Stock Annex for Irish Sea West *Nephrops* (FU15)

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Irish Sea West *Nephrops* (FU15)
Working Group	WK*NEPH* 2009 (WK*NEPH*2009)
Date	6 March 2009

A. General

A.1. Stock definition

Throughout its distribution, *Nephrops* is limited to muddy habitat, and requires sediment with a silt & clay content of between 10–100% to excavate its burrows, and this means that the distribution of suitable sediment defines the species distribution. Adult *Nephrops* only undertake very small scale movements (a few 100 m) but larval transfer may occur between separate mud patches in some areas. In the western Irish Sea the *Nephrops* stock inhabits an extensive area of muddy sediment between the Isle of Man and Northern Ireland and its fishery contributes to more than 90% of overall Irish Sea landings. There is little evidence of mixing between the east and west Irish Sea stocks due to the nature of water current movements, which is characterised in the west by a gyre, which has a retention affect on both sediment and larvae. The eastern and western *Nephrops* stocks are treated as separate populations as they have different population characteristics.

A.3. Ecosystem aspects

A number of studies have examined *Nephrops* larvae distribution in order to examine how recruitment may impinge upon the distribution of a "catchable" (adult) *Nephrops* population and the maintenance of the population. Hillis (1968) found that although generally the larvae occupied the same areas as the adults, there was some evidence of advective losses to the southeastern part of their range, most probably due to tidal currents (White *et al*., 1988). More recent studies in the western Irish Sea have uncovered the existence of a seasonal cyclonic gyre which appears to facilitate retention of larvae over the mud patch (Dickey-Collas *et al*., 1996; Hill *et al*., 1996; Horsburgh *et al*., 2000).

B. Data

B.1. Commercial catch

Length and sex compositions of *Nephrops* landed from the Irish Sea West are estimated from port sampling by Ireland and Northern Ireland and Ireland. A lack of co-operation by the Northern Ireland industry prevented sampling commercial catches over the period 2003–2007. The Irish LFDs are therefore 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. Sample data is used to compute international removals (Landings + dead discards).

Landings per unit of effort time-series are available from the following fleets:

Northern Ireland *Nephrops* trawl gears. Landings-at-age and effort data from this fishery since 1986 are used to generate a cpue index. There is also a cpue series since 1995

for a subset of Republic of Ireland *Nephrops* vessels. Catch-at-age are estimated by raising length sampling of discards and landings to officially recorded landings and slicing into ages (knife-edge slicing using growth parameters). Cpue is estimated using officially recorded effort (hours fished). Discard sampling commenced in the mid-1980s by Northern Ireland and the Republic of Ireland. There is no account taken of any technological creep in the fleet.

B.2. Biological

Mean weights-at-length for this stock are estimated from studies by Pope and Thomas (1955).

A natural mortality rate of 0.3 was assumed for males and immature females, with a value of 0.2 for mature females. The lower value for mature females reflects the reduced burrow emergence while ovigerous and hence an assumed reduction in predation.

Maturity for females is taken as 22.1 mm carapace length (McQuaid *et al*., 2006).

Proportion of F and M prior to spawning was specified as zero to give estimates of spawning–stock biomass at January 1. In the absence of independent estimates, the mean weights-at-age in the total catch were assumed to represent the mean weights in the stock.

B.3. Surveys

Ireland and Northern Ireland jointly carry out underwater television (UWTV) surveys on the main *Nephrops* grounds in the western Irish Sea (Figure 1) since 2003. These surveys are based on a randomised fixed grid design. The methods used during the survey are similar to those employed for UWTV surveys of *Nephrops* stocks elsewhere and are detailed in WKNEPHTV, 2007 and WKNEPHBID, 2008.

Northern Ireland have carried out a spring (April) and summer (August) *Nephrops* trawl surveys since 1994. These surveys provide data on catch rates and length frequency distributions from of stations throughout in the western Irish Sea. These surveys generate data on *Nephrops* size composition, mean size, maturity and sex ratio.

A number of factors are suspected to contribute bias to the UWTV surveys. In order to use the survey abundance estimate as an absolute it is necessary to correct for these potential biases. The history of bias estimates are given in the following table and are based on simulation models, preliminary experimentation and expert opinion, the biases associated with the estimates of *Nephrops* abundance in the Irish Sea West are:

	Time period	Edge effect	detection rate	species identification	occupancy	Cumulative bias
FU15: Irish Sea West	<=2009	1.24	0.75	1.15	1	1.14

B.4. Commercial cpue

B.5. Other relevant data

Table 1 is a summary of available data along with an assessment of its reliability.

Table 2 is a summary of assessment parameters.

C. Historical stock development

1) Survey indices are worked up annually resulting in the TV index.

2) Adjust index for bias (see Section B3). The combined effect of these biases is to be applied to the new survey index.

3) Generate mean weight in landings. Check the time-series of mean landing weights for evidence of a trend in the most recent period. If there is no firm evidence of a recent trend in mean weight use the average of the three most recent years. If, however, there is strong evidence of a recent trend then apply most recent value (don't attempt to extrapolate the trend further in the future).

D. Short-term projection

1) The catch option table will include the harvest ratios associated with fishing at $F_{0.1}$ and F_{max}. These values have been estimated by the Benchmark Workshop (see Section 9.2) and are to be revisited by subsequent benchmark groups. The values are FU specific and have been put in the Stock Annexes.

2) Create catch option table on the basis of a range of harvest ratios ranging from 0 to the maximum observed ratio or the ratio equating to F_{max}, whichever is the larger. Insert the harvest ratios from step 4 and also the current harvest ratio.

3) Multiply the survey index by the harvest ratios to give the number of total removals.

4) Create a landings number by applying a discard factor. This conversion factor has been estimated by the Benchmark Workshop and is to be revisited at subsequent benchmark groups. The value is FU specific and has been put in the Stock Annex.

5) Produce landings biomass by applying mean weight.

The suggested catch option table format is as follows.

		Implied fishery		
	Harvest rate	Survey Index	Retained number	Landings (tonnes)
	0%	12 345	0	0.00
	2%	"	247	123.45
	4%	"	494	246.90
	6%	"	741	370.35
	8%	"	988	493.80
$F_{0.1}$	8.60%	"	1062	530.84
	10%	"	1235	617.25
	12%	"	1481	740.70
F_{max}	13.50%	"	1667	833.29
	14%	"	1728	864.15
	16%	"	1975	987.60
	18%	"	2222	1111.05
	20%	"	2469	1234.50
	22%	"	2716	1357.95
$F_{current}$	21.5%	"	2654	1327.09

E. Medium-term projections

None presented.

F. Long-term projections

None presented.

G. Biological reference points

Harvest ratios equating to fishing at $F_{0.1}$ and F_{max} were calculated in WK*Neph* (2009). These calculations assume that the TV survey has a knife-edge selectivity at 17 mm and that the supplied length frequencies represented the population in equilibrium.

$F_{0.1}$ = 10.9%

F_{max}= 20.2%

References

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Horsburgh, K.J., Hill, A.E., Brown, J., Fernand, L., Garvine, R.W., Angelico, M.M.P. 2000. Seasonal evolution of the cold pool gyre in the western Irish Sea. *Progress in Oceanography* 46: 1–58.

Hill, A.E., Brown, J. and Fernand, L. 1996. The western Irish Sea gyre: a retention mechanism for the Norway Lobster (*Nephrops norvegicus)*. *Oceanologica Acta* 19: 357–369.

Hillis, J.P. 1968. Larval distribution of *Nephrops norvegicus* (L.) in the Irish Sea and North Channel. *ICRES C.M*. 1968. Doc. No. K6. (Mimeo).

McQuaid, N., Briggs, R.P.and Roberts, D. 2006. Estimation of the size of onset of sexual maturity in *Nephrops norvegicus* (L.). *Fisheries Research*.

White, R.G., Hill, A.E. and Jones, D.A. 1988. Distribution of *Nephrops norvegicus* (L.) larvae in the western Irish Sea: an example of advective control on recruitment. *Journal of Plankton Research* 10(4): 735–747.

Table 1. Summary table of available data.

Table 2: Biological Input Parameters.

Parameter	Value	Source
Discard Survival	0.10	ICES (1991a)
Discard rate	40.2%	2007 discard sampling.
MALES		
Growth - K	0.160	Hillis (1979) ; ICES (1991a)
Growth - L(inf)	60	"
Natural mortality - M	0.3	Brander and Bennett (1986, 1989)
Length/weight - a	0.00032	After Pope and Thomas (1955) (data for Scottish stocks)
Length/weight - b	3.210	"
FEMALES		
Immature Growth		
Growth - K	0.160	Hillis (1979) ; ICES (1991a)
Growth - L(inf)	60	"
Natural mortality - M	0.3	Brander and Bennett (1986, 1989)
Size at maturity	22.1	McQuaid *et al*., 2006
Mature Growth		
Growth - K	0.100	Hillis (1979) ; ICES (1991a)
Growth - L(inf)	56	"
Natural mortality - M	0.2	Brander and Bennett (1986, 1989)
Length/weight - a	0.00068	After Pope and Thomas (1955) (data for Scottish stocks)
Length/weight - b	2.960	"

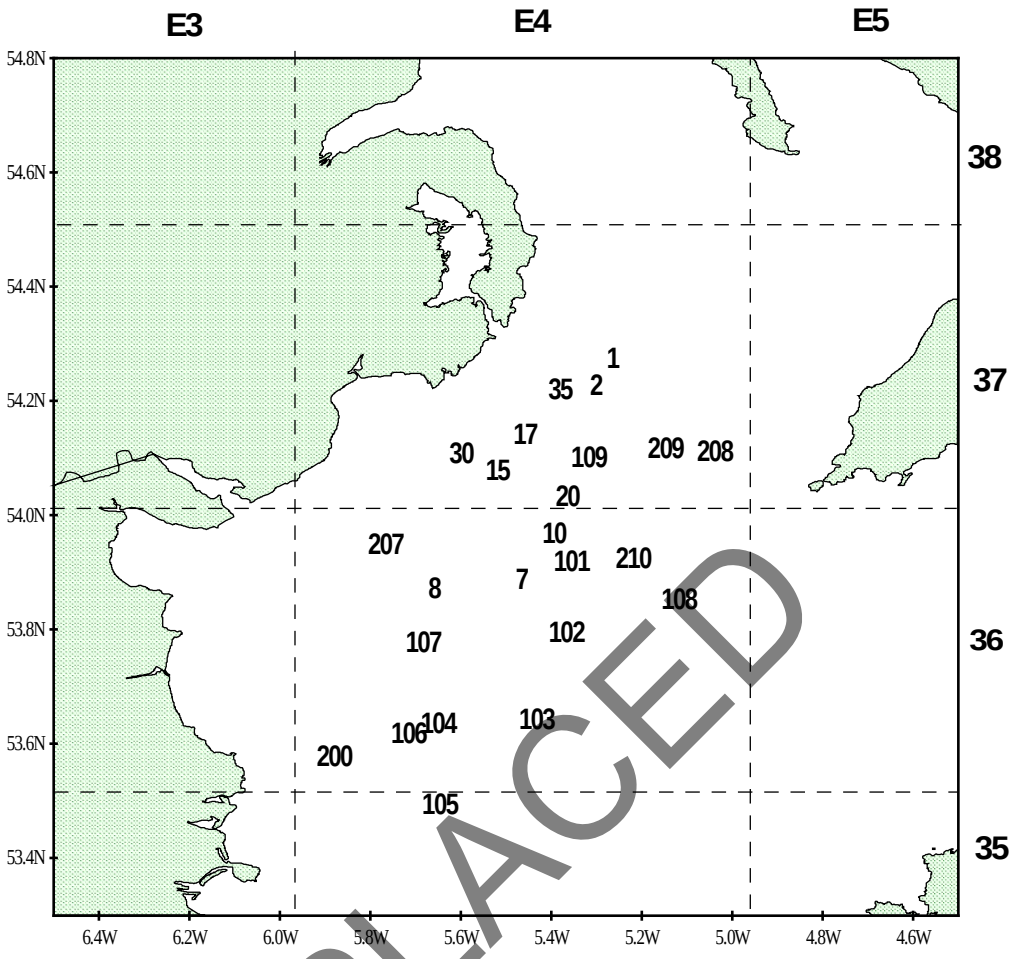

Figure 1: Western Irish Sea Nephrops stations