Stock Annex: Herring (*Clupea harengus*) in Division 7.a North of 52°30'N (Irish Sea)

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Herring
Working Group:	Herring Assessment Working Group for the Area South of 62ºN (HAWG)
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Authors:	
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Last updated by:	Pieter-Jan Schön

A. General

A.1. Stock definition

Herring spawning grounds in the Irish Sea are found in coastal waters to the west and north of the Isle of Man and on the Irish Coast at around 54ºN (ICES, 1994; Dickey-Collas *et al*., 2001). Spawning takes place from September to November in both areas, occurring slightly later on average on the Irish Coast than off the Isle of Man. ICES Herring Assessment Working Groups from 19XX to 1983 used vertebral counts to separate catches into Manx and Mourne stocks associated with these spawning grounds. However, taking account of inaccuracies in this method and the results of biochemical analyses, the 1984 WG combined the data from the two components to provide a "more meaningful and accurate estimate of the total stock biomass in the N. Irish Sea." All subsequent assessments have treated the 7.a(N) data as coming from a single stock. During the 1970s, catches from the Manx component were about three times larger than those from the Mourne component. By the early 1980s, following the collapse of the stock, the catches were of similar magnitude. The fishery off the Mourne coast declined substantially in the 1990s then ceased, whilst acoustic and larva surveys in this period indicate that the spawning population in this area has been very small compared to the biomass off the Isle of Man.

The occurrence in the Irish Sea of juvenile herring from a winter-spring spawning stock has been recognized since the 1960s based on vertebral counts (ICES, 1994). More recently, Brophy and Danilowicz (2002) used otolith microstructure to show that nursery grounds in the western Irish Sea were generally dominated by winter-spawned fish. Samples from the eastern Irish Sea were mainly autumn-spawned fish. Recaptures from 10,000 herring tagged off the SW of the Isle of Man in July 1991 occurred both on the Manx spawning grounds and along the Irish Coast with increasing proportions from the Celtic Sea in subsequent years (Molloy *et al*., 1993). The pattern of recaptures indicated a movement towards spawning grounds in the Celtic Sea as the fish matured.

A proportion of the Irish Sea herring stocks may occur to the north of the Irish Sea outside of the spawning period. This was indicated by the recapture on the Manx spawning grounds of 3-6 ring herring tagged during summer in the Firth of Clyde

(Morrison and Bruce, 1981). Aggregations of post-spawning adult herring were detected along the west coast of England during an acoustic survey in December 1996 (Department of Agriculture and Rural Development for Northern Ireland, unpublished data), showing that a component of the stock may remain within the Irish Sea.

The results of WESTHER, a recent EU-funded programme aiming to elucidate stock structures of herring throughout the western seaboard of the British Isles have recently been published. Using a combination of morphometric measurements, otolith structure, genetics and parasite loads the conductivity of stocks within and beyond the Irish Sea have been examined. The results of this programme and existing knowledge are currently being evaluated at SGHERWAY in light of the future assessment and management of stocks to the western British Isles.

A.2. Fishery

There have been three types of fishery on herring in the Irish Sea in the last 40 years:

- Isle of Man- aimed at adult fish that spawn around the Isle of Man.
- Mourne – aimed at adult fish that spawn off the Northern Irish eastern coast.
- Mornington- a mixed industrial fishery that caught juveniles in the western Irish Sea.

The Mornington fishery started in 1969 and at its peak it caught 10,000 tonnes per year. It took place throughout the year. The fishery was closed due to management concerns in 1978 (ICES, 1994). In the 1970s the catch of fish from the Mourne fishery made up over a third of the total Irish Sea catch. The fishery was carried out by UK and Republic of Ireland vessels using trawls, seines and drift nets in the autumn. However the fishery declined and ceased in the early 1990s (ICES, 1994). The biomass of Mourne herring, determined from larval production estimates is now 2-4% of the total Irish Sea stock (Dickey-Collas *et al.*, 2001).

The main herring fishery in the Irish Sea has been on the fish that spawn in the vicinity of the Isle of Man. The fish are caught as they enter the North Channel, down the Scottish coast, and around the Isle of Man. Traditionally this fishery supplied the Manx Kipper Industry, which requires fish in June and July. However the fish appeared to spawn slightly later in the year in the 1990s and this lead to problems of supply for the Manx Kipper Industry. In 1998 the Kipper companies decided to buy in fish from other areas. Generally the fishery has occurred from June to November, but is highly dependent on the migratory behaviour of the herring.

The fishery has been prosecuted mainly by UK and Irish vessels. TACs were first introduced in 1972, and vessels from France, Netherlands and the USSR also reported catches from the Irish Sea during the 1970s before the closure of the fisheries from 1978 to 1981. By the 1990s only the fishery on the Manx fish remained, and by the late 1990s this was dominated by Northern Irish boats. The number of Northern Irish vessels landing herring declined from 24 in 1995-96 to 6-10 in 1997-99 and to 4 in 2000. Only two vessels operated in 2002 and 2003. However, total landings have remained relatively stable since the 1980s whilst the mean amount of fish landed per fishing trip has increased, reflecting the increase in average vessel size.

A.3. Ecosystem aspects

The main fish predators on herring in the Irish Sea include whiting (*Merlangius merlangus*), hake (*Merluccius merluccius*) and spurdog (*Squalus acanthias*). The size composition of herring in the stomach contents indicates that predation by whiting is mainly on 0-ring and 1-ring herring whilst adult hake and spurdogfish also eat older herring (Armstrong, 1979; Newton, 2000; Patterson, 1983). Sampling since the 1980s has shown cod (*Gadus morhua*), taken by both pelagic and demersal trawls in the Irish Sea, to be minor predators on herring. Small clupeids are an important source of food for piscivorous seabirds including gannets, guillemots and razorbills (ref…) which nest at several locations in and around the Irish Sea. Marine mammal predators include grey and harbour seals (ref.) and possibly pilot whales, which occur seasonally in areas where herring aggregate.

Whilst small juvenile herring occur throughout the coastal waters of the western and eastern Irish Sea, their distribution overlaps extensively with sprats (*Sprattus sprattus*). The biomass of small herring has typically been less than 5% of the combined biomass of small clupeids estimated by acoustics (ICES, 2008 ACOM:02). However in recent years the proportions have increased in favour of small herring (ICES, 2009 ACOM:??).

There are irregular cycles in the productivity of herring stocks (weights-at-age and recruitment). There are many hypotheses as to the cause of these changes in productivity, but in most cases it is thought that the environment plays an important role (through transport, prey, and predation). Coincident periods of high and low production have been seen in the herring in 6.aN and Irish Sea herring. Exploitation and management strategies must account for the likelihood of productivity changing. The Irish Sea herring stock has shown a marked decline in productivity during the late 70's and remained on a low level since then.

Changes in Environment

There has been an increase in water temperatures in this area (ICES, 2006) which is likely to affect the distribution area of some fish species, and some changes of distribution have already been noted. Temperature increase is likely to affect stock recruitment of some species. In addition, the combined effects of over exploitation and environmental variability might lead to a higher risk of recruitment failure and decrease in productivity (ICES, 2007).

B. Data

B.1. Commercial catch

National landings estimates

The current ICES assessment of Irish Sea herring extends back to 1961, and is based on landings only. ICES WG reports (ICES 1981, 1986 and 1991) highlight the occurrence of discarding and slippage of catches, which can occur in areas where adult and juvenile herring co-occur. Discarding has been practised on an increasing scale since 1980 (ICES, 1986). This increase is primarily related to the onset of slippage of catches that coincided with the cessation of the industrial fishery in early 1979 (ICES, 1980). As a result of sorting practices, slippage has led to marked changes in the age composition of the catch since 1979 and considerable change in the mean weights at age in the catch of the three youngest age groups (ICES 1981). Estimates of discarding were sporadically performed in the 1980s (ICES, 1981, 1982, 1985 and 1986), but there are no estimates of discarding or slippage of herring in the Irish Sea fisheries since 1986. Highly variable annual discard rates are evident from the 1980s surveys. For example, discards estimates of juvenile herring (0-group) for the Mourne stock taken in the 1981 *Nephrops* fishery was estimated at 1.9×10^6 of vessels landing in Northern Ireland, which amounts to approximately 20% of the Mourne fishery (ICES 1982). In 1982, at least 50% of 1-group herring caught were discarded at sea by vessels participating in the Isle of Man fishery (ICES, 1983). A more comprehensive survey programme to determine the rate of discarding in 1985 revealed discard estimates of 82% by numbers of 1-ring fish, 30% of 2-ring and 6% of 3-ring fish, with the dominant age group in the landed catch being 3 ring (ICES, 1986). A similar survey in 1986, however, found the discarding of young fish fell to a very low level (ICES, 1987). The 1991 WG discussed the discard problem in herring fisheries in general and suggested possible measures to reduce discarding. No quantitative estimates were given, but reports of fishermen suggesting discards of up to 50% of catch as a result of sorting practices by using sorting machines (ICES, 1991). The variation in discard rates since 1980, as a result of changes in discard practices, can probably be attributed to several changes in the management of the fishery. These include the availability of different fishing areas, the change to fortnightly catch quotas per boat (ICES, 1987) and level of TAC, where lower discard rates are observed with a higher TAC (ICES, 1989). The level of slippage is also related to the fishing season, since slippage is often at a high level in the early months (ICES, 1987). Due to the variable nature of discard estimates and the lack of a continuous data series, it has not been included in the annual catch at age estimates (with the exception of the 1983 assessment when the catch in numbers of 1-ringers was doubled based on a 50% discard estimate of this age group).

Landings data for herring in Division 7.a(N) are generally collated from all participating countries providing official statistics to ICES, namely UK (England & Wales, Northern Ireland, Scotland and the Isle of Man), Ireland, France, the Netherlands and what was formally the USSR. The data for the period 1971 to 2002 are reported in the various Herring Assessment Working Group Reports and are reproduced in Table 1. The official Statistics for Irish landings from 7.a have been processed to remove data from the Dunmore East fishery in area 7.a(S), and represent landings from 7.a(N) only.

Over the past three decades, the WG highlighted the under- or misreporting of catches as the major problem with regards to the accuracy of the landing data. Related to this are the problems of illegal landings during closed periods and paper landings. Area misreporting was also recognised (ICES, 1999), although a less prominent problem that is mostly corrected for.

The 1980 WG first identified the problem of misreporting of landings based on the results of a 3-year sampling programme, which was initiated after 1975 when herring were being landed in metric units at ports bordering the Irish Sea (1 unit = 100 kg nominal weight). The study showed the weight of a unit to be very variable, but was usually well in excess of 100 kg. An initial attempt to allow for misreporting using adjusted catches made very little difference to any of the values of fishing mortality (ICES, 1980). Subsequently, despite serious concerns about considerable under-reporting being raised (ICES 1990, 1994, 2000 and 2001), the WG made no attempts to examination the extent of the problem. This uncertainty signifies no estimates of under-reporting and consequently no allowance for under-reporting of landings has been made. Considerable doubt was raised as to the accuracy of landing data over the period 1981-87 (ICES, 1994). However, after apparent re-examination all WG landing statistics are assumed to be accurate up to 1997 (ICES, 2000), but with no reliable estimates of landings from 1998-2000 (ICES, 2001). The WG acknowledged that poor quality landing data bring the catch in numbers at age data into question and hence the accuracy of any assessment using data from such periods (ICES, 1994).

In 2002 the ICES assessment was extended back to include data for 1961-1970 with the intention of showing the stock development prior to the large expansion in fishing effort and stock size in the early 1970s. This has now been extended further back to 1955. Landings data for this period were extracted from the UK fisheries data bases (England & Wales, Scotland and Northern Ireland: Table 1, columns 8-10) and publications by Bowers and Brand (1973) for Isle of Man landings (column 11). Landings data for Ireland and France were not available.

To estimate the 7.a(N) herring landings for Ireland and France during 1955-1970, the NE Atlantic herring catches for each country were obtained from the FAO database (column 16). Using the ICES landings data for each country (column 17) the mean proportion of the 7.a(N) catch to the NE Atlantic catch during 1971 to 1981 was estimated (column 18). This was applied to the NE Atlantic catches from each country, for the period 1955 to 1970, to give an estimated landing for both France and Ireland (column 19). These landings were added to the known catches from the CEFAS database to give the total landings. The landings data (tonnes) used in the assessment are given in Table 1, column 14. It is anticipated that landings data for 7.a(N) for years prior to 1971 can be extracted from the Irish databases. However, the French landings will remain as estimates. As yet there has been no analysis of magnitude of errors in the old data. Need discussion on errors due to misreporting

Catch at age data

Age classes in the ICES Canum file refer to numbers of winter rings in otoliths. As the Irish Sea stock comprises autumn spawners, *i*-ring fish taken in year *y* will comprise fish in their i_{th} year of life if caught prior to the spawning season and $(i+1)_{th}$ year if caught after the spawning period. An *i*-ring fish will belong to year-class *y*-2. As spawning stock is estimated at spawning time (autumn), spawning stock and recruitment relationships require estimates of recruitment of *i*-ring fish in year *y* and estimates of SSB in year *i*-2. The current assessment estimates recruitment as numbers of 1-ring fish.

The most recent description of sampling and raising methods for estimating catch at age of herring stocks is in ICES (1996). This includes sampling by UK(E&W) and Ireland, but not UK(NI) and Isle of Man

UK(NI):A random sample of 10-20kg of herring is taken from each landing into the main landing port (Ardglass) by the NI Department of Agriculture and Rural Development. Samples are also collected from any catches landed into Londonderry. Prior to the 1990s, the samples were mostly processed fresh. During the 1990s, there was an increasing tendency for samples to be frozen for a period of weeks before processing. No corrections have been applied to weight measurements to allow for changes due to freezing and defrosting. The length frequency (total length) of each sample is recorded to the nearest 0.5cm below. A sample of herring is then taken for biological analysis as follows: one fish per 0.5 cm length class, followed by a random sample to make the sample up to 50 fish.

Otoliths are removed from each fish, mounted in resin on a black slide and read by reflected light. Ages are assigned according to number of winter rings.

Length frequencies (LFDs) for 7.a(N) catches are aggregated by quarter. The weight of the aggregate LFD is calculated using a length-weight relationship derived from the biological samples. The LFD is then raised to the total quarterly landings of herring by the NI fleets. A quarterly age-length key, derived from commercial catch samples only, is applied to the raised LFD to give numbers at age and mean weight at age.

IOM: IOM sampling covers the period 1923 – 1997. Samples are collected from any landings into Peel, by staff of the Port Erin Marine Laboratory (Liverpool University). The sampling and raising procedures are the same as described for UK(NI) with the following exceptions: i) the weight of the aggregate quarterly LFD is obtained from the original sample weights rather than using a length-weight relationship, and ii) the biological samples are random rather than stratified by length. The 1993 ICES herring assessment WGs noted a potential under-estimation by one ring, of herring sampled in the IOM. This was caused by a change in materials used for mounting otoliths and appears to have been a problem for ageing older herring in 1990-92. This was since rectified. However, the bias for the 1990-92 period has not yet been quantified and will be examined in the near future.

Ireland: Irish sampling of 7.a(N) herring covers the period 19xx – 2001. Some samples are from landings into NI but transported to factories in southern Ireland. Irish sampling schemes for herring in Div. 6.a(S), 7.b, Celtic Sea and 7.j are described in ICES (1996). Methods for sampling catches in 7.a(N) are similar. The procedure is the same as described above for UK(NI) except that the biological samples are random rather than length stratified. ICES (1996) notes that a length-stratified scheme should be adopted to ensure proper coverage at the extremes of the LFDs.

Quality control of herring ageing has fallen under the remit of EU funded programmes EFAN and TACADAR, to which the laboratories sampling 7.a(N) herring contribute. An otolith exchange exercise was initiated in 2002 and is currently being completed.

B.2. Biological

Natural Mortality

Natural mortality (M) varies with age (expressed in number of winter rings) according to the following (since 2012):

Rings	M
1	0.787
2	0.380
3	0.353
4	0.335
5	0.315
6	0.311
7+	0.304

These values have been held constant from 1972 to date. These correspond to estimates for North Sea since 2012. A multi-species stock assessment model for the North Sea (SMS key-run 2010) has been used to inform the variable natural mortality pattern. The use of these values are considered preliminary until stock specific estimates can be obtained.

The values used up to the 2011 assessment correspond to estimates for North Sea herring based on recommendations by the Multi-species WG (Anon. 1987a), which were applied to adjacent areas (Anon. 1987b). Rings M

1	1
2	0.3
3	0.2
4+	0.1

Maturity at age

Combined, year-specific maturity ogives were used in the 2003 Assessment (ICES 2003). The way those values were derived is documented on Dickey-Collas *et al.* (2003). Prior to 2003 annually invariant estimates of the proportion of fish mature by age were used. Those were based on estimates from the 1970s (ICES, 1994). The use of the variable maturity ogive in 2003 did not change greatly the perception of the stock state (Dickey-Collas *et al., op cit*). Due to inconsistencies in the maturity data collected in 2003, the WG used a mean maturity ogive for the preceding nine years for 2003. The rationale for the 9 years was that there appeared to be a shift in the maturity ogive around 1993. After 2003 all weights and maturity-at-age data were based on corresponding annual biological samples.

SSB in September is estimated in the assessment. The survey larvae estimate is used as a relative index of SSB. The proportions of M and F before spawning are held constant over time in the assessment.

Stock weights

Stock weights at age have been derived from the age samples of the 3rd quarter landings since 1984 (R. Nash *pers comm.*). The stock mean weights for 1975-83 are time invariant and were re-examined in 1985 (Anon. 1985). They result from combining Manx and Mourne data sets. The weights at age of those stocks were considered relatively stable over time. No biological sampling information was available for 2009 and the weights at age for 2009 were replaced by averaging the weight at age observed in 2008 and 2010.

Mean weights

Mean weights-at-age in the catch (1985 to 2007) are given in Table 3. Mean weights-at-age of all ages remained low. There has been a change in mean weight over the time period 1961 to the present (ICES, 2003 ACFM:17). Mean weights-at-age increased between the early 1960s and the late 1970s whereupon there has been a steady decline to the early 1990s, where they remained low. In the assessment, mean weights-at-age for the period 1972 to 1984 are taken as unchanging. In extending the data series back from 1971 to 1961, mean weights-at-age in the catch were taken from samples recorded by the Port Erin Marine Laboratory (ICES, 2003 ACFM:17).

There was some uncertainty in the mean weights-at-age for 2003 presented to the WG, and consequently the WG replaced these with the average mean stock weights-at-age for the preceding five years (1998 to 2002). No biological sampling information was available for 2009 and the weights at age for 2009 were replaced by averaging the weight at age observed in 2008 and 2010.

Mean Lengths

Mean lengths-at-age are calculated using the catch data and are given for the years 1985 to 2006 in Table 4. In general, mean lengths have been relatively stable over the last few years and this trend has continued in 2006.

Catch at length

Catch at length are listed for the years 1990-2004 (Table 5)

B.3. Surveys

The following surveys have provided data for the 7.a(N) assessment:

Survey Acronym	Type	Abundance data	Area and Month	Period
AC(7.aN)	Acoustic survey	Numbers at age (1-ring and older); SSB	7.a(N) from 530 20′N – 55oN; September	1994 – present
NINEL	Larva survey	Production of larvae at 6mm TL	7.a(N) from 53o 50′N – 54o 50′N; November	1993 – present
DBL	Larva survey	Production of larvae at 6mm TL	East coast of Isle of Man; October	1989 – 1999 (1996 missing)
GFS-oct	Groundfish survey	Mean nos. caught per 3 n.miles (1&2 ringers), by region	7.a(N) from 530 20′N – 54o 50′N (stratified); October	1993 - 1999
GFS-mar	Groundfish survey	Mean nos. caught per 3 n.miles (1&2 ringers), by region	7.a(N) from 530 20′N – 54o 50′N (stratified); March	1993 - 1999

Data from a number of earlier surveys have been documented in the ICES WG reports. These include:

NW Irish Sea young herring surveys (Irish otter trawl survey using commercial trawler; 1980 – 1988)

Douglas Bank (East Isle of Man) larva surveys (ring net surveys; 1974 – 1988) (Port Erin Marine Lab)

Douglas Bank spawning aggregation acoustic surveys (1989, 1990, 1994, 1995) (Port Erin Marine Lab)

Western Irish Sea acoustic survey (July 1991, 1992) (UK(NI))

Eastern Irish Sea acoustic survey (December 1996)

Surveys used in recent assessments are described below.

AC(IIIaN) acoustic survey

This survey uses a stratified design with systematic transects, during the first two weeks of September. Vessel currently used is the R.V. Corystes (UK(NI)) replacing the R.V. *Lough Foyle* (UK(NI)). Starting positions are randomized each year (see recent HAWG reports for transect design and survey results). The survey is most intense around the Isle of Man (2 to 4 n.mile transect spacing) where highest densities of adult herring are expected based on previous surveys and fishery data. Transect spacing of 6 to 10 n.miles are used elsewhere. A sphere-calibrated EK-500 38kHz sounder is employed, and data are archived and analysed using Echoview (SonarData, Tasmania). Targets are identified by midwater trawling. Acoustic records are manually partitioned to species by scrutinising the echograms and using trawl compositions where appropriate. ICES-recommended target strengths are used for herring, sprat, mackerel, horse mackerel and gadoids. The survey design and implementation follows, where possible, the guidelines for ICES herring acoustic surveys in the North Sea and West of Scotland. The survey data are analysed in 15-minute elementary distance sampling units (approx. 2.5 n.miles). An estimate of density by age class, and spawning stock biomass, is obtained for each EDSU and a distance-weighted average calculated for each stratum. These are raised by stratum area to give population numbers and SSB by stratum.

NINEL larva survey

The DARD herring larva survey has been carried out in November each year since 1993. Sampling is carried out on a systematic grid of stations covering the spawning grounds and surrounding regions in the NE and NW Irish Sea (Figure 1). Larvae are sampled using a Gulf-VII high-speed plankton sampler with 280 μm net. Double-oblique tows are made to within 2m of the seabed at each station. Internal and external flow rates, and temperature and salinity profiles, were recorded during each tow. Lengths of all herring larva captured are recorded.

Mean catch-rates (nos.m^{-2}) are calculated over stations to give separate indices of abundance for the NE and NW Irish Sea. Larval production rates (standardised to a larva of 6mm), and birth-date distributions, are computed based on the mean density of larvae by length class. A growth rate of 0.35mm day^{-1} and instantaneous mortality of 0.14 day^{-1} are assumed based on estimates made in 1993 - 1997. More recent studies have indicated a mortality rate of 0.09, and this value is also applied to examine the effect on trends in estimates of larval production

DBL larva survey

Herring larvae were sampled on the east side of the Isle of Man in September or October each year. Double oblique tows with a 60 cm Gulf VII/PRO-NET high-speed plankton sampler with a 40cm aperture nose cone were undertaken on a 5 Nm square grid. The tow profile was followed with a FURUNO net sonde attached to the top of the equipment. The volume of water filtered was calculated from the nose cone mouth flow meter. The samples were preserved in 4% seawater buffered formalin and stored in 70% alcohol.

All herring larvae were sorted from the samples. The numbers of larvae per m^3 were calculated from the volume of water filtered and the number of larvae per tow. Up to 100 larvae from each tow were measured with an ocular graticule in a stereo microscope. Each sample was assigned to a sampling square and the total number of larvae per 0.5mm size class calculated from the average depth of the square and the surface area.

The total production and time of larvae hatch was calculated using an instantaneous mortality coefficient (k) of 0.14 and a growth rate of 0.35 mm d^{-1} in the formula:

$$N_t = N_o e^{-(kt)}$$

Production was calculated as the sum of all size classes/hatching dates. Spawning dates were taken as 10 days prior to the hatching date (Bowers 1952).

The Douglas Bank Larva survey has not been updated since 1999. Examination of the sum of squares surface from SPALY in 2005 indicated that the Douglas Bank larvae index (DBL) was having no influence in the assessment estimates for the current year.

Therefore, the WG agreed on removing DBL from the analysis (ICES, 2005). The DBL time series is listed in Table 6

GFS-oct and -mar groundfish surveys

The DARD groundfish survey of ICES Division 7.aN are carried out in March and October at standard stations between 53° 20'N and 54° 45'N (Figure 2). Data from additional stations fished in the St George's Channel since October 2001 have not been used in calculating herring indices of abundance. As in previous surveys, the area was divided into strata according to depth contour and sediment type, with fixed station positions (note that the strata in Fig. 2 differ from those in the September acoustic survey shown in Fig. 1). The sampling gear was a Rockhopper otter trawl fitted with non-rotating rubber discs of approximately 15 cm diameter on the footrope. The trawl fishes with an average headline height of 3.0 m and door spread of 30 - 40 m depending on depth and tide. A 20mm stretched-mesh codend liner was fitted. During March, trawling was carried out at an average speed of 3 knots across the ground, over a standard distance of 3 nautical miles at standard stations and 1 nautical mile in the St. George's Channel. Since 2002, all survey stations in the October survey have been of 1-mile distance. Comparative trawling exercises during the October surveys and during an independent exercise in February 2003 indicate roughly similar catch-rates per mile between 1-mile and 3-mile tows. It is planned to continue with some comparative trawling experiments during future surveys to improve the statistical power of significance tests between the 1-mile and 3-mile tows.

As the surveys are targeted at gadoids, ages were not recorded for herring. The length frequencies in each survey were sliced into length ranges corresponding to 0-ring and 1-ring herring according to the appearance of modes in the overall weighted mean length frequency for each survey. Some imprecision will have resulted because of the overlap in length-at-age distributions of 1-ring and 2-ring herring. The error is considered to be comparatively small for most of the surveys where clear modes are apparent. There was no clear division between 1-ring and 2-ring herring in the March 2003 groundfish survey, and the estimate for 1-ringers may include a significant component of small 2-ringers. The arithmetic mean catch-rate and approximate variance of the mean was computed for each age-class in each survey stratum, and averaged over strata using the areas of the strata as weighting factors.

Groundfish surveys were used by the 1996 to 1999 HAWG to obtain indices for 0- and 1-ring herring in the Irish Sea. These indices have performed poorly in the assessment and have not been used since 1999. The time-series is listed in Table 7.

B.4. Commercial CPUE

Commercial CPUE's are not used for this stock.

B.5. Other relevant data

C. Historical Stock Development

Model used as basis for advice:

The assessment model is based on the State-space Assessment Model (SAM) (Nielsen et al., 2012). Technical details of the SAM framework can be found in the peer-reviewed literature (Nielsen et al., 2012)

At the Benchmark (WKPELA, 2012) the state-space models SAM model was chosen as the assessment model for Irish Sea herring. This modelling framework has a number of highly desirable characteristics, such as the stochastic treatment of all observations, a full statistical framework for evaluating model results, open source and cross platform source code, and an extremely high degree of flexibility allowing ready customisation to the peculiarities of the stock. Assessment model configuration

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes	1961-last data year	NA	Yes
Canum	Catch at age in numbers	1961-last data year	1-8+	Yes
Weca	Weight at age in the commercial catch	1961-1971 1972-1983 1984-last data year	1-8+ 1-8+ 1-8+	Yes No Yes
West	Weight at age of the spawning stock at spawning time.	1961-1971 1972-1983 1984-last data year	1-8+ 1-8+ 1-8+	Yes No Yes
Mprop	Proportion of natural mortality before spawning	1961-last data year	NA	No
Fprop	Proportion of fishing mortality before spawning	11961-last data year	NA	No
Matprop	Proportion mature at age	1961-last data year	1-8+	Yes
Natmor	Natural mortality	1961-last data year	1-8+	No

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1	AC_VIIa(N)	1994-last data year	1-8+
Tuning fleet 2	NINEL	1993-last data year	SSB

The table below present the SAM configuration options (file model.cfg). In the file text following a hash-mark (“#”) is a comment:

Min, max age represented internally in model

1 8

Max age considered a plus group? (0 = No, 1= Yes)

1

Coupling of fishing mortality STATES (ctrl@states)

1 2 3 4 5 6 7 8

1 2 3 4 5 6 7 7 # catch

```
 0 0 0 0 0 0 0 0 # FLT01(AC)
 0 0 0 0 0 0 0 0 # NINEL
# Use correlated random walks for the fishing mortalities
# ( 0 = independent, 1 = correlation estimated)
0
# Coupling of catchability PARAMETERS (ctrl@catchabilities)
 # 1 2 3 4 5 6 7 8 #
 0 0 0 0 0 0 0 0 # catch
 1 2 3 4 4 4 4 4 # FLT01(AC)
 0 0 0 0 0 0 0 0 # NINEL
# Coupling of power law model EXPONENTS (ctrl@power.law.exps)
 # 1 2 3 4 5 6 7 8 #
 0 0 0 0 0 0 0 0 # catch
 0 0 0 0 0 0 0 0 # FLT01(AC)
 0 0 0 0 0 0 0 0 # NINEL
# Coupling of fishing mortality RW VARIANCES (ctrl@f.vars)
 # 1 2 3 4 5 6 7 8 #
 1 1 1 1 1 1 1 1 # catch
 0 0 0 0 0 0 0 0 # FLT01(AC)
 0 0 0 0 0 0 0 0 # NINEL
# Coupling of log N RW VARIANCES (ctrl@logN.vars)
 1 2 2 2 2 2 2 2
# Coupling of OBSERVATION VARIANCES (ctrl@obs.vars)
 # 1 2 3 4 5 6 7 8 #
 1 2 3 3 4 4 4 4 # catch
 5 6 6 7 7 8 8 8 # FLT01(AC)
 0 0 0 0 0 0 0 0 # NINEL
# Stock recruitment model code (0=RW, 1=Ricker, 2=BH, ... more in time
 0
# Years in which catch data are to be scaled by an estimated parameter (mainly cod related)
 0
# Fbar range
 4 6
# so called checksum
123 123
```

The options for "Coupling of fishing mortality STATES" show that random walk for F is independent by age for the ages 1-6, and combined for age 7 and 8.

It is assumed that F at age is correlated to some degree estimated by the models. Therefore the option for "Use correlated random walks for the fishing mortalities" is set to 1.

The "Coupling of catchability PARAMETERS" specifies the grouping of ages with respect to survey catchability. For the ACVIIa(N) survey there is assumed an age dependent catchability for age 1-3, and a combined (the same) catchability ages 4-8.

In the ACVIIa(N) survey a linear relation between CPUE and stock size is assumed, such that the options for "Coupling of power law model EXPONENTS" are all set to 0.

The variance for the random walk for F ("Coupling of fishing mortality RW VARIANCES ") is assumed the same for all ages.

The "Coupling of OBSERVATION VARIANCES" specifies the options for observation noise for both catches and survey indices. For catches the observation variance is age dependent for age 1 and 2. For ages 3-4 the variance is assumed the same, and different from the variance for ages 5-8. For the ACVIIa(N) survey the variance is set the same within the groups of age 1, 2-3, 4-5 and 6-8.

There is no obvious relation between SSB and recruitment, but recruitment seems to be correlated between years. To reflect this, the "Stock recruitment model code" is set to 0=Random Walk.

D. Short-Term Projection

Model used: Age structured

Software used: MFDP ver 1a

Initial stock size: Taken from the last year of the assessment. 1-ring recruits taken from a geometric mean for the years 1995 to two years prior to the terminal year.

Maturity: Mean of the previous three years of the maturity ogive used in the assessment.

F and M before spawning: Set to 0.9 and 0.75 respectively for all years.

Weight at age in the stock: Mean of the previous three years in the assessment.

Weight at age in the catch: Mean of the previous three years in the assessment.

Exploitation pattern: Mean of the previous three years (not scaled to the last year, as the terminal estimate of F is not considered more informative)

Intermediate year assumptions: TAC constraint.

Stock recruitment model used: None used

Procedures used for splitting projected catches: Not relevant

E. Medium-Term Projections

F. Long-Term Projections

G. Biological Reference Points

Until there is confidence in the assessment the Working Group decided not to revisit the estimation of $\mathbf{B}_{pa}$ (9,500 t) and $\mathbf{B}_{lim}$ (6,000 t). There were no new points to add to the discussions and deliberations presented in 2000 (ICES 2000/ACFM:10).

H. Other Issues

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Coverage	% of landings sampled	No of samples	Total landings	landings by Q?	Ireland				Northern Ireland				Isle of Man				Otherr UK/UK offshore				Total			
Year					Landings	Samples	Lengths	Ages	Landings	Samples	Lengths	Ages	Landings	Samples	Lengths	Ages	Landings	Samples	Lengths	Ages	Landings	Samples	Lengths	Ages
1988(4)					**2579																	0	0	0
1989(3) temp spread good		88	4962	NO	1430	21	1843	555		45	11464	2249		21	5173	1057		1	96	0	4962	88	18576	3861
1990p(1,2)	68%	100	6312	YES	1699	44	5176	1022	2322	38	9310	1900	542	18	5276	897	179/1570	0	0	0	6312	100	19762	3819
1991g	90%	138	4398	YES	80	5	1255	247	3298	105	16724	2484	629	28	8280	1392	0/391	0	0	0	4398	138	26259	4123
1992g	98%	32	5270	YES	406	3	593	99	4120	16	1588	770	741	13	3488	680	3	0	0	0	5270	32	5669	1549
1993p (1)	65%	48	4408	YES	0	5	1378	245	3632	34	3744	832	776	9	1560	448	0	0	0	0	4408	48	6682	1525
1994v.g	95%	59	4828	YES	0	21	569	100	3956	43	3691	1175	716	14	3724	614	156	0	0	0	4828	59	7984	1889
1995g (1)	87%	85	5076	YES	0	21	569	100	3860	75	8282	2545	615	8	2182	400	601	0	0	0	5076	85	11033	3045
1996g (1,5)	70%	51	5301	YES	100	1	537	55	4335	45	4813	1050	537	5	997	228	329	0	0	0	5301	51	6347	1333
1997g (1,2)	91%	34	6649	YES	0	2	473	50	5679	25	2900	1199	765	7	2246	340	205	0	234	76	6649	34	5853	1665
1998g (2)	84%	31	4904	YES	0	2	150	50	4131	29	2979	1450	0	0	0	0	7732	0	0	0	4904	31	3129	1500
1999g (2)	72%	32	4127	YES	0	4	0	200	2967	28	2518	1400	0	0	0	0	11602	0	0	0	4127	32	2518	1600
2000v.g	97%	28	2002	YES	0	5	932	0	2002	23	1915	1150	0	0	0	0	0	0	0	0	2002	28	2847	1150
2001p (2)	70%	31	5461	YES	862	8	1031	222	3786	23	2915	1149	86	0	0	0	7272	0	0	0	5461	31	3946	1371
2002p (1)	62%	9	2392	YES	286	0	0	0	2051	9	949	450	4	0	0	0	51	0	0	0	2392	9	949	450
2003		9	2399	YES	0				2399	9	1132	445												
2004		9	2531	YES	749	2	190	133	1782	7	991	350												
2005		26	4387	YES	1153	5	1312	372	3234	21	4135	1018												
2006		22	4402	YES	581	8	2248	549	3821	14	1982	686												
2007		29	4629	YES	0				4629	29														
2008		19	4895	YES	0				4895	19														
2009p (6)			4594	YES					4594	4											4594			
2010g (2)	79%	31	4894	YES					4894	31	4115	1517									4894	31	4115	1517

COVERAGE: Sum of the landings (by Q and Nation (UK disaggregated))/total landings. From 1993 (possibly from 1990) to date landings and sampling levels are presented by quarter so coverage is related to this level of detail:

VERY GOOD (v.g) : all landings which individually are >10% of the total were sampled, all Q for which there were landings were sampled

GOOD (g) : landings that constitute the majority of the catch (adding to approx 70% or more of total) were sampled

POOR (p) : some of the large landings not sampled

(1): unsampled quarters

(2): large landings with few samples or unsampled. High level of sampling corresponds to 1 sample per 100t landed (WG rep 1997)

(3): Comment from WG rep. From 1990 going back, Report landings and sampling levels are shown aggregated for the whole year. UK landings lumped in one figure.

(4): no information in the WGrep of level of sampling prior to 1988. Sampling levels believed to be good. Actual figures to be provided by R. Nash, M Armstrong and CEFAS after going back to their labs.

(5): NO samples for NI landings in 4th Q, there is a suspicion that the figures correspond to 'paper landings'.

[1]Samples applied to NI landings: [2]Large unsampled landings.

(6): no samples taken from pair trawlers landings.

Table 2: Data and method used to estimate landings from Division 7.a(N) herring.

																ESTIMATES OF MAXIMUM LIKELY CATCH FOR 7.A(N) INCL. OF FRENCH AND ROI CATCHES							
Column No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		17		18		19	
	ICES table							British Isles catches						CATCH IN ASSESS-MENT		NE Atlantic catch		ICES 7a catch		% of NE atlantic		max likely catch	
	Ireland	UK	France	Netherlands	USSR/ Russia	Unallocated	Total	England	Northern Ireland	Wales	Manx	Irish	Total			France	Ireland	France	Ireland	France	Ireland	France	Ireland
1955								0	0	72	3815		3887	8056		60500	4900					3630	539
1956								5	0	20	4762		4787	8743		52000	7600					3120	836
1957								21	0	1638	2832		4491	7966		36100	11900					2166	1309
1958								31	0	12	2482		2525	6261		38800	12800					2328	1408
1959								20	0	96	3577		3693	7833		40400	15600					2424	1716
1960								1	0	9	2093		2103	6607		36200	21200					2172	2332
1961								32	0	144	1941		2117	5710		36600	12700					2196	1397
1962								4	0	21	1528		1552	4343		29100	9500					1746	1045
1963								5	0	34	974		1013	3947		33500	8400					2010	924
1964								2	0	0	556		558	3593		35000	8500					2100	935
1965								1629	0	398	1135		3162	5923		26400	10700					1584	1177
1966								2041	0	46	596		2683	5666		22400	14900					1344	1639
1967								2911	0	8	1959		4878	8721		20600	23700					1236	2607
1968								1504	0	5	3253		4762	8660		22800	23000					1368	2530
1969								3591	0	63	5044		8698	14141		27100	34700					1626	3817
1970								4662	0	16	9782		14461	20622		24400	42700					1464	4697
1971	3131	21861	1815				26807							26807		23500	31200	1815	3131	0.08	0.10		

1972	2529	23337	1224	260			27350							27350		29900	47800	1224	2529	0.04	0.05		
1973	3614	18587	254	143			22598							22598		30800	38900	254	3614	0.01	0.09		
1974	5894	27489	3194	1116	945		38638							38638		21199	39608	3194	5894	0.15	0.15		
1975	4790	18244	813	630	26		24503							24503		25645	29752	813	4790	0.03	0.16		
1976	3205	16401	651	989			21246							21246		20466	22227	651	3205	0.03	0.14		
1977	3331	11498	85	500			15414							15414		4164	23436	85	3331	0.02	0.14		
1978	2371	8432	174	98			11075							11075		4201	27717	174	2371	0.04	0.09		
1979	1805	10078	455				12338							12338		3596	27454	455	1805	0.13	0.07		
1980	1340	9272	1				10613							10613		6126	36917	1	1340	0.00	0.04		
1981	283	4094					4377							4377		6952	29926			0.00	0.00		
1982	300	3375				1180	4855							4855									
1983	860	3025	48				3933							3933						0.06	0.11		
1984	1084	2982					4066							4066									
																Estimates of maximum likely catch for 7.a(N) incl. of French and ROI catches							
Column No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		17		18		19	
	ICES table						British Isles catches							CATCH IN ASSESS-MENT		NE Atlantic catch		ICES 7a catch		% of NE atlantic		max likely catch	
	Ireland	UK	France	Netherlands	USSR/ Russia	Unallocated	Total	England	Northern Ireland	Wales	Manx	Irish	Total			France	Ireland	France	Ireland	France	Ireland	France	Ireland
1985	1000	4077				4110	9187							9187									
1986	1640	4376				1424	7440							7440									
1987	1200	3290				1333	5823							5823									
1988	2579	7593					10172							10172									
1989	1430	3532					4962							4962									
1990	1699	4613					6312							6312									
1991	80	4318					4398							4398									

1992	406	4864		5270	5270
1993	0	4408		4408	4408
1994	0	4828		4828	4828
1995	0	5076		5076	5076
1996	100	5180	22	5302	5302
1997	0	6651		6651	6651
1998	0	4905		4905	4905
1999	0	4127		4127	4127
2000	0	2002		2002	2002
2001	862	4599		5461	5461
2002	286	2107		2393	2393
2003	0	2399		2399	2399
2004	749	1782		2531	2531
2005	1153	3234		4387	4387
2006	581	3821		4402	4402
2007	0	4629		4629	4629
2008	0	4895		4895	4895
2009	0	4594		4594	4594
2010	0	4894		4894	4894

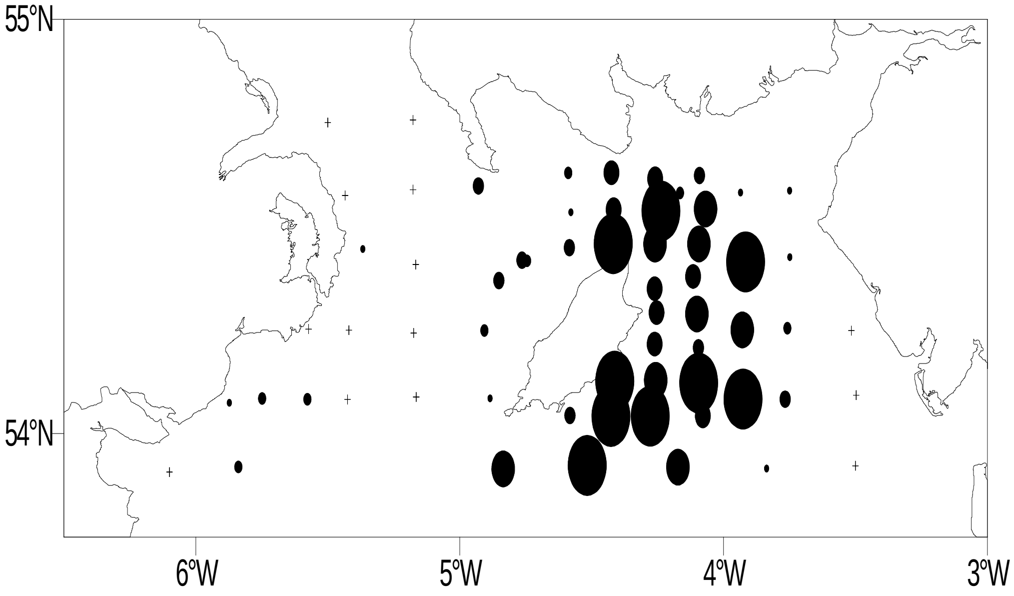
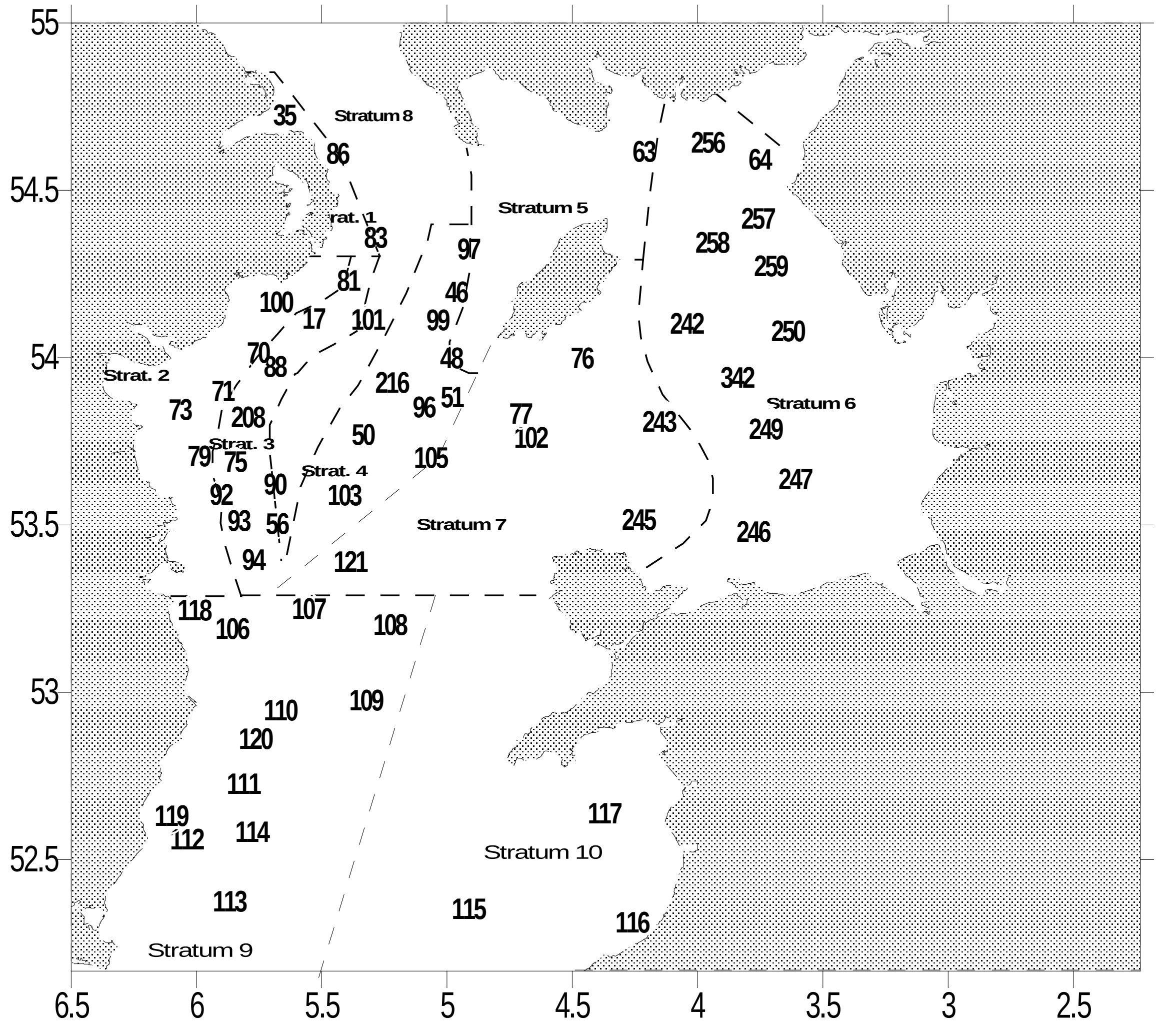


Figure 1. Sampling stations for larvae in the North Irish Sea (NINEL). Sampling is undertaken in November each year.



Key to strata: 1. Irish Coast (N), <100m, Mixed sediments
2. Irish Coast, < 50m, sand and finer sediments
3. Irish Coast, 50 - 100m, Muddy sediments
4. W and SW Isle of Man, 50 - 100m, mud and muddy sand
5. N Isle of Man, <50m, gravel sediments
6. Eastern Irish Sea, <50m, sand and finer sediments
7. S. Isle of Man, <100m, gravel sediments
8. Deep western channel and North Channel >100m
9. St George's Channel west; sandy/mixed sediments; <100m
10. St George's Channel east; sandy/mixed sediments; <100m

Figure 2. Standard station positions for DARD groundfish survey of the Irish Sea in March and October. Boundaries of survey strata are shown. Indices for the "Western Irish Sea" use data from strata 2 - 4. Indices for the "Eastern Irish Sea" use data from stratum 6 only (few juvenile herring are found in stratum 7). (Note different stratification to Fig. 1.). New stations fished in the St Georges Channel (strata 9 and 10) since October 2001 are not included in the survey indices. Stratum 5 (1 station only in recent years) is also excluded from the index. There are no stations in stratum 8 due to difficult trawling conditions for the gear used in the survey. Station 121 in stratum 7 has been fished only once and is excluded from the index.

Table 3. Irish Sea Herring Division 7.a(N). Mean weights-at-age in the catch.

Year	Weights-at-age (g)							
	Age (rings)							
	1	2	3	4	5	6	7	8+
1985	87	125	157	186	202	209	222	258

1986	68	143	167	188	215	229	239	254
1987	58	130	160	175	194	210	218	229
1988	70	124	160	170	180	198	212	232
1989	81	128	155	174	184	195	205	218
1990	77	135	163	175	188	196	207	217
1991	70	121	153	167	180	189	195	214
1992	61	111	136	151	159	171	179	191
1993	88	126	157	171	183	191	198	214
1994	73	126	154	174	181	190	203	214
1995	72	120	147	168	180	185	197	212
1996	67	116	148	162	177	199	200	214
1997	64	118	146	165	176	188	204	216
1998	80	123	148	163	181	177	188	222
1999	69	120	145	167	176	188	190	210
2000	64	120	148	168	188	204	200	213
2001	67	106	139	156	168	185	198	205
2002	85	113	144	167	180	184	191	217
2003*	81	116	136	160	167	172	186	199
2004	73	107	130	157	165	187	200	205
2005	67	103	136	156	166	180	191	209
2006	64	105	131	149	164	177	184	211
2007	67	112	135	158	173	183	199	227
2008	71	110	135	153	156	182	196	206
2009*	68	107	133	155	165	182	194	212
2010	53	106	131	145	153	164	175	172

*** Average for the preceding five years**

Table 4. Irish Sea Herring Division 7.a(N). Mean length-at-age in the catch.

YEAR	LENGTHS-AT-AGE (CM)							
	Age (rings)							
	1	2	3	4	5	6	7	8+
1985	22.1	24.3	26.1	27.6	28.3	28.6	29.5	30.1
1986	19.7	24.3	25.8	26.9	28.0	28.8	28.8	29.8
1987	20.0	24.1	26.3	27.3	28.0	29.2	29.4	30.1
1988	20.2	23.5	25.7	26.3	27.2	27.7	28.7	29.6
1989	20.9	23.8	25.8	26.8	27.8	28.2	28.0	29.5
1990	20.1	24.2	25.6	26.2	27.7	28.3	28.3	29.0
1991	20.5	23.8	25.4	26.1	26.8	27.3	27.7	28.7
1992	19.0	23.7	25.3	26.2	26.7	27.2	27.9	29.4
1993	21.6	24.1	25.9	26.7	27.2	27.6	28.0	28.7
1994	20.1	23.9	25.5	26.5	27.0	27.4	27.9	28.4
1995	20.4	23.6	25.2	26.3	26.8	27.0	27.6	28.3
1996	19.8	23.5	25.3	26.0	26.6	27.6	27.6	28.2
1997	19.6	23.6	25.1	26.0	26.5	27.1	27.7	28.2
1998	20.8	23.8	25.2	26.1	27.0	26.8	27.2	28.7

1999	19.8	23.6	25.0	26.1	26.5	27.1	27.2	28.0
2000	19.7	23.8	25.3	26.3	27.1	27.7	27.7	28.1
2001	20.0	22.9	24.8	25.7	26.2	26.9	27.5	27.8
2002	21.1	23.1	24.8	26.0	26.6	26.7	27.0	28.1
2003	21.1	23.7	25.0	26.5	26.9	27.1	27.8	28.5
2004	20.7	23.1	24.6	25.8	26.1	27.1	27.6	28.3
2005	20.0	22.6	24.5	25.5	26.0	26.6	27.1	27.8
2006	19.5	22.7	24.3	25.3	26.0	26.6	26.9	28.0
2007	20.1	23.0	24.1	25.1	25.8	26.2	26.7	27.8
2008	20.0	22.7	24.1	25.0	25.2	26.3	26.9	27.3
2009*	-	-	-	-	-	-	-	-
2010	19.2	23.2	24.3	25.0	25.2	25.8	26.3	26.1

***no commercial samples available**

Table 5. Irish Sea Herring Division 7.a (N). Catch-at-length for 1990-2010. Numbers of fish in thousands.

Length	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
14															
14.5															
15			95												
15.5			169							10					
16	6		343			21	21	17		19	12	9			
16.5	6	2	275			55	51	94		53	49	27			13
17	50	1	779		84	139	127	281	26	97	67	53			25
17.5	7	4	1106		59	148	200	525	30	82	97	105			84
18	224	31	1263		69	300	173	1022	123	145	115	229			102
18.5	165	56	1662		89	280	415	1066	206	135	134	240	36		114
19	656	168	1767	39	226	310	554	1720	317	234	164	385	18		203
19.5	318	174	1189	75	241	305	652	1263	277	82	97	439	0	29	269
20	791	454	1268	75	253	326	749	1366	427	218	109	523	0	73	368
20.5	472	341	705	57	270	404	867	1029	297	242	85	608	18	215	444
21	735	469	705	130	400	468	886	1510	522	449	115	1086	307	272	862
21.5	447	296	597	263	308	782	1258	1192	549	362	138	1201	433	290	1007
22	935	438	664	610	700	1509	1530	2607	1354	1261	289	1748	1750	463	1495
22.5	581	782	927	1224	785	2541	2190	2482	1099	2305	418	1763	1949	600	2140
23	2400	1790	1653	2016	1035	4198	2362	3508	2493	4784	607	2670	2490	1158	2089
23.5	1908	1974	1156	2368	1473	4547	2917	3902	2041	4183	951	2254	1552	1380	2214
24	3474	2842	1575	2895	2126	4416	3649	4714	3695	4165	1436	3489	1029	1273	2054
24.5	2818	2311	2412	2616	2564	3391	4077	4138	2769	3397	1783	4098	758	1249	2269
25	4803	2734	2792	2207	3315	3100	4015	5031	2625	2620	2144	5566	776	1163	1749
25.5	3688	2596	3268	2198	3382	2358	3668	3971	2797	1817	1791	4785	1335	1211	1206
26	4845	3278	3865	2216	3480	2334	2480	3871	3115	1694	1349	3814	1570	1140	823
26.5	3015	2862	3908	2176	2617	1807	2177	2455	2641	1547	840	2243	1552	1573	587
27	3014	2412	3389	2299	2391	1622	1949	1711	2992	1475	616	1489	776	1607	510
27.5	1134	1449	2203	2047	1777	990	1267	1131	1747	867	479	644	433	1189	383
28	993	922	1440	1538	1294	834	906	638	1235	276	212	496	162	726	198

28.5	582	423	569	944	900	123	564	440	170	169	58	179	108	569	51
29	302	293	278	473	417	248	210	280	111	61	42	10	36	163	
29.5	144	129	96	160	165	56	79	59	92		12	0	36	129	
30	146	82	70	83	9	40	32	8	84		6	9		43	
30.5	57	36	36	15	27	5	0	5	3					43	
31	54	12	2	4		1	2							43	
31.5	31	3													
32	29														
32.5															
33															
33.5															
34															

Table 5 (continued). Irish Sea Herring Division 7.a (N). Catch-at-length for 1990-2010. Numbers of fish in thousands.

Length	2005	2006	2007	2008	2009*	2010
14					-	
14.5					-	
15					-	
15.5			16		-	93
16		2			-	107
16.5	1	44	33	1	-	487
17	39	140	69	3	-	764
17.5	117	211	286	11	-	1155
18	291	586	852	34	-	1574
18.5	521	726	2088	64	-	1405
19	758	895	2979	85	-	866
19.5	933	1246	3527	108	-	673
20	943	984	3516	100	-	787
20.5	923	1443	2852	133	-	888
21	1256	1521	3451	192	-	1470
21.5	1380	1621	2929	217	-	1758
22	1361	2748	3821	271	-	2363
22.5	1448	3629	3503	229	-	3362
23	1035	4358	4196	322	-	4530
23.5	1256	2920	3697	264	-	5232
24	1276	3679	3178	259	-	4559
24.5	1083	2431	2136	204	-	3616
25	1086	3438	1503	148	-	3083
25.5	584	2198	952	114	-	2582
26	438	1714	643	78	-	1777
26.5	203	605	330	42	-	950
27	165	445	147	23	-	460
27.5	60	155	72	10	-	216
28	45	104	33	12	-	9
28.5	18	9	26	1	-	

29	12	46		-	9
29.5			7	-	
30				-	
30.5				-	
31				-	
31.5				-	
32				-	
32.5				-	
33				-	
33.5				-	
34				-	

***no commercial samples available.**

Table 6. Irish Sea herring Division 7.a(N). Northern Ireland groundfish survey indices for herring (Nos. per 3 miles). (a) 0-ring herring: October survey

	Western Irish Sea			Eastern Irish Sea			Total Irish Sea		
Survey	Mean	N.obs	SE	Mean	N.obs.	SE	Mean	N. obs	SE
1991	54	34	22						
1992	210	31	99	240	8	149	177	46	68
1993	633	26	331	498	10	270	412	44	155
1994	548	26	159	8	7	5	194	41	55
1995	67	22	23	35	9	18	37	35	11
1996	90	26	58	131	9	79	117	42	50
1997	281	26	192	68	9	42	138	43	70
1998	980	26	417	12	9	10	347	43	144
1999	389	26	271	90	9	29	186	43	96
2000	202	24	144	367	9	190	212	38	89
2001	553	26	244	236	11	104	284	45	93
2002	132	26	84	18	11	10	63	45	31
2003	1203	26	855	75	11	47	446	45	296
2004	838	26	292	447	11	191	469	45	125
2005	1516	26	1036	256	11	152	627	45	363
2006	4677	26	2190	2140	11	829	2468	45	822
2007	215	26	82	263	11	114	177	45	52
2008	1075	26	436	540	11	505	599	45	247
2009	3073	26	1803	8908	11	4186	4499	45	1730
2010	2123	26	974	6071	11	2844	3075	45	1147

Table 6. (Continued) Irish Sea herring Division 7.a(N). Northern Ireland groundfish survey indices for herring (Nos. per 3 miles). (b) 1-ring herring: March Surveys.

	Western Irish Sea			Eastern Irish Sea			Total Irish Sea		
Survey	Mean	N.obs	SE	Mean	N.obs.	SE	Mean	N.obs	SE
1992	392	20	198	115	10	73	190	34	77
1993	1755	27	620	175	10	66	681	45	216
1994	2472	25	1852	106	9	51	923	39	641

1995	1299	26	679	73	8	32	480	42	235
1996	1055	22	638	285	9	164	487	39	230
1997	1473	26	382	260	9	96	612	43	137
1998	3953	26	1331	250	9	184	1472	43	466
1999	5845	26	1860	736	9	321	2308	42	655
2000	2303	26	853	546	10	217	1009	44	306
2001	3518	26	916	1265	11	531	1763	45	381
2002a	2255	25	845	185	11	84	852	44	294
2002b	7870	26	5667	185	11	84	2794	45	1960
2003	2103	26	876	896	11	604	1079	45	382
2004	6611	25	2726	491	11	163	2486	44	945
2005	7274	26	3097	1240	8	375	3001	42	1121
2006	4249	26	1687	2630	11	813	2496	45	662
2007	9340	26	3051	631	11	388	3480	45	1066
2008	2310	26	568	404	11	141	956	45	204
2009	11738	26	2853	1490	11	664	4638	45	1357
2010	2327	26	525	6304	11	3782	3272	45	1470

a. Unusually large catch removed, b. unusually large catch retained.

Table 6. (Continued) Irish Sea herring Division 7.a(N). Northern Ireland groundfish survey indices for herring (Nos. per 3 miles.). (c) 1-ring herring: October Surveys

	Western Irish Sea			Eastern Irish Sea			Total Irish Sea		
Survey	Mean	N.obs	SE	Mean	N.obs.	SE	Mean	N.obs	SE
1991	102	34	34	n/a	n/a	n/a	n/a	n/a	n/a
1992	36	31	18	20	8	11	21	46	8
1993	122	26	66	4	10	2	44	44	23
1994	490	26	137	17	6	10	176	40	47
1995	153	22	61	3	9	1	55	35	21
1996	30	26	13	2	9	1	11	42	5
1997	612	26	369	0.2	9	0.2	302	43	156
1998	39	26	15	13	9	10	53	43	35
1999	81	26	41	104	9	95	74	43	40
2000	455	24	250	74	9	52	579	38	403
2001	1412	26	641	5	11	3	513	45	223
2002	370	26	111	4	11	2	291	45	158
2003	314	26	143	410	11	350	267	45	144
2004	710	26	298	103	11	74	299	45	108
2005	3217	25	1467	18	11	12	1121	44	507
2006	1458	26	669	40	11	18	523	45	231
2007	6194	26	3169	1569	11	1379	2758	45	1218
2008	1922	26	1207	1930	11	1210	1410	45	626
2009	3169	26	2115	112	11	55	1146	45	732
2010	2318	26	1115	173	11	72	935	45	391

Table 7. Irish Sea Herring Division 7.a (N). Larval production (10^{11}) indices for the Manx component.

Year	Douglas Bank		
		Isle of Man	
	Date	Production	SE
1989	26 Oct	3.39	1.54
1990	19 Oct	1.92	0.78
1991	15 Oct	1.56	0.73
1992	16 Oct	15.64	2.32
1993	19 Oct	4.81	0.77
1994	13 Oct	7.26	2.26
1995	19 Oct	1.58	1.68
1996			
1997	15 Oct	5.59	1.25
1998	6 Nov	2.27	1.43
1999	25 Oct	3.87	0.88