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Stock Annex: Cuckoo ray (*Leucoraja naevus*) in Division 678abd (West of Scotland, southern Celtic Seas, western English Channel and Bay of Biscay)

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Cuckoo ray (*Leucoraja naevus*) in Division 678abd (West of Scotland, southern Celtic Seas, western English Channel and Bay of Biscay)
Working Group:	Working Group on Elasmobranch Fishes (WGEF)
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A. General

A.1. Stock definition

The stock structure of the species along the all ICES areas is unknown, although migrations between different areas are admitted (ICES, 2013. Further studies to better understand stock structure are required. Such studies are needed for *L. naevus* and other offshore species, such as *L. fullonica, L. circularis* or *Dipturus* spp., which may have a degree of connectivity between this ecoregion (Celtic Sea, Irish Sea and NW Scotland) and adjacent ICES Divisions in other ecoregions (4.a, 8).

The stock was formerly included in the management unit of the demersal elasmobranch in the Bay of Biscay and Iberian waters ecoregion (rjn.27.bisc). Since 2015, the cuckoo ray from ICES subareas 6 and 7 in the Celtic seas ecoregion and the northern Bay of Biscay is considered to form one single stock

A.2. Distribution

The cuckoo ray *Leucoraja naevus* is a species with a wide geographic distribution in the northeast Atlantic. It occurs off coasts northward from the Shetland Isles and southern Norway in the north, to Morocco and Senegal in the south (Stehmann and Bürkel, 1984; Whitehead *et al.*, 1986). It is also widespread in the Mediterranean Sea, it occurs in northern, western and central-eastern waters, excluding the Adriatic Sea.

Cuckoo ray (*Leucoraja naevus*) is common in the Irish Sea, Celtic Sea and northern North Sea at depths of 12–290 m. This species was rarely recorded in the eastern English Channel and southern North Sea (Ellis *et al*., 2005).

A.3. Fishery

Most skate species in the Celtic Seas ecoregion are taken as a bycatch in various mixed demersal fisheries, which are usually either directed at flatfish or gadoids. The main countries involved in these fisheries are France, United Kingdom, Belgium and Ireland, with smaller catches by Spain, Norway and the Netherlands. The main gears used are otter trawl, beam trawl and bottom-set gillnets.

L. naevus is one of the most common species in the French trawl demersal fishery along the Bay of Biscay (8.abd) making approximately 65% of the total rays landing in this subarea since 1999.

European fishery regulations have required species-specific landings data to be reported for the main commercial skate species since 2009 and, whilst an increasing proportion of landings are reported to species-level, there are some issues with regards the accuracy of identification or codings used. The accuracy of data varies between nations.

A TAC for skates in Subarea 6 and divisions 7.a–c and 7.e–k was first established for 2009 and set at 15 748 t. Since then, the TAC has been reduced by approximately 15% (in 2010), 15% (in 2011), 13% (in 2012), 10% (in 2013) and a further 10% (in 2014). In 2017, the TAC was increased by 5%, (including separate TAC for R. microocellata), and in 2018, this was increased by a further 15% (including separate TAC for R. microocellata and R. undulata).

A.4. Ecosystem aspects

It is a demersal species found in depth range 20–500 m, but usually 20–250 m. It seems to be more abundant sandy and muddy bottoms.

These observer programmes, funded under the EU Data Collection Framework, routinely collect species and length data from commercial and non-commercial species. A study carried out by Johnston *et al*., (2014 WD) based on this data provided information on some aspects such as location of nursery areas (Figure 1).

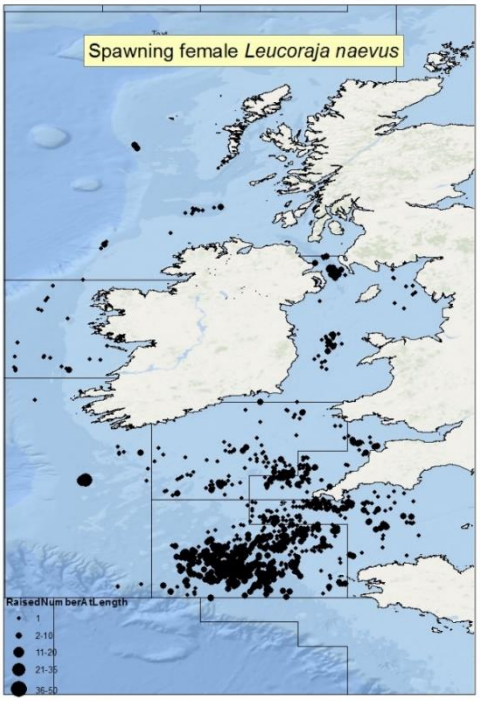

Figure 1. Nominal locations of potential nursery areas and areas with adult females during Q2 of *Leucoraja naevus*. Source: Irish, UK and French discard observer programmes, Subareas 6 and 7 only.

B. Data

B.1. Commercial catch

The landing estimates (tonnes) of this species in subareas 6–7 and 8.abd since 2005 are given in the table below (Table 1). Increasing landings might be ascribed to the reporting of rays and skates landings in an aggregated category in earlier years.

Table 1. Landings (tns) of *L. naevus* by fishing area for rjn.27.678abd stock

	ICES AREAS		
Year	6	7	8abd
2005	46	1828	1290
2006	40	1598	927
2007	37	1536	1002
2008	51	1780	987
2009	70	3028	1310
2010	98	2896	1102
2011	107	2826	982
2012	96	2357	935
2013	55	2014	959
2014	59	2093	1057
2015	70	2076	1214
2016	60	1899	996
2017	54	1835	915
2018	64	1931	1043
2019	62	2126	923
Total	971	31825	15645

Cuckoo ray landings reported by country is presented on Table 2.

Table 2. Landings (tns) of *L. naevus* (rjn.27.678abd) by country from 2005 to 2019.

	BEL	ESP	FRA	GBR	IRL	NLD	Total
2005			3164				3164
2006			2565				2565
2007	0		2575				2575
2008	86	1	2507	225			2819
2009	81	778	3217	321	12		4408
2010	70	480	3069	421	55	0	4096
2011	112	387	2909	402	106		3916
2012	93	311	2571	306	108		3388
2013	97	373	2195	269	93	0	3028
2014	48	300	2515	262	83	0	3209
2015	51	343	2621	266	79		3360
2016	27	372	2233	254	69		2955
2017	26	305	2144	260	69	0	2804
2018	28	335	2288	272	115		3037
2019	25	295	2398	289	103		3111

B.1.2. Discard Data

Discards of skates are known to take place in many fisheries for different reasons such as the capture of smaller (less marketable) individuals, prohibited species, as well as regulatory discards (when vessels have restrictive quota).

Discard estimates are usually obtained from the official data provided by the national DCF programs. However in many cases the historical series are too short or contain significant gaps or missing data and for that reason WGEF members do not consider them as reliable data for the advice calculation of some stocks. Discard information available for *L naevus* (stock rjn.27.678abd) is presented in the Table 3

In WKSHARK3 (ICES, 2017), current sampling programmes for discards were evaluated to examine the suitability for the estimation of discard rates and quantities for the elasmobranch case study considered.

Table 3. Discard estimates (t) by country of *L naevus* stock (rjn.27.678abd).

	Belgium	Spain	France	UK	Ireland
2009				59	857
2010				177	1886
2011				52	746
2012				52	866
2013	67			102	469
2014	42			198	719
2015	48	315		50	673
2016	169	315	820	196	562
2017	859	128	1030	101	597
2018	34	139		207	732
2019	131	241	855	33	
Total	**1351**	**1139**	**2705**	**1227**	**8106**

Belgium fleet in subarea 8

Beam trawl reported only discards of *L. naevus* since 2013. Discards amounts are very variable with a minimum of 34 t in 2018 to a maximum of 859 t in 2017. It is worth noting that part of the reported discards may have been caught in subareas 6 and 7.

UK fleet in Subarea 8

UK only reports discard of L. naevus ranging from from 33 t to 207 t. Notice that part of the reported discards can belong to the subareas 6 and 7.

French fleet in Subarea 8

Gill- and trammel net métiers discard a fraction of large fish, which might be considered as damaged fish (e.g. partly scavenged catch). These discards are dead discards.

In trawl fisheries, due to the low commercial value of small specimens, the mean size of discarded specimens is much smaller than that of landed specimens. It is likely that some discarded specimens may survive.

Spanish fleet in Subarea 8

The IEO "Spanish Discards Sampling Programme" started in 1988, focused on the Spanish trawl fleets operating in the "Celtic Seas" (ICES Subareas 6 and 7) and the "Bay of Biscay and the Iberian coast" (ICES subareas 8 and 9) Ecoregions. However, it did not have annual continuity until 2003, after the Data Collection Regulation (DCR) implementation According to these data, the most discarded skates by Spanish otter fleet (despite annual variations) are *R. clavata,* followed by *R. montagui* and *L. naevus* (see Table 19.3a Chapter 19 ICES WGEF 2020). Discards from the Basque OTB (Bottom Otter Trawler) fleet in Divisions 8.abd indicates that small skate specimens are commonly discarded. *L. naevus* and *R. clavata* are the most discarded species and representing depending on the year 4–51% and 0–52%of the total catches of theses species (Table 4).

Table 4. Estimates (in percentage) of the relationship discards/catches of *L. naevus* and *R. clavata* by the Basque OTB (Bottom otter trawl) in Divisions 8.abd.

Year	*L. naevus*	*R. clavata*
2009	4%	0%
2010	11%	3%
2011	14%	11%
2012	9%	1%
2013	18%	10%
2014	12%	3%
2015	30%	13%
2016	51%	52%
2017	50%	15%
2018	53%	12%
2019	42%	19%

B.2. Biological information

Studies on biological aspects, e.g. age and growth, reproduction, length-weight parameters, and diet are available for this species. The size at maturity is estimated at 55 cm total length (TL) for both males and females (Walker, 1999) with a maximum size of about 72 cm TL (Stehmann and Bürkel 1984, Ellis *et al*. 2005). Age at maturity for females and males is estimated at 7.4 and 6.8 years, respectively, in the North Sea (Walker 1999), and age at 50% maturity is just over four years in the Irish Sea (Gallagher *et al.* 2005). Around the British Isles, males and females first mature at 48 and 45 cm TL, respectively (McCully *et al*. 2012). Additionally, length at 50% maturity (L50) is estimated as 56.3 cm (males) and 59.4 cm (females). There is a significant difference in the L50 for both sexes between the North Sea and Celtic Seas ecoregions, with females and males in the North Sea 6.2 to 6.5 cm smaller at this stage than in the Celtic Seas. The estimated L50 in Portuguese waters is 56.5 and 56 cm TL for females and males,

respectively (Maia *et al.* 2012). Longevity is reported at 12 years (Du Buit, 1976), which in conjunction with an age at 50% maturity of four years would indicate a generation time of eight years for individuals in the Irish Sea.

The maximum potential fecundity is estimated between 60 and 63 mature follicles for spawning-capable and actively spawning females, respectively.. Other studies have indicated that females produce about 90 eggs per year after an eight month gestation period (Clark, 1922; Du Buit, 1976; Bauchot, 1987).

According a recent study carried out in subarea 8 the percentage of adult females in 3a (spawning capable) and 3b (actively spawning) stages indicates that individuals of both stages coexist simultaneously throughout the year and a proportion of the total cuckoo rays sampled (usually <20%) is in spawning stage at any time, except in perhaps the months of June–July and December. (G. Diez, pers. comm.)

B.3. Surveys

The list of fishery-independent surveys undertaken for this stock include:

- The French EVHOE Survey in 8.abd (EVHOE-WIBTS-Q4): 1995–present)
- The Irish groundfish Survey (IGFS-WIBTS-Q4): 2003–present.
- the Spanish IEO survey carried out in Porcupine Bank (SP-PGFS-Q4-IBTS) (ICES Divisions 7c and 7k) since 2001- present.
- The UK (Northern Ireland) Groundfish Survey (NIGFS-WIBTS-Q4) from 1992–present.
- Scottish West Coast Groundfish Survey Q4 (ScoGFS-WIBTS-Q4): 1990–present.
- Rockall survey (Rock-IBTS-Q3): 1991–present.and in Celtic Sea

The French EVHOE survey showed peaks in relative abundance in 2001–2002 and 2007–2008, with the lowest catches in 2000. The relative abundance in the combined Celtic Sea/Biscay region has been increasing in recent years (Figure 2).. However, this survey did not take place in 2017 (Figure 18.3c).

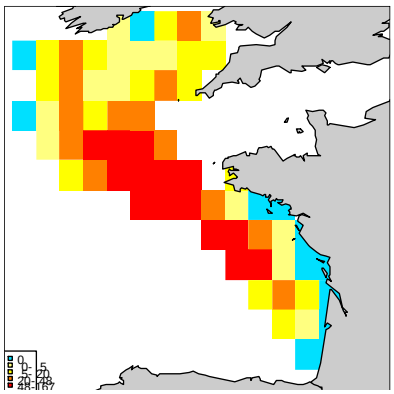

Figure 2. Spatial distribution of catches of cuckoo ray in the EVHOE survey years 1997–2013 combined.

Population indices are available from the EVHOE survey both for the part of the stock in subarea 8 since 1987 and for the enlarged survey coverage in 7 and 8 since 1997 (Figure 3).

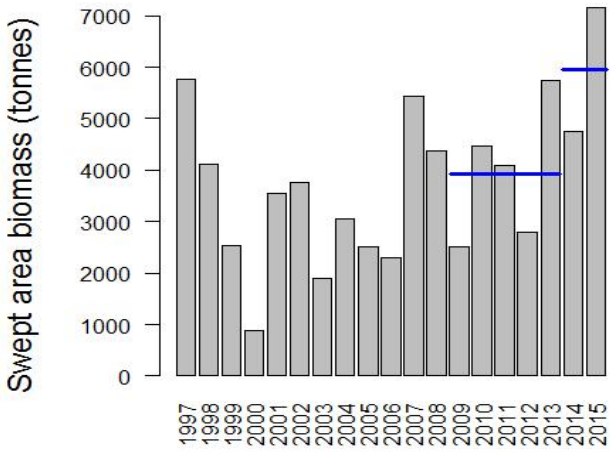

Figure 3. Mean swept-area biomass of *Leucoraja naevus* from the French EVHOE survey (1997–2015). Blue lines indicate mean annual biomass for 2014–2015 and mean annual biomass for 2009–2013.

In Spanish survey on the Porcupine Bank *L. naevus* were found in a shallower stratum around the Bank, (ICES Divisions 7c and 7k) both in the North and South area (Figure 4). The biomass and abundance index of this species indicates this species is not very abundant however in this area however it follows an increasing trend of the previous two years (Figure 5). This survey catches mostly larger fish, from 40 to 60 cm ,with specimens < 30 cm LT sampled infrequently.

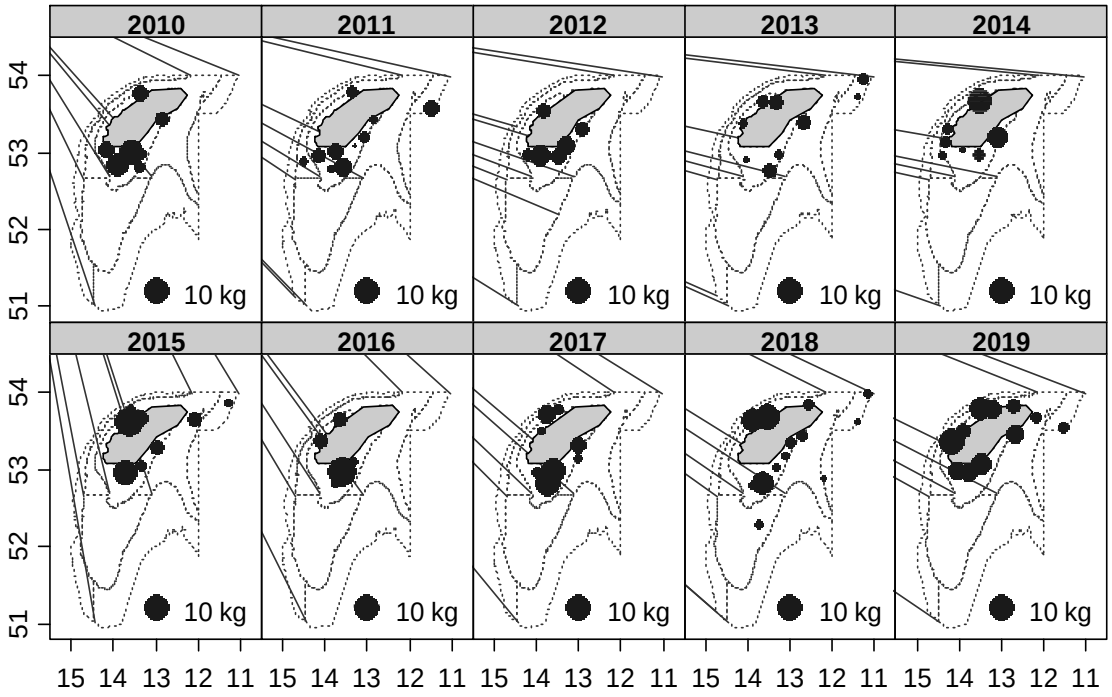

Figure 4. Geographic distribution of *Leucoraja naevus* catches (kg·haul^{-1}) in Spanish (IEO) Porcupine surveys from 2010 to 2019.

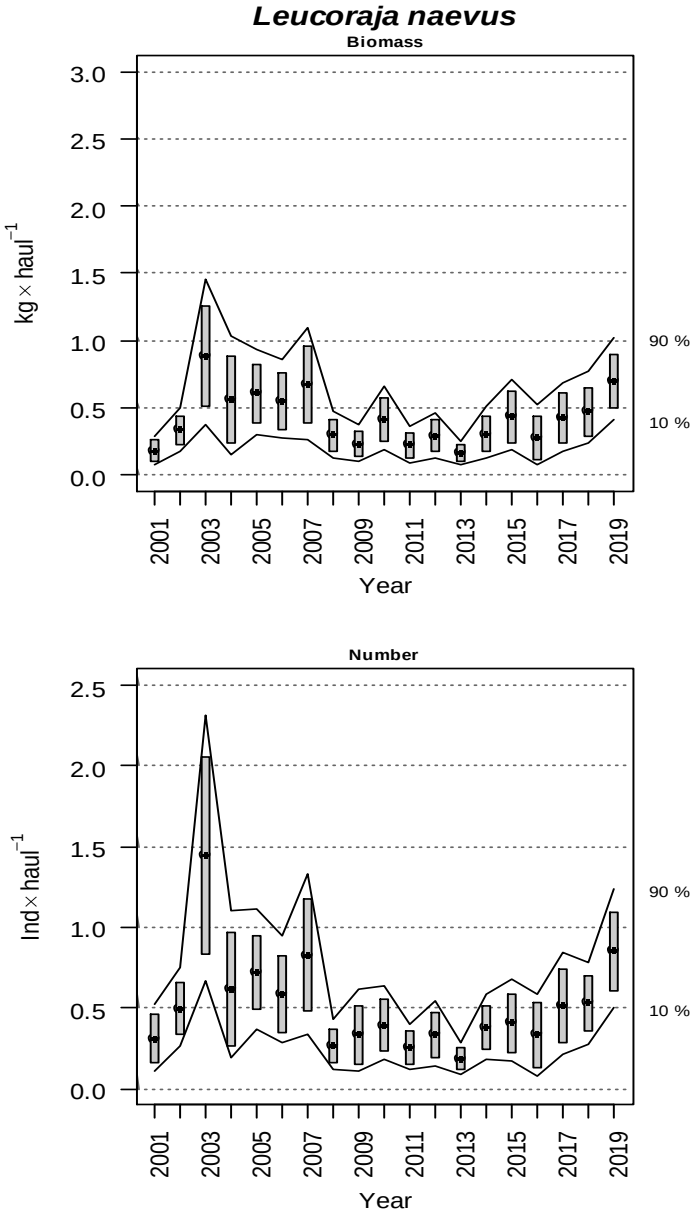

Figure 5. Changes in *Leucoraja naevus* a biomass and abundance indices in Porcupine surveys (2001-2019). Boxes mark parametric standard error of the stratified biomass index. Lines mark bootstrap confidence intervals (a = 0.80, bootstrap iterations = 1000).

The UK (England) beam trawl in western English Channel and wider Celtic Sea caught this species mostly on grounds to the west of Falmouth, occasionally on the Eddystone grounds and, infrequent in the more easterly parts of the survey area (in Division 7.e). Since 2014, this species has been found on the Celtic Seas strata, extending into the more southern and deeper waters (Silva et al., 2020).The Irish Groundfish Survey mainly catches *L. naevus i*n offshore areas. There are annual variations in abundance. In general, biomass trends are similar to those seen in the EVHOE survey, however in 2015, there was a conflicting signal with the EVHOE survey.

B.4. Commercial Effort and CPUE

An updated nominal LPUE-series for the Basque Country's OTB DEF>=70 and OTB DEF=100 in Subarea 8 from 2001–2019 is given for *L. naevus* (Table 5). The LPUE of *L. naevus* was generally > 100 kg day^{-1} in the first half of the series, declined from 2009 to 2014 and increased again in 2015 and 2016. The lowest level was observed in 2010 (44 kg day^{-1}) and the greatest in 2007 (169 kg day^{-1}). From 2017 to 2019, the values dropped strongly to 58 and 50 kg day^{-1} respectively (Figure 6).

Table 5. LPUE (kg day^{-1}) of the *L. naevus* caught by the Basque Country OTB DEF >= 70 and OTB DEF = 100 (Bottom otter trawl) in Subarea 8.

Year	*L. naevus*
2001	112
2002	91
2003	136
2004	120
2005	134
2006	140
2007	169
2008	137
2009	84
2010	44
2011	115
2012	33
2013	72
2014	79
2015	130
2016	119
2017	58
2018	51
2019	50

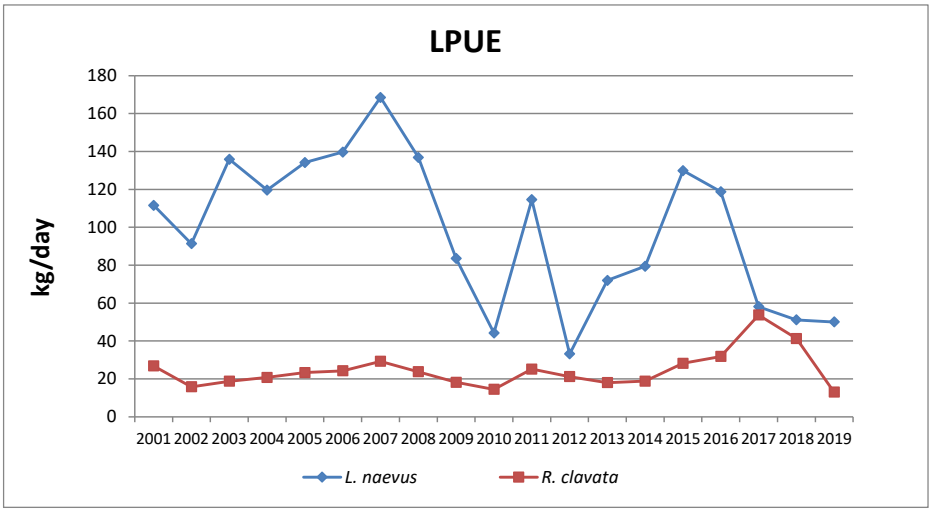

Figure 6. Nominal LPUE (kg day^{-1}) of *Leucoraja naevus* and *Raja clavata* caught in the OTB DEF >= 70 Basque fleet in Subarea 8 (2001–2019).

Irish raw LPUE trends in effort units of fishing days and fishing hours at several aggregation levels were examined by Davie (2014 WD). The methodology and specific details of all identified métiers is given in Davie and Lordan (2011) for trawl gears and Davie (2013) for other gear types.

Spatial LPUE estimates of (*Raja brachyura, R. clavata, R. montagui* and *L. naevus*) for the years 2011–2013, were examined by gear type, métier and for seasonal variability (quarter). Estimates of cuckoo ray LPUE (kg/h) and trend plots are shown (Figure 7).

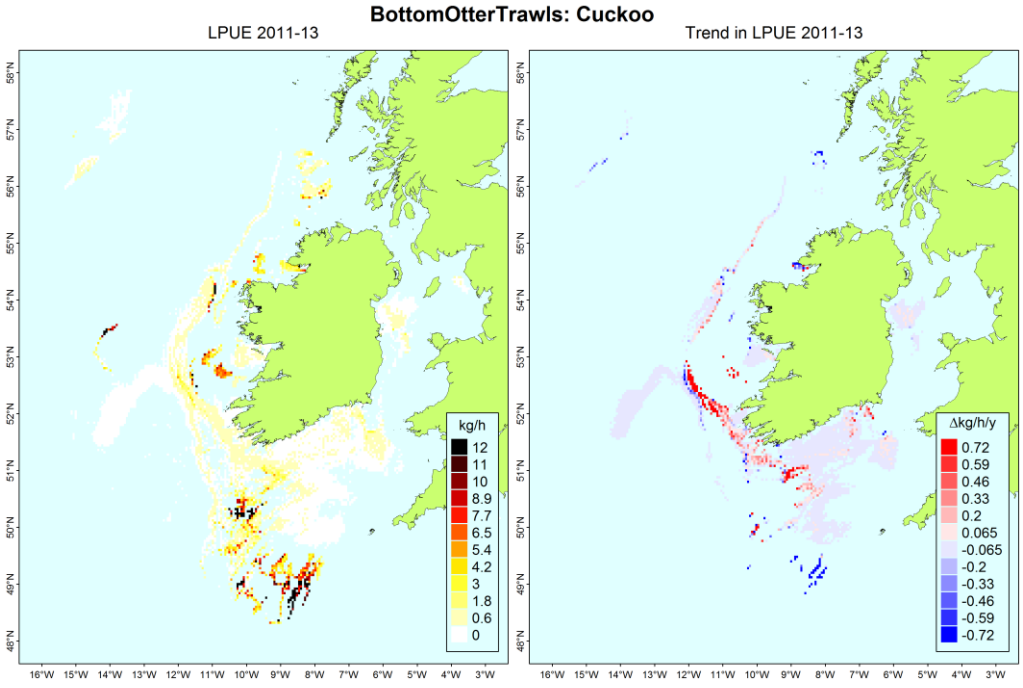

Figure 7. Lpue (kg/h) distribution and trend plots of *L. naevus* landed by otter trawls, in the Celtic Seas for the period 2011–2013.

B.5. Other relevant data

B.5.1. Discard survival

Studies in UK waters have examined the vitality and discard survival of various skates in a range of fisheries. Skate discard survival, based on the short-term maintai-nance of captured skates, is approximately 55% in otter trawl fisheries (Enever *et al*., 2009), but this is influenced by the other catch component of the trawl.

Preliminary studies on beam trawlers indicate that survival of skates may be up to 50% when tow duration is <2 hours, but is likely to increase with higher tow duration. Kaiser & Spenser (1995) examined the short-term survival of *L. naevus* caught by beam trawl, but this was a scientific study using a relatively small (4 m) beam trawl deployed for standard scientific survey times (0.5 h), and so would not be representative of commercial fisheries.

Inshore gillnet fisheries have a relatively high discard survival when soak time is short (immediate capture survival is >95% when soak times are ca. 24 hours), but longer soak times (40–48 hours) resulted in greater mortality rates (Ellis *et al.*, 2014 WD). The soak times for offshore gillnet fisheries are generally greater, and so there is also an increased mortality, and also an increased incidence of scavenging by isopods (Bendall *et al*., 2012; Ellis *et al*., 2012a WD).

C. Assessment: data and method

Model used: None

Survey trends-based assessment using the French EVHOE Survey and the Irish Groundfish Survey, and indicates that the stock has increased following low stock levels in 2012–2013 (Figure 7). Results of the predicted advice for 2021 and 2022 are shown on table 6.

Table 6. Cuckoo ray in subareas 6 and 7 and divisions 8.a–b and 8.d. The basis for the catch scenarios*.

Index A (2018–2019)		1.27
Index B (2013–2017)		1.10
Index ratio (A/B)		1.16
Uncertainty cap	Not applied	
Advised landings for 2019–2020 (issued to 2018)		3281 t
Discard rate	Unknown	
Precautionary buffer	Applied	-0.8
Landings advice **		3050 t
% Advice change ***		-7%

* The figures in the table are rounded. Calculations were done with unrounded inputs and computed values may not match exactly when calculated using the rounded figures in the table.
** [Advised landings for 2019–2020 × index ratio x PA buffer].
*** Advice value for 2021 and 2021 relative to the advice value for 2019 and 2020.

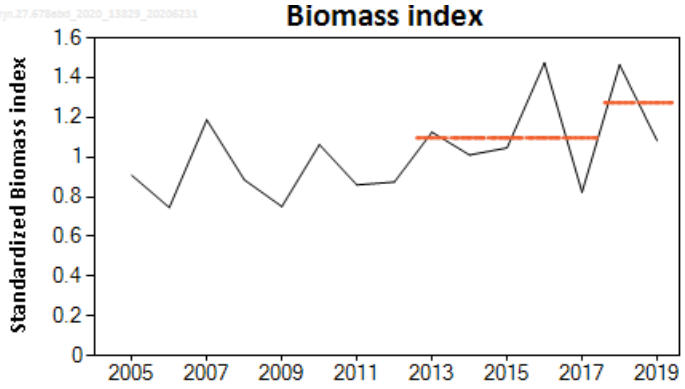

Figure 7. Cuckoo ray in subareas 6 and 7 and divisions 8.a–b and 8.d. Left: ICES landings for the period 2009–2019. Right: combined biomass indices from the IGFS-WIBTS-Q4 (kg km^{-2}) and EVHOE-WIBTS-Q4 (?) surveys. Dashed lines show the mean stock size indicator for 2013–2017 and 2018–2019. 2017 survey data only available for IGFS-WIBTS-Q4

D. Short-Term Projection

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E. Medium-Term Projections

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F. Long-Term Projections

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G. Biological Reference Points

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H. Other Issues

H.1. Historical overview of previous assessment methods

Table 7.Cuckoo ray in subareas 6 and 7 and divisions 8.a–b and 8.d. History of ICES advice and ICES estimates of landings*. All weights are in tonnes.

Year	ICES advice	Landings corresp. to advice	ICES species-specific landings: minimum estimate based on reported landings
2009	No specific advice		4408
2010	No specific advice		4096
2011	No specific advice		3916
2012	No specific advice		3388
2013	Decrease catch by at least 36%	-	3029
2014	No new advice, same as 2013	-	3209
2015	Decrease landings by 34%	1998	3360**
2016	No new advice, same as 2015	1998	2955**
2017	Precautionary approach	≤ 2734	2804**
2018	Precautionary approach (same value as advised catches for 2017)	≤ 2734	3037
2019	Precautionary approach	≤ 3281	3111
2020	Precautionary approach	≤ 3281	
2021	Precautionary approach	≤ 3050	
2022	Precautionary approach	≤ 3050	

* There is no a specific TAC for this stock. Fishing opportunities are managed through an overall TAC across each of the two management units (Subarea 6 and divisions 7.a–c and 7.e–k; and subareas 8–9), which includes all species of skates and rays.
** Data revised in 2020.

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