Stock Annex: Whiting (*Merlangius merlangus*) in divisions 7.b –c and 7.e–k (southern Celtic Seas and eastern English Channel)

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Whiting
Working Group	Working Group for the Celtic Seas Ecoregion (WGCSE)
Last updated	4 February 2014
Last updated by	David Stokes at WGCSE 2019

General

Historically this stock has been managed by TAC covering 7.b,k while the assessment area considered only 7.e,k. Having reviewed the available information, the WKCELT Benchmark proposed inclusion of 7.b,c within an overall 7.b,k assessment and management area, but excluding 7.d.

Found in the shelf seas of Iceland and Northern Norway to north coast of Portugal in the south and western Baltic, Mediteranean, Agean, Adriatic and Black Seas in the east (Hureau, 1984). Voracious feeders appearing in large shoals; feeding largely on crustaceans and increasingly small fish with age (Hureau, 1984). Generally found from 30–100 m over sandy/muddy ground, juveniles found close inshore. Considered "shy" by Day ((Day, 1880) whiting tend to remain 0.5–3 miles off the coast and are also reported susceptible to the influence of cold by the same author, moving to deeper water with temperature changes of a few degrees.

http://www.fishbase.org/summary/Merlangius-merlangus.html

A.1. Stock definition

The degree of separation of whiting stocks between the Irish Sea, North Sea and ICES Divisions 7.b–c from the Celtic Sea, is currently not conclusive. Genetic studies suggest NE Atlantic whiting, including northern North Sea is quite genetically homogeneous. In contrast potentially low levels of structuring has been suggested between this NE stock and that in the southern Bay of Biscay as well as within the Irish Sea and particularly the North Sea (Charrier, Coombs, McQuinn, and Laroche, 2007).

Since 2012 Irish landings of cod, haddock and whiting, reported from ICES rectangles immediately north of the Irish Sea–Celtic Sea boundary (ICES rectangles 33E2 and 33E3) have been reallocated into the Celtic Sea. These represent a combination of inaccurate area reporting and catches considered by ICES to be part of the Celtic Sea stocks (ICES, 2009). WKROUND 2012 reviewed this practice and concluded it should continue in the future.

See WKCELT 2014 report for brief overview of stock structure.

A.2. Fishery

Whiting in Divisions 7.b,c and e–k are taken as a component of catches in mixed demersal trawl and seine fisheries. The whiting landings data for 2012 from the STECF database are mapped in Figure A.2.1. The spatial distribution shows that whiting landings were concentrated in several discrete areas in western waters and the North Sea. Within this stock area there are two regions with a higher volume of landings i) 7.g and

the east part of 7.j (Celtic Sea Shelf); ii) 7.e (western Channel). The landings by country shows 7.b–k whiting are mostly taken by Ireland and France. For the 2014 benchmark officially reported whiting landings were reconstructed back to 1904 from the ICES databases.

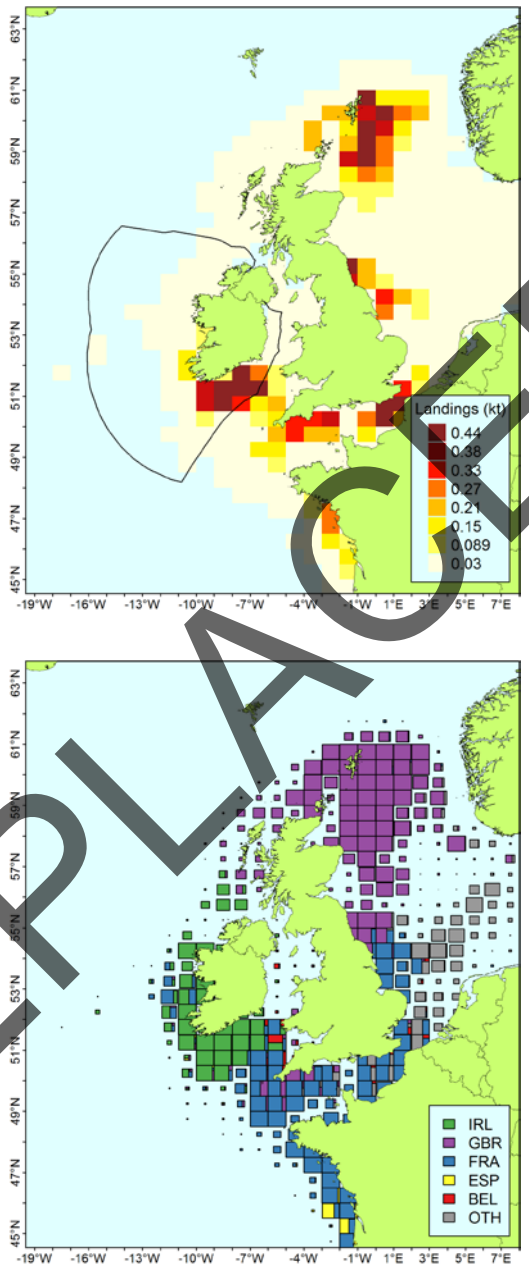

Figure A.2.1. Spatial distribution of whiting landings in 2012 (left panel); Landings by country 2012 (right panel).

Figure A.2.2 shows that landings over time have fluctuated considerably. The underlying trend has been an increase in landings from less than 5000 t in the 1950s to a peak of around 20 000 t in the late 1980s and 1990s. Since then landings shown a declining trend.

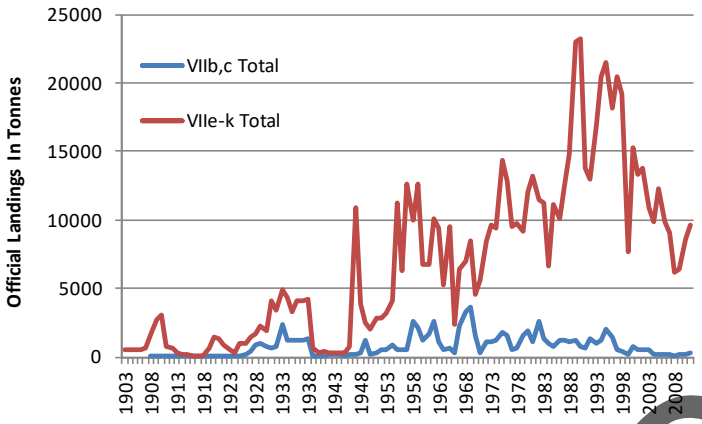

Figure A.2.2. Official landings in tonnes.

Further details can be found in the WKCELT 2014 Report.

A.3. Ecosystem aspects

There is some evidence of a relationship between whiting mean weight-at-age in the Celtic Sea and herring abundance. This was discussed briefly at WKCELT and summarised in the WKCELT report.

B. Data

B.1. Commercial catch

Data on international landings-at-age and mean weight-at-age are available for Irish, French and UK fleets from 1999 to present. Data made available through InterCatch from the fishing year 2012 onwards are already raised to 7.b,c,e,k. The Table below presents the data available and the procedures used to derive quarterly length compositions, age compositions and mean weights-at-age.

National landings are used to raise the national length–frequency and age-sampling data in the first instance. Thereafter, landings for countries without sampling are used to raise the sampling of another national fleet with similar dynamics. These allocations on average count for significantly less than 2% annually.

1) Annual quarterly length, age and mean catch weights data for each country are raised by ICES division to the total landings for that division.

2) Where countries have additional landings by ICES division for which they have no sampling, these landings are used to raise the national length weight and age data to the national annual landings figure.

3) A small number of countries with minimal landings have no sampling available. To reach a final international catch numbers-at-age figure these landings are used to scale the raised national numbers-at-age data from an appropriate other nation. Given the fleet characteristics landings from Belgium, Jersey and Gurnsey have been allocated to the UK, landings from UK Scotland and UK Northern Ireland have been allocated to Ireland.

Division	Data	UK	France	Ireland	Belgium* /Other**	Derivation of international landings:
7.b,k	Length composition	7.b–k	7.b–k	7.b–k		7.b,k
	ALK	7.b–k	7.b–k	6.b–k		7.b,k
	Age Composition	7.b–k	7.b–k	7.b–k		7.b,k
	Mean weight-at-age	7.b–k	7.b–k	7.b–k		7.b,k Weighted by numbers caught
	Landings	7.b,k	7.b,k	7.b,k	7.b,k	7.b,k

*** Belgian landings used to raise quarterly length, age and weight-at-age data from the UK.**

**** Others cover UK Scotland and UK Northern Ireland (allocated to Ireland) and Jersey and Gurnsey (allocated to the UK).**

B.2. Biological

Age group 0 is included in the assessment data to allow inclusion of 0-group indices in the XSA, although in most years, no landings are recorded. However, inclusion of discards for the recent time-series (1999–present) has provided more significant 0-group data for the final catch numbers-at-age file. Mean weights-at-age in the catch were derived by combining landings and discards weight-at-age data, divided by the combined landings and discard numbers-at-age.

With the inclusion of discards and consequential difficulty in generating quarterly mean weights-at-age, it was decided at WKCELT to use the NOAA NFT Calculator Utility (v2.1) which applies a Rivard correction to annual weights-at-age data to produce the January 1st whiting stock weights for the catch. Stock weights are quite variable and need to be monitored on an ongoing basis!

Assumed natural mortality has been modified from the fixed value of 0.2 for all ages to values depending on the mean weight-at-age according to the Lorenzen power function.

Age	0	1	2	3	4	5	6	7+
Nat.mortality	1.22	0.86	0.65	0.5	0.43	0.40	0.38	0.36

Maturity data collected in the Irish Q1 Biological Groundfish Survey 2004–2009 survey were presented to the WG (Working Document 1: WGCSE 2013). Results indicated 34% of age 1 females and 60% of male fish are mature. For age 2 fish 99% female and 94% males were mature with full maturity occurring at approximately age 3 and older. However, since the estimates of proportions mature at-age one and even more the estimates of abundance at-age two, the decision was made by the 2014 WKCELT benchmark to use the 2+ biomass as a proxy for the SSB. This is in line with the practise for the other whiting stocks in the region. The proportions of F and M before spawning were both set to zero to reflect the SSB calculation date of 1 January.

Age	0	1	2	3	4	5	6	7+
Maturity	0	0	1.00	1.00	1.00	1.00	1.00	1.00

B.3. Surveys

The 2014 WKCELT benchmark decided to use a combined survey index as the only tuning index for the assessment. This index is obtained by combining the Q4 IBTS survey of Irish Groundfish Survey (IGFS) in areas 7.b,g,j and the French EVHOE survey in 7.e,h,j (Figure 1). The method used to combine the surveys is to apply an ALK to the raised whiting length–frequency for each haul within a spatial grid of 0.5◦Lon x 0.25◦Lat. The mean number-at-age within each grid cell are then summed to produce an annual combined survey index. The grid method and cell size was based on a previous analysis used for Celtic Sea cod (WD 12, WKROUND 2012).

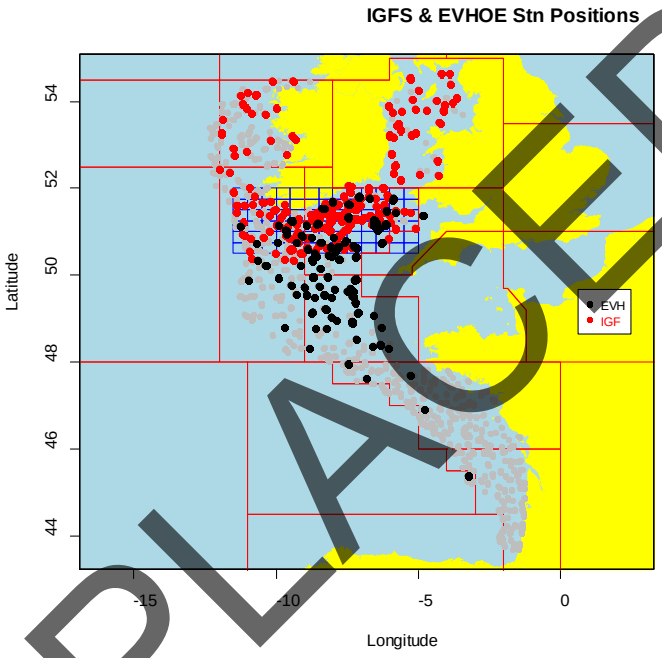

Figure 1. Map of all survey hauls collated for the index calculations. Positive Irish survey catches (IGF) in red, positive French survey catches (EVH) in black. Data are aggregated using a cell size of 0.25 deg Latitude by 0.5 deg Longitude.

B.4. Commercial cpue

Both the French and Irish commercial cpue data were eliminated from the assessment during the 2014 benchmark due to strong trends in residuals.

B.5. Other relevant data

Discards

Discards were made available by Ireland (WD x, WKCELT 2014) and France, the two main exponents of the fishery. The discards for both countries were raised by taking the ratio of annual effort (Hrs) of discard trips proportional to the effort (Hrs) for the landings of the appropriate fleet. Resolution of the discard data for either country precluded stratification by quarter and age, and as such the numbers-at-length were raised by effort per year and further allocated to age by length split. The Irish length split was used for Irish and French data alike.

The time-series for Irish discards is from 1995 to present, but truncated in WKCELT as 1999 to present. French data was available for 2004 to present. This was extrapolated

back to 1999 based on the annual ratio of numbers-at-age between discards:landings within the discard time-series for ages 2–4. Where historically age groups 0–1 would not be represented in the landings the ratio used to generate discards-at-age from the historical landings were based on age 1 discards:age 2 landings and age 0 discards: age 2 landings within the discard time-series available.

Recruitment

Cohort tracking of 0-grp fish is not very consistent with this stock and therefore recruitment is in the current year is given as the geometric mean of the time-series (1999–present) minus the estimate for the last year.

C. Historical stock development

Model used: XSA

Software used: R version 2.14 in conjunction with FLCore 2.5 and FLXSA 2.0. Lowestoft VPA95 software also for XSA and separable VPA

Model Options:

Option	Setting
F_{BAR}	2–5
Weightings Required	F_{bar}
Ages Used	0–7+
First Age for Stock Size Indep. Catchability	0
Q plateau	5
Taper	No
F shrinkage SE	1.00
F shrinkage year range	5
F shrinkage age range	3
Fleet SE threshold	0.50
Prior weights	No

Input data types and characteristics:

Type	Name	Year range	Age range	Variable year to year
Caton	Catch in tonnes	1999–current	0–7+	Yes
Canum	Catch-at-age in numbers	1999–current	0–7+	Yes
Weca	Weight-at-age in the commercial catch	1999–current	0–7+	Yes
West	Weight-at-age of the stock at spawning time	1999–current	0–7+	Yes
Mprop	Proportion of natural mortality before spawning	1999–current	0–7+	No
Fprop	Proportion of fishing mortality before spawning	1999–current	0–7+	No
Matprop	Proportion mature-at-age	1999–current	0–7+	No
Natmor	Natural mortality	1999–current	0–7+	No

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1	IGFSEVHOE (combined IBTS Q4 and EVHOE)	2003–current	0–5

D. Short-term projection

Model used: Multi Fleet Deterministic Projection

Software used: MFDP1a

Initial stock size: initial stock numbers derived from XSA analyses. Numbers-at-age 0 are not considered to be well estimated and are replaced with a geometric mean of the full time-series (1999–present) less the final year only.

Natural mortality: That used in the assessment

Maturity: Maturity ogive used in the assessment

F and M before spawning: Those used in the assessment method

Weight-at-age in the stock: Rivard corrected mean catch weights

Weight-at-age in the catch: Raw mean catch weights-at-age

Exploitation pattern: Unscaled three year arithmetic mean (though alternative options may be used depending on recent F trajectories and the Working Group's perception of the fishery).

Intermediate year assumptions: *Status quo* F

Stock–recruitment model used: Geometric mean of full time-series (1999 to present-1) for age 0 recruitment

F_{BAR}: That used in the assessment

E. Medium-term projections

F. Long-term projections

Model used: Multi Fleet Yield-per-recruit

Software used: MFYPR2a

Yield-per-recruit calculations are conducted using the same input values as those used for the short-term forecasts.

G. Biological reference points

A summary of reference point proposals to date, their technical basis and currently adopted reference points is given in the text table below:

	WG 1998	ACFM 1998	WG 2000	ACFM 2000
F_{lim}	No Proposal	No Proposal	1.18 (Flim=Floss)	No Proposal
F_{pa}	No Proposal	No Proposal	0.72 ($F_{pa}=F_{lim} \times e^{-1.645 \times 0.3}$)	No Proposal
B_{lim}	15,000 t	15,000 t	15 000 t (Blim=Bloss)	15,000 t (Blim=Bloss)
B_{pa}	18,000 t	21,000 t	21 000 t (Bpa=Bloss x 1.4)	21,000 t (Bpa=Bloss x 1.4)

Since the assessment has been revised, and some of these revisions lead to rescaling of the assessment, revised reference points are proposed. The table below summarizes the proposed values. With F_{MSY} and $B_{MSY\ trigger}$ in place, it is assumed that F_{PA} and B_{PA} are redundant.

	Value	Basis
B_{lim}	25 000	B_{loss}
$B_{MSY\ trigger}$	40 000	Lower bound of expected SSB-range at $F_{0.1}$ and B_{loss}*1.6
F_{lim}	0.5	Increasing risk to B_{lim}
F_{MSY}	0.32	$F_{0.1}$

H. Other issues