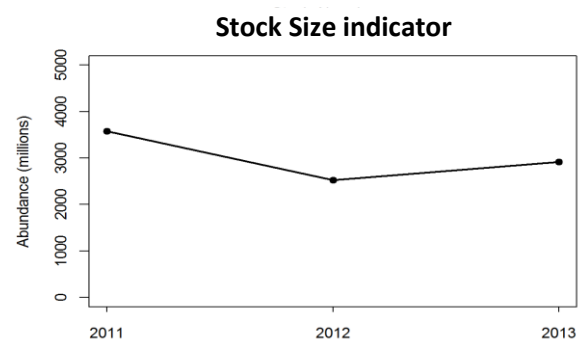
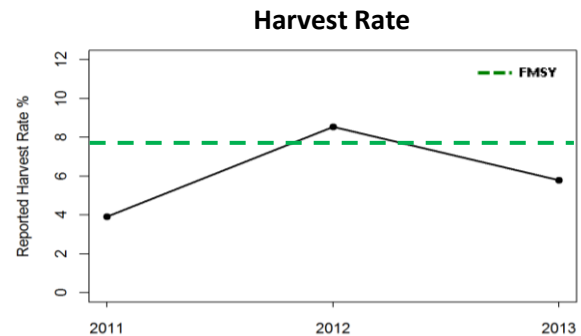
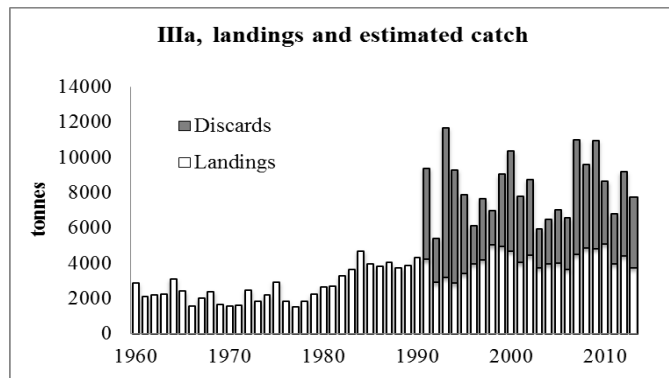


Figure 6.3.14.1 *Nephrops* in Division IIIa. Long-term trends in landings (1960-2013) and catches (1991-2013), harvest rate, and UWTV abundance (used as F and SSB proxies. Weights in tonnes, UWTV in millions).

Estimates of absolute abundance, available for 2011, 2012 and 2013 from an underwater TV (UWTV) survey for the whole area are considered to be stable. The estimated harvest ratios suggest that the stock is exploited sustainably.

Management plans

No specific management objectives are known to ICES.

Biology

Nephrops live in burrows in suitable muddy sediments and are characterized as being omnivorous. They emerge out of their burrows to feed; however, they are also able to sustain themselves by suspension feeding (in the burrows). There are differences between males and females regarding growth rates and behaviour. Males normally dominate the commercial catches due to more frequent emergence from their burrows.

Environmental influence on the stock

Severe depletion in oxygen content in the water can force the animals out of their burrows, thus temporarily increasing the trawl catchability of this species during such environmental changes. An especially severe case was observed in the late 1980s in the southern part of Division IIIa in late summer, where unusually high catch rates of *Nephrops* were observed. The ability of *Nephrops* to suspension feed may contribute to maintaining a high production rate of this species in Division IIIa, as a result of increased organic production.

The fisheries

There are two types of fisheries: trawl fisheries and creel fisheries. Part of the trawl fisheries operate with species-selective gears (sorting grids or SELTRA). Creel fisheries take place mainly on locations where trawling is impossible or difficult, along the Swedish and Norwegian coasts. As a consequence of the current minimum landing size of 40 mm carapace length (CL), the proportion of the catch discarded is high. Cod, sole, and plaice are bycatch species in the SELTRA trawl fishery in Division IIIa.

Catch distribution Total catch (2013) = 7.8 kt, where 3.76 kt were official landings (91% trawling, 9% creels) and total discards 4.01 kt .

Effects of the fisheries on the ecosystem

The high mud content and soft nature of sediments inhabited by *Nephrops* means that trawling severely marks the seabed. Burrowing fauna can be seen re-emerging from freshly trawled grounds, implying that there is some resilience to trawling.

Quality considerations

The UWTV surveys in 2011, 2012 and 2013 were conducted in all six main fishing areas in Division IIIa. Yearly calibrations between countries on counting *Nephrops* burrows should be continued. The UWTV survey in Division IIIa should be continued.

Scientific basis

Stock Data Category	1 (ICES, 2014a)
Assessment type	Underwater TV survey linked to yield-per-recruit analysis from length data.
Input data	Commercial catches (from logbook data). One survey index (UWTV), length–frequency data, and discard samples. One commercial index (Ipue). Length frequencies (landings and discards) from at-sea onboard sampling. Annual maturity data from commercial catch samples. Natural mortalities from literature (Morizur, 1982).
Discards and bycatch	Included in the assessment since 2011, data series from the majority of the fleet/ main fleets (covering 100% of the landings)
Indicators	Landings per unit effort, mean size.
Other information	None.
Working group	Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK)

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Reference points

	<i>Type</i>	<i>Value</i>	<i>Technical basis</i>
MSY Approach	MSY B_{trigger}	Undefined.	
	$F_{\text{MSY}} = F_{\text{max}}$	Harvest ratio 7.9%.	Equivalent to F_{max} combined sex.
Precautionary Approach	Not defined.		

(Last changed 2012)

Harvest ratios as proxy for F_{MSY} for Division IIIa from length cohort analysis 2011 (2008–2010):

	Male	Female	Combined
F_{max}	6.8 %	10.0 %	7.9 %
$F_{0.1}$	4.9 %	7.6 %	5.6 %
$F_{35\% \text{SPR}}$	8.1 %	12.9 %	10.5 %

The estimated burrow density in Division IIIa is medium (0.3–0.8 burrows m^{-2}) and the observed harvest ratio is between $F_{0.1}$ and F_{max} . Based on the ICES MSY approach for *Nephrops* this means that $F_{35\% \text{SPR}}$ may be selected as a proxy for F_{MSY} . $F_{35\% \text{SPR}}$ is unusually higher than F_{max} for this stock due to the very high discard proportions observed in the fishery. Therefore, F_{max} is chosen as a conservative proxy for F_{MSY} .

MSY B_{trigger} is undefined. For other *Nephrops* stocks which have a longer time-series, the UWTV survey is used to define a proxy for MSY B_{trigger} , either at the low point in the time-series or the point at which the stock showed signs of stress. As the survey is relatively new and the survey design has only recently been settled, it would be inappropriate to determine MSY B_{trigger} at this point.

For background information on setting the reference points for *Nephrops* stocks, see Additional information. All F_{MSY} proxy harvest rate values are considered preliminary and may be modified following further data exploration and analysis.

Outlook 2015

$F_{2014} = F_{2013} =$ average harvest rate over 2011–2013 = 6.1%; Absolute survey index 2015 = 2914 million (= 2013 index); Mean individual weight in landings (2011–2013) = 58.7g; Mean individual weight in discards (2011–2013) = 26.7g.

Basis	Total catches*	Landings	Dead discards**	Surviving discards**	Harvest rate
	L+DD+SD	L	DD	SD	for L+DD
MSY approach	10290	5318	3729	1243	7.9
Other options	6513	3366	2360	787	5.0
	7294	3770	2643	881	5.6
	7555	3904	2738	913	5.8
	11723	6059	4248	1416	9.0
	13677	7068	4956	1652	10.5
	15630	8078	5664	1888	12.0

Weights in tonnes.

* Total catches are the landings including dead and surviving discards.

** Total discard ratio is assumed to be 67.2% of the catches (by number, average of last three years, 2011–2013), discard survival is assumed to be 25% (WKNEPH; ICES, 2009).

MSY approach

Since MSY B_{trigger} has not been identified for this stock, the ICES MSY approach has been applied without considering SSB in relation to MSY B_{trigger} . Lpue data indicate that the stock is on a relatively high level (Figure 6.3.14.3).

Following the ICES MSY approach implies a harvest ratio of 7.9%, resulting in catches of no more than 10290 t in 2015. If discard rates do not change from the average of the last three years (2011–2013, assuming 25% discard survival), this implies total landings in 2015 of no more than 5318 t.

Additional considerations

Management considerations

The main reason for the high amount of discards (67% in numbers in 2011-2013) is the high minimum landing size (40 mm CL) and low mesh size. The use of larger mesh sizes would reduce the catch of undersized *Nephrops*, but would also result in loss of marketable *Nephrops* in the short term (Cardinale and Hjelm, 2012).

MSY approach

No precautionary reference points have been defined for *Nephrops*. Exploitation rates that are likely to generate high long-term yield (and low probability of stock overfishing) have been explored and proposed under the ICES MSY approach. Because of the way *Nephrops* are assessed, it is not possible to estimate F_{MSY} directly and hence proxies for F_{MSY} are determined. Three candidates for F_{MSY} are $F_{0.1}$, $F_{35\%SPR}$, and F_{max} . Many stocks show a great difference in relative exploitation rate between the sexes. To account for this values for each of the candidates have been determined individually for males, females, and the two sexes combined. The appropriate F_{MSY} candidate has been selected for each functional unit (FU) independently according to the perception of stock resilience, factors affecting recruitment, population density, knowledge of biological parameters, and the nature of the fishery (relative exploitation of the sexes and historical harvest rate vs. stock status).

A decision-making framework based on the table below was used in the selection of preliminary stock-specific F_{MSY} proxies (ICES, 2010). These proxies may be modified following further data exploration and analysis. The combined-sex F_{MSY} proxy should be considered appropriate if the resulting percentage of virgin spawner-per-recruit for males or females does not fall below 20%. When this happens a more conservative sex-specific F_{MSY} proxy should be picked instead of the combined proxy.

		Burrow density (average burrows m ⁻²)		
		Low < 0.3	Medium 0.3–0.8	High >0.8
Observed harvest rate or landings compared to stock status (historical performance)	> F_{max}	$F_{35\%SPR}$	F_{max}	F_{max}
	$F_{max}-F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$	F_{max}
	< $F_{0.1}$	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	Unknown	$F_{0.1}$	$F_{35\%SPR}$	$F_{35\%SPR}$
Stock size estimates	Variable	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	Stable	$F_{0.1}$	$F_{35\%SPR}$	F_{max}
Knowledge of biological parameters	Poor	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	Good	$F_{35\%SPR}$	$F_{35\%SPR}$	F_{max}
Fishery history	Stable spatially and temporally	$F_{35\%SPR}$	$F_{35\%SPR}$	F_{max}
	Sporadic	$F_{0.1}$	$F_{0.1}$	$F_{35\%SPR}$
	Developing	$F_{0.1}$	$F_{35\%SPR}$	$F_{35\%SPR}$

Quality considerations

To improve the quality of the UWTV survey, yearly calibrations between countries on counting *Nephrops* burrows has been done and should be continued.

Lpue could be considered as an indicator for stock size to cross reference with the UWTV survey. However, lpue is influenced by changes in catchability (due to sudden changes in the environmental conditions), as well as changes in selectivity and/or gear efficiency.

Stock definition

At present there are two functional units in Division IIIa: Skagerrak (FU 3) and Kattegat (FU 4). This separation was based on observed variable differences between Skagerrak and Kattegat regarding size compositions in catches in the 1980s and 1990s. However, the distribution of *Nephrops* is continuous from the southern Kattegat into Skagerrak, and the exchange of recruits between the southern and northern areas is very likely. With the longer data series now

available, it seems the differences in size composition between the two areas are more likely to be random or caused by factors from fishing operations. The assessment is therefore conducted on *Nephrops* in Division IIIa as one stock.

The effects of regulations

The *Nephrops* fisheries in Division IIIa are heavily influenced by the management of cod stocks. Effort restrictions in the EU were introduced in 2003 (annual annexes to the TAC regulations) for the protection of the North Sea–Skagerrak and Kattegat cod stocks. In 2009, the management programme switched from a days-at-sea to a kW-days system (2009 Council Regulation (EC) N° 43/2009); within each area different amounts of kW-days are allocated by Member State to different groups of vessels, depending on gear and mesh size. A specific amount of kW-days is allocated to the Kattegat fisheries; the kW-days allocations in the Skagerrak are considered within a pool which includes also the North Sea (Subarea IV) and the Eastern English Channel (Division VIId).

Effort ceilings are updated annually, and have become increasingly restrictive for *Nephrops* trawls in Kattegat. In 2009, Sweden obtained full derogation (article 11) from the kW-days system for *Nephrops* trawlers using the Swedish sorting grid, leading to the increased use of this species-selective device and consequently a decrease in cod bycatch. The Swedish *Nephrops* quota is allocated to different gear categories (30% to creels, 50% to grid trawls, and the remaining 20% to other trawls). In 2010, Denmark obtained partial derogation (article 13) that sanctioned no further decrease of the effort ceiling on the basis of cod avoidance behaviour.

Since 1 February 2013, EU and Norway have agreed on new technical measures. This implies that *Nephrops* trawl fishery in the Skagerrak should use species-selective trawls (35 mm grid and 70 mm square mesh codend, or SELTRA trawls carrying 90 mm diamond mesh codends with large mesh panels). The mixed *Nephrops*/demersal fishery now has a minimum mesh size of 120 mm (diamond mesh).

The minimum landing size for *Nephrops* in Division IIIa is 40 mm CL. Discards of *Nephrops* are known to be very high and any improvement in the size selectivity in trawls would benefit the stock and the medium-term yield. Discard survival is assumed to be 25% (Wileman *et al.*, 1999).

Environmental influence on the stock

Nephrops live in burrows in suitable muddy sediments and are characterized as being omnivorous. They emerge out of their burrows to feed, however, they are also able to sustain themselves as suspension feeders (in the burrows). This ability may contribute to maintaining a high production of this species in Division IIIa, as a result of increased organic production. Severe depletion in oxygen content in the water can force the animals out of their burrows, thus temporarily increasing the trawl catchability of this species during such environmental changes (Bagge and Munch-Petersen, 1979).

Comparison of the basis of previous assessment and advice

The basis for the assessment has not changed from last year. The basis for the advice this year is the same as last year: the MSY approach.

Sources

- Bagge, O., and Munch-Petersen, S. 1979. Some possible factors governing the catchability of Norway lobsters in the Kattegat. *Rapports et Procès-Verbeaux de la Réunion du Conseil International pour l'Exploration de la Mer*, Vol. 175: 143–146.
- Cardinale, M. and Hjelm, J. (2012). Short term loss and long term revenue in a size-selective fishery. *Marine Policy*, 36: 903–906.
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- Morizur, Y. 1982. Estimation de la mortalité pour quelque stocks de langoustine, *Nephrops norvegicus*. ICES CM 1982/K:10.
- 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. EC Contract No: FAIR-CT95-0753. Final Report 1999. 125 pp. + appendix.

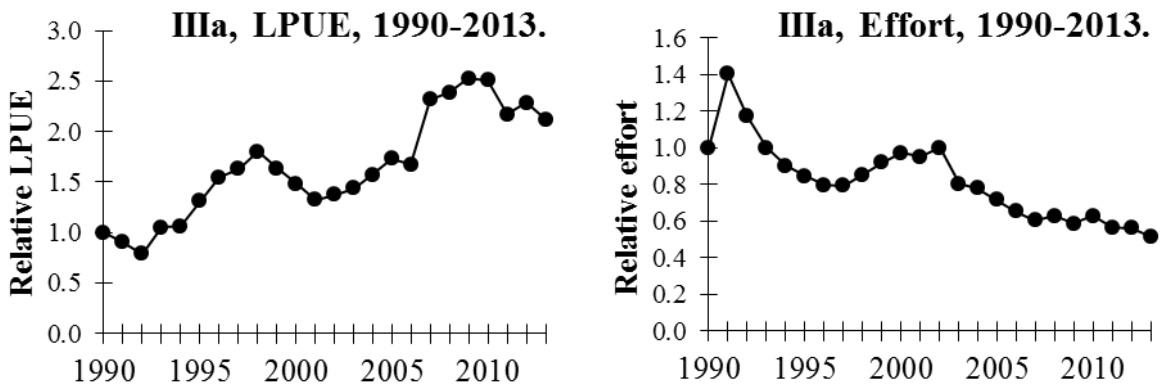


Figure 6.3.14.2. *Nephrops* in Division IIIa. Long-term trends in international landings per unit effort (lpue, left) and effort. Trends are relative to 1990 (= 1.0).

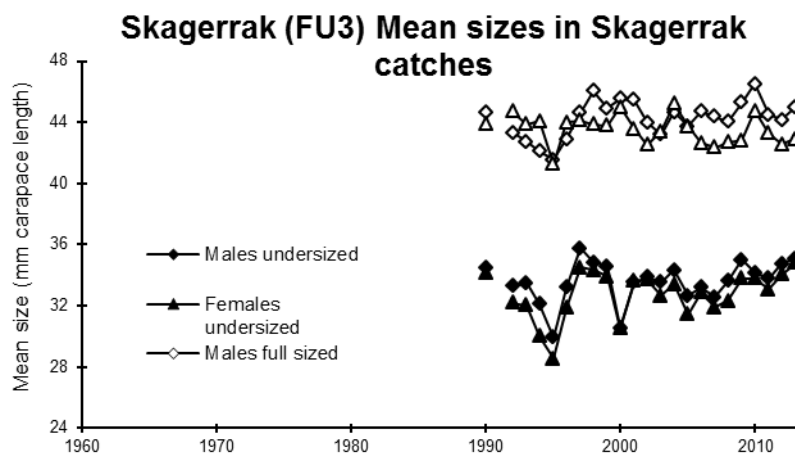


Figure 6.3.14.3 *Nephrops* in Division IIIa. Mean sizes in the catches.

Table 6.3.14.1 *Nephrops* in Division IIIa. ICES advice, management, and landings.

Year	ICES advice	Predicted landings corresp. to advice	Predicted catch corresp. to advice	Agreed TAC	ICES landings	ICES catch
1991					4.228	9.411
1992		~4.0		3.5	2.905	5.428
1993		~4.3		3.5	3.212	11.705
1994		2.9		3.5	2.874	9.324
1995		2.9		4.8	3.427	7.891
1996	<i>Status quo</i> TAC	2.9		4.8	3.980	6.128
1997	<i>Status quo</i> TAC	2.9		4.8	4.206	7.675
1998		4.0		4.8	5.056	7.000
1999		4.0		4.8	4.949	9.057
2000		3.8		5.0	4.710	10.374
2001		3.8		4.5	4.056	7.823
2002	Catches to be maintained at the 2000 level	4.7		4.5	4.448	8.760
2003	Catches to be maintained at the 2000 level	4.7		4.5	3.767	5.975
2004	Catches to be maintained at the 2000 level	4.7		4.7	3.965	6.497
2005	Catches to be maintained at the 2000 level	4.7		5.2	4.034	7.048
2006	No increase in effort	-		5.2	3.672	6.598
2007	No increase in effort	-		5.2	4.512	11.036
2008	No increase in effort	-		5.2	4.860	9.606
2009	Current effort appears to be sustainable	< 5.2		5.2	4.846	10.975
2010	Current effort appears to be sustainable	< 5.2		5.2	5.123	8.671
2011	Recent average landings (2007–2009) ¹⁾	< 4.7		5.2	3.986	6.833
2012	MSY approach	< 6.0		6.0	4.429	9.200
2013	MSY approach ¹⁾	< 5.2		5.2	3.760	7.770
2014	MSY approach	< 5.019		5.019		
2015	MSY approach	< 5.318	< 10.290			

Weights in thousand tonnes.

¹⁾ In 2011, biennial advice was given for both 2012 and 2013. In 2012, new advice was drafted for 2013 because new information was available.

Table 6.3.14.2 *Nephrops* in Division IIIa. Official landings per country, total discards, and total catch (tonnes).

Year	Denmark	Norway	Sweden	Germany	Total landings	Total disc.	Total catch
1991	2824	185	1219		4228	5183	9411
1992	2052	104	749		2905	2523	5428
1993	2250	103	859		3212	8493	11705
1994	2049	62	763		2874	6450	9324
1995	2419	90	918		3427	4464	7891
1996	2844	102	1034		3980	2148	6128
1997	2959	117	1130		4206	3469	7675
1998	3541	184	1319	12	5056	1944	7000
1999	3486	214	1243	6	4949	4108	9057
2000	3325	181	1197	7	4710	5664	10374
2001	2880	138	1037	1	4056	3767	7823
2002	3293	116	1032	7	4448	4311	8760
2003	2757	99	898	13	3767	2208	5975
2004	2955	95	903	12	3965	2532	6497
2005	2901	83	1048	2	4034	3014	7048
2006	2432	91	1143	6	3672	2926	6598
2007	2887	145	1467	13	4512	6524	11036
2008	3174	158	1509	19	4860	4746	9606
2009	3372	128	1331	15	4846	6129	10975
2010	3721	124	1249	29	5123	3548	8671
2011	2937	87	945	17	3986	2847	6833
2012	2970	104	1355	0	4429	4771	9200
2013	2550	73	1134	3	3760	4010	7770

Table 6.3.14.3 *Nephrops* in Division IIIa. Assessment data, discard proportion, and mean individual weight in catches and landings.

Year	TV abundance index (million)	Total discard ratio (number)	Dead discard ratio (number)	Dead discard ratio (weight)	Mean weight Landings (g)	Mean weight Catches (g)	Mean weight Discards (g)	Numbers removed (millions)	Observed harvest rate
2010	*	63.8%	56.9%	30.7%	66.0	40.5	26.0	180	
2011	3577	62.6%	55.7%	31.3%	60.5	38.7	25.8	149	3.9
2012	2526	69.8%	63.4%	38.9%	55.9	35.1	26.1	216	8.6
2013	2914	69.3%	62.9%	38.7%	59.8	37.9	28.2	169	5.8
Average (2011-2013)	3006	67.2%	60.7%	36.3%	58.7	37.2	26.7	178	6.1

* TV survey in Division IIIa started with coverage of the whole area in 2011.