# Stock Annex: Ling (*Molva molva*) in subareas 6–9, 12, and 14, and in in divisions 3.a and 4.a (Northeast Atlantic and Arctic Ocean)

Stock specific documentation of standard assessment procedures used by ICES.

**Stock:** Ling

**Working Group:** Working Group on Biology and Assessment of Deep-sea Fisheries Resources (WGDEEP)

**Created:**

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**Last updated**: March 2011

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## A. General

### A.1. Stock definition

WGDEEP 2006 indicated: '*There is currently no evidence of genetically distinct populations within the ICES area. However, ling at widely separated fishing grounds may still be sufficiently isolated to be considered management units, i.e. stocks, between which exchange of individuals is limited and has little effect on the structure and dynamics of each unit. It was suggested that Iceland (5.a), the Norwegian Coast (2), and the Faroes and Faroe Bank (5.b) have separate stocks, but that the existence of distinguishable stocks along the continental shelf west and north of the British Isles and the northern North Sea (Subareas 4, 6, 7 and 8) is less probable. Ling is one of the species included in a recently initiated Norwegian population structure study using molecular genetics, and new data may thus be expected in the future*'

### A.2. Fishery

Significant fisheries for ling have been conducted in Subarea 3 and 4 at least since the 1870s, pioneered by Swedish longliners. Since the mid-1900s and currently, the major targeted ling fishery in 4.a is by Norwegian longliners conducted around Shetland and in the Norwegian Deep. There is little activity in 3.a. Of the total Norwegian 2010 landings, 83% were taken by longlines, 8% by gillnets, and the remainder by trawls. The bulk of the landings from other countries were taken by trawls as bycatches in other fisheries, and the landings from the UK (Scotland) are the most substantial. The comparatively low landings from the central and southern North Sea (4.b,c), are only bycatches from various other fisheries.

The major directed ling fishery in 6 is the Norwegian longline fishery. Trawl fisheries by the UK (Scotland) and France primarily take ling as bycatch.

When areas 3-4 and 6-14 are pooled over the period 1988-2010, 40% of the landings were in area 4, 29% in area 6, and 26% in area 6.

In Subarea 7 the Divisions b, c, and g–k provide most of the landings of ling. Norwegian landings, and some of Irish and Spanish landings are from targeted longline fisheries, whereas other landings are primarily bycatches in trawl fisheries. Data split by gear type were not available for all countries, but the bulk of the total landings (at least 60–70%) were taken by trawls in these areas.

In Subareas 8 and 9, 12 and 14 all landings are bycatches in various fisheries.

There was a decline in landings from 1988 to 2003, afterwards the landings have been stable (Figure 5.5.1). When areas 3-4 are pooled, the total landings averaged 32 thousand tons in 1988-1998 and then declined to an average of 15 thousand tons in 2003-2010. The decline has been simultaneous in the main areas 4, 6 and 7, but area 7 has had a greater reduction in landings than in areas 4 and 6 (Figure 5.5.2).

In Division 4.a the total landings have varied between 10 000 and 13 000 t until 1998, then declined until 2003 to about half previous level, and have since remained stable.

In Division 4.a the statistics are incomplete for the period 1989–1993. In the period 1994–2008, when the data are complete, they demonstrate a declining trend towards a level less than half that in the 1990s. The Norwegian landings declined substantially since the mid-1990s compared with earlier years. In Division VIb landings decreased in the late 1990s and reached a minimum in 2002, after which a gradual increase has occurred. In 2010 the landings were above the mean annual landings for the period 1988–1995.

In Subarea 7 landings were around 10 000 t in the period 1995–1998. After this there was a gradual decrease, and the preliminary estimate of catch for 2010 is only 1233t.

In Subarea 8 annual ling landings have totaled only a few hundred tons since 1999, and in Subareas 9, 12, and 14 the landings have remained minor.

### A.3. Ecosystem aspects

## B. Data

### B.1. Commercial catch

Full landings data are available from 1988 to present but it is thought that fisheries in some of these areas pre-date the time series. Incomplete landings data are available from Norwegian longline fisheries from 1889 onwards. Additional landings data from other areas may be available from 1950 onwards.

### B.2. Biological

Length data for the Norwegian reference fleet in other areas have been routinely collected since 2002.

Considerable general information is available on the life history characteristics of this species.

### B.3. Surveys

### B.4. Commercial CPUE

Norway started in 2003 to collect and enter data from official logbooks into an electronic database and data are now available for the period 2000–2009. Vessels were selected that had a total landed catch of ling, tusk and blue ling exceeding 8 tonnes in a given year. The logbooks contain records of the daily catch, date, position, and number of hooks used per day. Cpue were calculated as the average total catch of ling per vessel ($C$), and the average number of hooks per set and per vessel ($N$) associated with these catches. Then, for each year and catch category, the estimated cpue for the entire fleet was determined as $C/N$. Thus the estimated cpue for each year and Subarea was the mean catch in kg per hook for the entire fleet.

The boats that provided logbooks are the primary sampling units, and $C$ and $N$ are both random variables. It follows that this is a ratio-type estimator, therefore the standard errors of the cpue estimates could be calculated as described in Cochran (1977, page 32). This cpue estimator is a weighted average, that is the more hooks a boat sets, the more influence it has on the estimate (Cochran, 1977). For comparison, an unweighted cpue series was also constructed (i.e. the average cpue per boat).

A standardised series will be developed in preparation for WGDEEP 2012.

### B.5. Other relevant data

## C. Assessment: data and method

Model used: The stock is assessed using trends in catch and cpue.

Software used:

Model Options chosen:

Input data types and characteristics:

## D. Short-Term Projection

Model used:

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight at age in the stock:

Weight at age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock recruitment model used:

Procedures used for splitting projected catches:

## E. Medium-Term Projections

### Uncertainty models used:

## F. Long-Term Projections

## G. Biological Reference Points

### Evaluation of reference points

At the 2012 WGDEEP meeting several methods were trialled to estimate reference points for ling in all other areas. These methods included the Gislason method, the Extended Beverton–Holt yield simple model (BHAC) and FLAdvice as recommended in WKLIFE.

The input parameters were as follows:

**For Gislason:** $L_{max}$ of 180 cm

AFC = 5.

**For BHAC**: natural mortality M = 0.15

k VB growth K = 0.09

Length 1st maturity $L_{mat}$ <- 70

L infinity L_inf <- 160

**For FLadvice:** Age range is 1–16

L infinity L_inf <- 160

k VB growth K = 0.09

LW relationship a = 0.0043

LW relationship b = -3.051

Several estimates from the different approaches were available. The table below summarizes the outputs of the different methods:

| METHOD/ESTIMATE | FMAX | F0.1 | F30%SPR | F40%SPR | FMSY |
|---|---|---|---|---|---|
| Gislason spreadsheet (WKLIFE) with AFC=5 | 0.22 | 0.1 | 0.13 | 0.09 | |
| BHAC (WKLIFE) | 0.21 | 0.11 | | | |
| FLAdvice (WKLIFE) based on Linf and K | 0.16 | 0.08 | 0.10 | | |
| FLAdvice (WKLIFE) based on Linf, K and LW parameters | 0.14 | 0.06 | 0.08 | | 0.09 |

This analysis indicated that $F_{max}$ (around 0.22) for the Gislason spreadsheet and (0.21) for the BHAC methods were similar, in both methods the estimation of $F_{0.1}$ is similar at ca. 0.1. FLAdvice was tested with the input of LW parameters and without, The $F_{max}$ values were lower for FLAdvice based on Linf and K and lower still when LW parameters were included in the calculations.

There is no obvious basis for selecting an $F_{MSY}$ proxy from the range of values described above however values between 0.1 and 0.2 would seem appropriate.

No biological reference points have been defined

## H. Other Issues

### H.1. Historical overview of previous assessment methods

## I. References