**High survival exemption for skates and rays caught by all fishing gears in the North Western Waters**

*Request under Article 15.4(b) of Regulation (EU) 1380/2013 to exempt from the landing obligation skates and rays caught by all fishing gears in the North Western Waters.*

**To note:**

1. This evidence is submitted to support a proposed high survival exemption for skate and rays caught in the North Western Waters by all fishing gears, as outlined in the Commission delegated regulation (EU) 2016/2375 (Article 2).
2. The evidence supporting this request recognises the challenge of a multispecies exemption across multiple fisheries. The proposal consists of three sections, i) details on existing relevant scientific estimates of discard survival for skates and rays, ii) evidence from which inferred discard survival estimates can be drawn based on assessments of the health of skates and rays at the point of release, and iii) recognition of the requirement for further evidence and a commitment to a research programme to fill these gaps.
3. A note has been added to outline how the industry will be encouraged to adopt mitigation measures (on avoidance, selectivity and survival) during the period of this exemption in order to promote the best possible survival of skate and ray species.

# Summary

Article 15.4(b) of Regulation (EU) 1380/2013 on the Common Fisheries Policy states that the landing obligation shall not apply to:

“species for which scientific evidence demonstrates high survival rates, taking into account the characteristics of the gear, of the fishing practises and of the ecosystem;”

Skate and ray species are caught in almost all demersal mixed fisheries, both trawl and netting, mostly as bycatch in fisheries for flatfish and other demersal species. In some parts of North Western Waters there is a seasonal small targeted fishery. These species that make up most of the catch of skates and rays in this region are:

* thornback skate;
* blonde ray;
* spotted ray;
* undulate ray;
* sandy ray;
* small eyed ray;
* starry skate;
* cuckoo ray.

# Key Information

Exemption target: Skates and rays subject to quota

Exemption grounds: High survivability

Survivability rates:

* Thornback ray 57-69% ICES VIIf otter trawl fishery
* Thornback ray 95% ICES IVc trammel net fishery
* Thornback ray 81% ICES IV otter trawl (inferred) fishery
* Thornback ray 53% ICES IV beam trawl fishery
* Blonde ray 41-44% ICES subarea VIIe beam trawl fishery
* Cuckoo ray 34-35% ICES VIIe beam trawl fishery
* Spotted ray 44% ICES IV beam trawl fishery
* Nine species of skates and rays 98% at-vessel (immediate) survival for combined otter trawl, static net and long-line; 72% assessed as excellent/good health condition
* Survival probability assessed at 85% for Thornback ray in excellent/good health; 57% for moderate/poor health

Stock health: Skates and rays are managed under a combined TAC for the order Rajiformes, and comprise a range of species and stocks. Stock status varies across the species and stocks.

* The main commercial skate species in the Celtic Seas ecoregion are thornback, spotted, blonde, small-eyed, undulate, cuckoo ray, sandy and shagreen ray.
* The stock size indicators used by ICES for several of the main commercial stocks in the Celtic Sea (e.g. thornback ray in 7.d and 7.a.f-g, spotted ray and cuckoo ray) are increasing. The status of blonde ray (a coastal species that is not sampled effectively in current trawl surveys) is less well known, but appears to be increasing in the eastern Channel. Small-eyed ray is locally common in the Bristol Channel, with survey indices stable over the entire time series (albeit with a slight decline in recent years).
* Other skate species occurring in the Celtic Seas ecoregion include sandy and shagreen ray, and these are offshore species not sampled effectively in existing trawl surveys.
* The more depleted skate stocks in the Celtic Sea ecoregion (e.g. flapper skate and white skate) are prohibited, and so will not be included within the landing obligation, as are grey skate and Norwegian skate.
* Undulate ray was listed as a species that could not be retained by commercial fleets between 2009 and 2014, and the stock size indicator used by ICES increased during this time (ICES, 2017). That a bycatch species increased in relative abundance during a period of non-retention is suggestive that fishing practices were not precluding population growth, which may include an element of discard survival (although levels and distribution of fishing effort would also be key factors).
* For details by stock see Annex 1.

**References**

EU. 2018. Council Regulation (EU) 2018/120 of 23 January 2018 fixing for 2018 the fishing opportunities for certain fish stocks and groups of fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, and amending Regulation (EU) 2017/127. Official Journal of the European Union L27, 1–168.

ICES. 2017. ICES. 2017. Report of the Working Group on Elasmobranchs (2017), 31 May-7 June 2017, Lisbon, Portugal. ICES CM 2017/ACOM:16. 1018 pp.

Vessels affected: Estimates of the number of vessels likely to land skate and ray quota species by Member State:

|  |  |
| --- | --- |
| **Member State** | **Estimated number of vessels affected in North Western Waters** |
| Belgium | - |
| France | 1000 |
| Ireland | 188 |
| Netherlands | 16 |
| Spain | 67 |
| United Kingdom | 1435 |

Discard rate: Discard rates averaged over 2014-2016 for skates and rays species combined are estimated at 45%. For the main species the DR is estimated at Thornback ray 43%, Blonde ray 17%, Sandy ray 0%, Spotted ray 43%, Cuckoo ray 41%, Starry ray 100% (source: STECF FDI database)

Biomass affected: Annual landings of skate and ray quota species in the North Western Waters (FDI STECF database):

|  |  |
| --- | --- |
| **2014** | 2728.8 tonnes |
| **2015** | 3070.1 tonnes |
| **2016** | 2945.2 tonnes |
| **Average (2014-2016)** | 2914.7 tonnes |

**Evidence on the discard survival of EU skate and ray species**

1. **Relevant directly observed estimates of skate and ray discard survival**

Information on discard survival of skates and rays in northern European waters (e.g. Catchpole *et al*., 2017; Enever *et al*. 2009; Ellis *et al*., 2017; 2018) and in the NW Atlantic (Mandelman *et al*., 2013) where the starry ray (*Amblyraja radiata*), which also occurs in the North Western Waters and North Atlantic, is also present. See Table 1 for an overview.

There have also been studies on the discard mortality of skates and rays in other fisheries around the world (Endicott & Agnew, 2004; Laptikhovsky, 2004; Benoît et al., 2010a, 2010b, 2012; Cicia et al., 2012; Lyle et al., 2014; Saygu & Deval, 2014; Knotek et al., 2018; Sulikowski et al., 2018).

In terms of direct estimations of discard survival, Catchpole et al. (2017), identified relevant literature for EU fisheries and applied a critical review process to assess the robustness of the available estimates (provided as separate document). Eight references were identified which contained original information on the survival of the commercial ray species caught in EU fisheries; and six provided discard survival estimates. The critical review applied was developed by the ICES Working Group on Methods to Estimate Discard Survival, and was the same as that which has been used by STECF to evaluate previous survivability exemption proposals.

Table 1 shows the results from the review of the 8 identified references to which two further references, recently reported, have been added. The references provide 15 estimates of discard survival for different skate and ray species caught in different fisheries. Table 1 provides the estimated discard survival rate and a note on the quality of the estimate based on the critical review process.

Table 1 Existing estimates of discard survival of skate and rays

| ID | Author | Title | Source | Year | Survival Est. | Species | Fishery | Gear | Quality and comment |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | Bendall, V. A., Hetherington, S. J., Ellis, J. R., Smith, S. F., Ives, M. J., Gregson, J. and Riley, A. A. | Spurdog, Porbeagle and Common Skate Bycatch and Discard Reduction | CEFAS Report | 2012 | At-vessel mortality only, based on vitality assessments | common skate complex (Dipturus batis) | Mixed target gill net fishery in ICES Division VIIe-f | GN1 | Health assessment was not the focus of the study; tagging results incomplete |
| 2 | Ellis, J.R., Burt, G.J. and Cox, L.P.N. (2008) | Thames ray tagging and survival. | CEFAS Report | 2008 | At-vessel mortality only, based on vitality assessments | Mixed ray species dominated by thornback ray (Raja clavata) | North Sea trawl, longline and gillnet fisheries  | GN1, LL1 | Health assessment was not the focus of the study; tagging results incomplete |
| 3 | Depestele, J., Desender, M. Benoît, H.P., Polet, H., Vincx, M. | Short-term survival of discarded target fish and non-target invertebrate species in the “eurocutter” beam trawl fishery of the southern North Sea. | FISHERIES RESEARCH 154: 82-92. | 2014 | 72% (n=141) | Mixed ray species dominated by thornback ray (Raja clavata) | North Sea Beam trawl | BT2 | Modelled to asymptote; mixed ray species; survival rate likely overestimated |
| 4 | Enever, R.; Catchpole, T. L.; Ellis, J. R.; Grant, A. | The survival of skates (Rajidae) caught by demersal trawlers fishing in UK waters | FISHERIES RESEARCH 97(1–2): 72–76 | 2009 | 55-87% (n=162) | Thornback ray (Raja clavata) | Bristol Channel otter trawl | TR2 | Not monitored to asymptote; survival rate overestimated  |
| 4 | Enever, R.; Catchpole, T. L.; Ellis, J. R.; Grant, A. | The survival of skates (Rajidae) caught by demersal trawlers fishing in UK waters | FISHERIES RESEARCH 97(1–2): 72–76 | 2009 | 33% (n=6) | Cuckoo ray (Leucoraja naevus) | Bristol Channel otter trawl | TR2 | Not monitored to asymptote; survival rate overestimated  |
| 4 | Enever, R.; Catchpole, T. L.; Ellis, J. R.; Grant, A. | The survival of skates (Rajidae) caught by demersal trawlers fishing in UK waters | FISHERIES RESEARCH 97(1–2): 72–76 | 2009 | 51% (n=39) | Small-eyed ray (Raja microocellata) | Bristol Channel otter trawl | TR2 | Not monitored to asymptote; survival rate overestimated  |
| 4 | Enever, R.; Catchpole, T. L.; Ellis, J. R.; Grant, A. | The survival of skates (Rajidae) caught by demersal trawlers fishing in UK waters | FISHERIES RESEARCH 97(1–2): 72–76 | 2009 | 55-67% (n=14) | Blonde ray (Raja brachyura) | Bristol Channel otter trawl | TR2 | Not monitored to asymptote; survival rate overestimated  |
| 5 | Kaiser M.J., Spencer, B. E. | Survival of by-catch from a beam trawl | MARINE ECOLOGY PROGRESS SERIES 134: 303-307. | 1995 | 59% (n=32) | Cuckoo ray (Leucoraja naevus) | Irish Sea beam trawl | BT2 | Not monitored to asymptote; no control; survival rate likely overestimated |
| 6 | Ellis, J. R., McCully, S. R., Silva, J. F., Catchpole, T. L., Goldsmith, D., Bendall, V. and Burt, G. | Assessing discard mortality of commercially caught skates (Rajidae) – validation of experimental results. | DEFRA Report MB5202, 142 pp. | 2012 | 0-100% (n=2) | Small-eyed ray (Raja micro-ocellata) | Western Channel beam trawl | BT2 | Not monitored to asymptote; no control; survival rate likely overestimated |
| 6 | Ellis, J. R., McCully, S. R., Silva, J. F., Catchpole, T. L., Goldsmith, D., Bendall, V. and Burt, G. | Assessing discard mortality of commercially caught skates (Rajidae) – validation of experimental results. | DEFRA Report MB5202, 142 pp. | 2012 | 25-74% (n=25) | Blonde ray (Raja brachyura) | Western Channel beam trawl | BT2 | Not monitored to asymptote; no control; survival rate likely overestimated |
| 6 | Ellis, J. R., McCully, S. R., Silva, J. F., Catchpole, T. L., Goldsmith, D., Bendall, V. and Burt, G. | Assessing discard mortality of commercially caught skates (Rajidae) – validation of experimental results. | DEFRA Report MB5202, 142 pp. | 2012 | 40-67% (n=13) | Spotted ray (Raja montagui) | Western Channel beam trawl | BT2 | Not monitored to asymptote; no control; survival rate likely overestimated |
| 6 | Ellis, J. R., McCully, S. R., Silva, J. F., Catchpole, T. L., Goldsmith, D., Bendall, V. and Burt, G. | Assessing discard mortality of commercially caught skates (Rajidae) – validation of experimental results. | DEFRA Report MB5202, 142 pp. | 2012 | 25-83% (n=26) | Cuckoo ray (Leucoraja naevus) | Western Channel beam trawl | BT2 | Not monitored to asymptote; no control; survival rate likely overestimated |
| 7 | Saygu, I., Deval, M. C. | The Post-Release Survival of Two Skate Species Discarded by Bottom Trawl Fisheries in Antalya Bay, Eastern Mediterranean | TURKISH JOURNAL OF FISHERIES AND AQUATIC SCIENCES 14: 947-953 | 2014 | 81% (n=120) | Thornback ray (Raja clavata) | GFCM Geographical subarea 24 otter trawl | TR1 | Not monitored to asymptote; survival rate likely overestimated |
| 7 | Saygu, I., Deval, M. C. | The Post-Release Survival of Two Skate Species Discarded by Bottom Trawl Fisheries in Antalya Bay, Eastern Mediterranean | TURKISH JOURNAL OF FISHERIES AND AQUATIC SCIENCES 14: 947-954 | 2014 | 21% (n=68) | Brown skate (Raja miraletus) | TR1 | Not monitored to asymptote; survival rate likely overestimated |
| 8 | Enever, R., Revill, A. S., Caslake, R., Grant, A. | Discard mitigation increases skate survival in the Bristol Channel | FISHERIES RESEARCH 102(1–2): 9–15 | 2010 | 55-67% (n=278) | Small-eyed skate (Raja micro-ocellata) | Bristol Channel, otter trawl | TR2 | Not monitored to asymptote; no control; survival rate likely overestimated |
| 9 | Tom Catchpole, Serena Wright, Victoria Bendall, Stuart Hetherington, Peter Randall, Elizabeth Ross, Ana Ribiero Santos, Jim Ellis, Jochen Depestele (ILVO), Suzanna Neville | Ray Discard Survival - Enhancing evidence of the discard survival of ray species | CEFAS Report | 2017 | 41-44% (n=25) | Blonde ray (Raja brachyura) | Western Channel beam trawl | BT2 | Ellis et al (2012) enhanced estimates modelled to assymtote |
| 9 | Tom Catchpole, Serena Wright, Victoria Bendall, Stuart Hetherington, Peter Randall, Elizabeth Ross, Ana Ribiero Santos, Jim Ellis, Jochen Depestele (ILVO), Suzanna Neville | Ray Discard Survival - Enhancing evidence of the discard survival of ray species | CEFAS Report | 2017 | 34-35% (n=26) | Cuckoo ray (Leucoraja naevus) | Western Channel beam trawl | BT2 | Ellis et al (2012) enhanced estimates modelled to assymtote |
| 9 | Tom Catchpole, Serena Wright, Victoria Bendall, Stuart Hetherington, Peter Randall, Elizabeth Ross, Ana Ribiero Santos, Jim Ellis, Jochen Depestele (ILVO), Suzanna Neville | Ray Discard Survival - Enhancing evidence of the discard survival of ray species | CEFAS Report | 2017 | 57-69% (n=162) | Thornback ray (Raja clavata) | Bristol Channel otter trawl | TR2 | Enever et al (2009) enhanced estimates modelled to assymtote |
| 9 | Tom Catchpole, Serena Wright, Victoria Bendall, Stuart Hetherington, Peter Randall, Elizabeth Ross, Ana Ribiero Santos, Jim Ellis, Jochen Depestele (ILVO), Suzanna Neville | Ray Discard Survival - Enhancing evidence of the discard survival of ray species | CEFAS Report | 2017 | 95% (n=15) | Thornback ray (Raja clavata) | North Sea gill netter | GT1 | DST tagging, effect of predation included within estimate |
| 9 | Tom Catchpole, Serena Wright, Victoria Bendall, Stuart Hetherington, Peter Randall, Elizabeth Ross, Ana Ribiero Santos, Jim Ellis, Jochen Depestele (ILVO), Suzanna Neville | Ray Discard Survival - Enhancing evidence of the discard survival of ray species | CEFAS Report | 2017 | 92% (n=5) | Blonde ray (Raja brachyura) | North Sea gill netter | GT1 | DST tagging, effect of predation included within estimate; not representative sorting |
| 10 | Christopher Bird, Victoria Bendall, Jim Ellis, Thomas Catchpole | Health and vitality of discarded skates and rays | CEFAS Report | 2018 | At-vessel mortality only, based on vitality assessments | Nine skate ray species | NS, NWW various | TR2,GT1,GN1,LL1 | Compiled vitality (health) scores from 10 projects |
| 11 | *Edward Schram and Pieke Molenaar, 2018.* Wageningen, Wageningen Marine Research (University & Research centre), Wageningen Marine Research report C037/18. | *Discards survival probabilities of flatfish and rays in North Sea beam-trawl fisheries*. | Wageningen Marine Research (University & Research centre), Wageningen Marine Research report C037/18. | 2018 | 53% (40%-65%) n=95 | Thornback ray | NS | BT2 |  |
| 11 | *Edward Schram and Pieke Molenaar, 2018.* Wageningen, Wageningen Marine Research (University & Research centre), Wageningen Marine Research report C037/18. | *Discards survival probabilities of flatfish and rays in North Sea beam-trawl fisheries*. | Wageningen Marine Research (University & Research centre), Wageningen Marine Research report C037/18. | 2018 | 44% n=22 | Spotted ray | NS | BT2 | Limited data: 2 trips and n=22 |

The review illustrated that the eight studies met some, but not all, of the key criteria required to produce a fishery representative estimate of discard survival (Table 1). To address these limitations, some studies were selected for re-analysis using more recently developed statistical methods. The critical review report also includes new evidence of enhanced exiting estimates and original directly observed estimates of ray discard survival based on electronic tagging. The work concludes that, while published estimates of ray discard survival are unable to meet all recently developed quality criteria; the re-analysis of the data did enable enhanced discard estimates to be generated. Alongside a new estimate based on tagging studies, the robust estimates of ray discard survival are:

* Discard survival of thornback ray is estimated at 57-69% for the ICES subarea VIIf *otter trawl* fishery.
* Discard survival of blonde ray is estimated at 41-44% for the ICES subarea VIIe *beam trawl* fishery
* Discard survival of cuckoo ray is estimated at 34-35% for the ICES subarea VIIe *beam trawl* fishery
* Discard survival of thornback ray is estimated at 95% for the ICEC subarea IVc *trammel net* fishery
* Discard survival of thornback ray is estimated at 53% for the ICES subarea IV *beam trawl* fishery
* Discard survival of spotted ray is estimated at 44% for the ICES subarea IV *beam trawl* fishery
1. **Secondary supporting evidence on skate and ray discard survival levels**

It is recognized that while there are some reliable estimates of skate and ray discard survival, these cover just a few of the many combinations of area, gear and species of skates caught in EU fisheries. While further studies are being undertaken, the number of combinations of gear and area that warrant investigating means that it is not practical to investigate them all. At the same time, extrapolating the data beyond the conditions under which direct observations are made assumes that the factors effecting survival are known. However, there are other sources of supporting evidence that can be applied to enable informed extrapolation of survival estimates and mitigate against awarding unsuitable exemptions. For example, where the fishing operations and environment are consistent with studied fisheries. Also, based on a relationship between health condition and survival, inferred survival rates can be established when health condition of discarded fish is known. The proportion of fish alive at the point of discarding does not provide a robust survival estimate because mortality can occur some period after release. However, the health status of the fish when released is often used to predict its chance of survival.

Data on the health condition of skates at the point of discarding from a series of projects have been collated to supplement directly observed discard survival estimates (Bird, et al., 2018). Vitality data, describing the health of commercially caught skate and ray species at the point of release back to the sea, were available from 17,259 individual fish from 10 projects. These data show that 99.8%, 97.9% and 95.4% of skates and rays survived fishing capture in longline, otter trawl and netter fisheries, respectively. At-vessel mortality rates, those assessed as dead at the point of release, were low across these gears, with only 2% of rays being reported dead when discarded.

In summary, the data show that 72% of rays were assessed to be in excellent or good health condition at the point of release, 17% in poor or moderate health and 2% were dead. Details of this evidence can be found in the supporting document (Bird et al., 2018). Studies generating direct observations of discard survival have shown that rays in the healthiest vitality categories have a higher survival probability than those with lower health scores. For example, Thornback rays caught in an otter trawler assessed as excellent or good had a survival probability of 85% and those moderate or poor had a 57% probability of survival. Based on these data, it was inferred that 81% of thornback ray caught and released in the North Sea otter trawl fisheries could survive the catch and discard process (Bird et al., 2018).

Table 2: Raised proportional health vitality scores for each species captured using the three main fishing gears. Standardized health conditions are Excellent/Good (A), Poor/Moderate (B), Dead (D), or Unknown (U).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Gear | Species | A | B | D | U | Total |
| Longline | Blonde ray | 80 (89%) | 9 (10%) | 1 (1%) |   | 90 |
|   | Spotted Ray | 217 (95%) | 10 (4%) |   | 1 (0%) | 228 |
|   | Thornback ray | 2741 (76%) | 156 (4%) | 7 (0%) | 715 (20%) | 3619 |
|   | Undulate ray | 6 (100%) |   |   |   | 6 |
| Otter Trawl | Blonde ray | 166 (29%) | 384 (67%) | 19 (3%) |   | 569 |
|   | Cuckoo ray | 1 (4%) | 21 (89%) | 2 (6%) |   | 23 |
|   | Painted ray | 230 (23%) | 730 (72%) | 48 (5%) |   | 1008 |
|   | Spotted ray | 58 (13%) | 337 (74%) | 62 (14%) |   | 457 |
|   | Shagreen ray | 5 (45%) | 6 (55%) |   |   | 11 |
|   | Thornback ray | 5214 (78%) | 748 (11%) | 41 (1%) | 649 (10%) | 6651 |
|   | Undulate ray | 65 (49%) | 68 (51%) | 1 (1%) |   | 134 |
| Static Net | Blonde ray | 1 (50%) | 1 (50%) |   |   | 2 |
|   | Blue skate | 2497 (85%) | 241 (8%) | 185(6%) | 2 (0%) | 2925 |
|   | Flapper skate | 9 (100%) |   |   |   | 9 |
|   | Painted ray | 3 (50%) | 3 (50%) |   |   | 6 |
|   | Spotted Ray | 31 (66%) | 12 (26%) | 3 (6%) | 1 (2%) | 47 |
|   | Shagreen ray | 1 (100%) |   |   |   | 1 |
|   | Thornback ray | 1128 (79%) | 282 (20%) | 18 (1%) |   | 1428 |
|   | Undulate ray | 42 (93%) | 3 (7%) |   |   | 45 |
| Grand Total |   | 12494 (72%) | 3010 (17%) | 386 (2%) | 1368 (8%) | 17259 |

1. **Discard survival evidence in the context of the North Western Waters fisheries**

Data were extracted from the FDI STECF database for all skate and ray quota species caught in the North Western Waters. Table 3 shows the gear types that catch most of the skates and rays and the average discard rates for these gears across all species. During the period 2014-2016, 40% of catches were taken by TR2 gears, around one third by BT2 and 13% by TR1 and 10% by GN1. These four gear types generate 98% of the catches of skates and rays in NWW. The discard rates associated with the main gear types are shown in Table XX. Discard rates are highest for BT2 gears at 47% of the catch of skates and rays, then 38% for TR2 and 24% for TR1.

Table 3. Data from the FDI STECF database for all skate and ray quota species caught in the North Western Waters, landings, discards and discard rates by main gear category.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Gear | Disc. 2014 (t) | Land 2014 (t) | DR 2014 (t) | Disc. 2014 (t) | Land 2015 (t) | DR 2015 (t) | Disc. 2014 (t) | Land 2016 (t) | DR 2016 (t) | Propnt total catch | Average DR |
| TR2 | 677.7 | 963.8 | 0.4 | 440.1 | 1112.5 | 0.3 | 771.9 | 1023.3 | 0.4 | 35% | 38% |
| BT2 | 1201.6 | 939.3 | 0.6 | 577.6 | 1048.0 | 0.4 | 915.7 | 997.8 | 0.5 | 40% | 47% |
| TR1 | 159.2 | 387.7 | 0.3 | 121.8 | 534.4 | 0.2 | 157.1 | 496.2 | 0.2 | 13% | 24% |
| GN1 | 1.3 | 356.3 | 0.0 | 47.6 | 310.5 | 0.1 | 409.3 | 350.3 | 0.5 | 10% | 23% |
| GT1 | 0.3 | 81.8 | 0.0 | 13.9 | 64.7 | 0.2 | 25.2 | 77.6 | 0.2 | 2% | 14% |
| Grand Total | 2040.0 | 2728.8 | 0.4 | 1201.1 | 3070.1 | 0.3 | 2279.1 | 2945.2 | 0.4 | 100% | 38% |

Table 4 shows the main species that make up the catches of skates and rays and the average discard rates for these species across all gears. Based on STECF FDI published data, during the period 2014-2016, over one third of catches were of Thornback rays, 25% were Blonde rays and 17% Cuckoo rays. Discard rates were 31% for Thornback rays, 62% for Spotted rays and 57% for Cuckoo rays. Almost all landings were recorded to species level in the North Western waters region.

Table 4 Data from the FDI STECF database for all skate and ray quota species caught in the North Western Waters, landings, discards and discard rates by main gear category.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Species | Disc. 2014 (t) | Land 2014 (t) | DR 2014 (t) | Disc. 2014 (t) | Land 2015 (t) | DR 2015 (t) | Disc. 2014 (t) | Land 2016 (t) | DR 2016 (t) | Propnt total catch | Average DR |
| Thornback ray | 574.7 | 994.4 | 0.4 | 481.3 | 1154.2 | 0.3 | 449.6 | 1140.0 | 0.3 | 34% | 31% |
| Blonde ray | 204.2 | 941.2 | 0.2 | 190.2 | 1068.7 | 0.2 | 201.0 | 974.2 | 0.2 | 25% | 17% |
| Cuckoo ray | 726.0 | 304.1 | 0.7 | 139.3 | 313.4 | 0.3 | 638.5 | 273.3 | 0.7 | 17% | 57% |
| Spotted ray | 247.3 | 114.0 | 0.7 | 85.5 | 118.8 | 0.4 | 475.6 | 143.3 | 0.8 | 8% | 62% |
| Sandy ray | 2.3 | 95.1 | 0.0 | 3.8 | 116.0 | 0.0 | 93.8 | 142.7 | 0.4 | 3% | 15% |
| Longnose skate | 0.0 | 62.6 | 0.0 | 0.0 | 124.6 | 0.0 | 0.0 | 108.4 | 0.0 | 2% | 0% |
| Small-eye ray | 201.7 | 132.4 | 0.6 | 19.4 | 135.4 | 0.1 | 254.3 | 88.9 | 0.7 | 6% | 49% |
| Grand Total | 2040.5 | 2745.9 | 0.4 | 1242.9 | 3088.3 | 0.3 | 2330.7 | 2966.3 | 0.4 | 100% | 38% |

The available discard survival evidence corresponds with those fisheries taking the highest catches and showing the highest discard rates. Moreover, the available evidence corresponds to those species taken in the largest quantity and with fisheries with the highest discard rates.

Table 5 shows how the evidence on discard survival maps to the discard levels for the main gear-species combinations generating discards. There is some evidence of discard survival levels for all the main fisheries discarding skates and rays. In some cases, the evidence given is extrapolated from other areas, and it is recognized that further analysis on how different factors effect survival will be needed assess the suitability of this approach.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 5 Mapping the discard survival evidence against catches, selected gear-species combination generated ~80% of discards of skates and rays in North Western WatersGear | Species | Total Disc. 2014-2018 (t) | Primary evidence (% survival):  | Secondary evidence (vitality at point of release): |
| BT2 | Cuckoo ray | 1121 | 25-83% (Ref 6); 34-35% (Ref 9) (ICES VIIe) | - |
| BT2 | Thornback ray | 643 | 72% (Ref 3) North Sea | - |
| TR2 | Thornback ray | 598 | 55-87% (Ref 4); 57-69% (Ref 9) (ICES VIIf) | 78% Excellent/Good, 11% Moderate/Poor, 1% dead (Ref 10) |
| TR2 | Spotted ray | 329 | - | 13% Excellent/Good, 74% Moderate/Poor, 14% dead (Ref 10) |
| BT2 | Blonde ray | 325 | 25-74% (Ref 6); 41-44% survival (Ref 9) (ICES VIIe) | - |
| GN1 | Spotted ray | 292 | - | 66% Excellent/Good, 26% Moderate/Poor, 2% dead (Ref 10) |
| TR2 | Undulate ray | 273 | - | 49% Excellent/Good, 51% Moderate/Poor, 1% dead (Ref 10) |
| TR2 | Small-eye ray | 261 | 55-57% (Ref 8); 51% (Ref 4) (ICES VIIf) | 23% Excellent/Good, 72% Moderate/Poor, 5% dead (Ref 10) |
| TR2 | Blonde ray | 248 | 55-67% (Ref 4) (ICES VIIf) | 29% Excellent/Good, 67% Moderate/Poor, 1% dead (Ref 10) |
| BT2 | Small-eye ray | 213 | 0-100% (Ref 6) (ICES VIIe) | - |

**Future work:** **Framework for research programme to accompany the interim high survival exemption for skates and rays**

The current data outlined in support of this exemption is limited and more work is needed to provide a more complete picture of survival across different skate and ray species in different fisheries. Additional work on skate and ray species will also help to formulate a longer-term management plan. Therefore, it is planned to formulate a three-year research programme to accompany the proposal for this provisional high survival exemption.

Important points to consider will be:

* Developing standardised procedures for data collection and analysis
* Building on existing work develop new survival studies
* Re-analyse existing captive observation data
* Re-analyse existing catch-and-release data
* Further data collection using tagging technologies (e.g. conventional, electronic, satellite, acoustic) for quantification of estimates of both short and long-term post-release survival

For directing the research activities into species and/or métiers the current information on species-métier interactions and the species composition of the bycatch should be used. Knowledge of the biological characteristics of each species and comparability between species/metiers should also be taken into account.

*Joining current initiatives*

Currently two research projects are being carried out which will provide information and results to help identify discard survival of skates and rays, as well as how to improve survival. These are *SUMARiS : Sustainable management of rays and skates* an INTERREG funded project which is coordinated by FROM-Nord (France)[[1]](#footnote-1); and a project being carried out in the Netherlands with WMR and the fishing sector (VisNEd) on survival of flatfish and rays in the North Sea sole beam trawl fisheries in which the survival of thornback and spotted rays will be estimated (Schram & Molenaar, 2018.)[[2]](#footnote-2).

*SUMARiS : Sustainable management of rays and skates*

The main aim of the SUMARiS project is to prepare a sustainable and cross-border management strategy for rays and skates stocks. During three years the project SUMARiS will be lead in France, Belgium, the United Kingdom and the Netherlands and involves producer organisations, fishermen organisations, scientific institutes and an aquarium. The work package on ray survival (WP2) will be coordinated by ILVO (Belgium).

The SUMARiS project is specifically designed to address some of the issues arising from the fact that rays will be subject to the Landing Obligation (LO) from 2019 onwards, and will anticipate the rays’ LO, by encouraging fishermen to adapt their fishing strategies, so to avoid discards and/or release rays alive at sea.

The project will run from 13th July 2017 to 30th June 2020. In the period June 2018 – June 2019 approximately 23 seagoing trips with commercial vessels of different métiers (beam trawl, otter trawl, netters) will be organized. As this project is ongoing, it might be possible to liaise with this project if there are proposals from this research framework. For example, no tagging experiments have been planned, but it may be possible to organize the implementation of different types of tagging experiments.

*Survival of skates and rays in the North Sea sole beam trawl fisheries*

This Dutch project has been carried out since 1st June 2016 and will carry on until 31st December 2018. Skates and rays caught as bycatch in the fishery are taken back on land in tanks and observed for at least 18 days, sometimes longer. The control fish used underwent a comparable handling procedure. All experiments are carried out until asymptote. First results are expected from mid-2018 onwards and will cover:

* An indication of the survival of the thornback ray (based on 9 trips)
* An indication of the survival of the spotted ray (based on 2 trips)
* A protocol for the vitality and injuries for rays
* Guidelines how to keep and monitor fish for controls
* Data analysis on the relationship between vitality and survival
* Data analysis on abiotic factors and survival

*Setting research priorities*

As a first step in scoping the issues, a detailed overview will be made per country of the fisheries in which skates and rays are caught, including:

* Details of métier: mesh size, average tow duration
* Details of processing practice: time to sort the catch; handling practice of skates and rays
* Species caught and relative catch of skates and rays

This information will aid the discussions on research priorities.

Further setting of research priorities can be done by looking at the expected mortalities in different métiers and ranking these from high to low. Studying métier-species interactions in which survival is expected to be relatively high or relatively low will provide a range of estimates of discard survival. Both the fishing métier and processing activities should be taken into account. E.g. if the catch from a métier that might damage fish is processed quickly, survival may be higher than in a métier which is less damaging, but in which the skates and rays are left on board for many hours. The métiers and species will vary per country.

Variables affecting discard survival are: season; weather conditions; life stage (length). A research protocol should take these into account and aim to cover at least the summer and winter periods.

*Research framework*

The research programme can be developed using the WKMEDS protocol and from the aspect of methods for estimating mortality (ICES, 2014). See also Annex 1. Research should focus on developing quantitative estimates of discard survival and trialing methods for improving survival on board. As an initial framework the following approach is proposed.

*Quantitative estimates of discard survival*

* **Carry out estimates of at-vessel mortality and vitality for the selected métier/species.**
	+ This method on its own does not give a robust and quantitative estimate of discard survival. It will be necessary to develop a methodology to estimate short- or long-term survival from the estimated vitality on board. For example, by following the survival of skates and rays from different vitality categories in tanks until asymptote is reached is recommended (ICES, 2014).
* **Long-term survival in tanks and linked to vitality**
	+ Keep a sub-sample of the skates and rays from above in tanks for periods of more than 18 days or until asymptote
	+ Use WGMEDS protocol to design future experiments
	+ Link the mortality estimates to on-board vitality
	+ Seek collaboration with aquaria to keep rays for longer periods
* **Tag-and-recapture studies**
	+ Analysis of historical data-sets
	+ Develop approaches to link relative survival as estimated from tagging to absolute survival, by carrying out tagging experiments with multiple tagging methodologies
* **Deployment of electronic data tags (e.g. satellite data storage tags)**
	+ This method can be used to quantify absolute levels of discard survival, including all discard mortalities, but is expensive. A prioritization of métiers and species will have to be carried out to guarantee a sufficient recapture and retrieval of data loggers.

It is not recommended to carry out any more short-term (up to 5 days) survival experiments in tanks. Tank experiments running longer than 5 days show that up until 3-5 days the majority of the skates and rays survive. After this period the mortality increases (Schram & Molenaar, in prep.). WKMEDS protocol stipulates that the experiments are carried out to asymptote (ICES, 2014).

*Improving survival*

Concurrent with the research to develop robust, quantitative estimates of discard survival and pre-empting potential bottlenecks if low survival is measured, methods to improve survival of skates and rays should be developed and trialed.

**Mitigation measures and adopting best practice**

During the period of this temporary exemption the North Western Waters Member States will promote good practice to fishers making use of the exemption, in order to encourage behaviours that will maximise the chance of survival for skate and ray species and contribute to filling in data gaps. Avoidance and selectivity measures will also be encouraged to minimise the chance of skate and ray species being caught.

***Annual fishing plan***

Fisheries fleets requesting to use the high survival exemption will be asked to present an annual fishing plan in which is explained in more detail how the survival, selectivity and avoidance measures will be implemented in their fishery. Not all measures are at a stage that they can be implemented and three levels can be identified: (i) potential measures still needing some basic research; (ii) measures which could be trialed; and (iii) measures which can be implemented. A distinction was made between towed and fixed gear. If research is part of the fishing plan any effort undertaken should be set up through a standardized format (trail duration, number of vessels involved, analytical methods used etc.).

The annual plan will be drafted by the North Western Waters Advisory Council (NWWAC) and be submitted to the North Western Waters Group no later than 1 April 2019. The North Western Waters Group will review the plan and will submit the plan to the European Commission and STECF.

The NWWAC is also asked to provide an annual report on the state of play. The first report should be sent to the North Western Waters Group no later than 1 April 2020.

***Matrix on best practices***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Status |  | Type of measure | Gear |
|  | 1. research still needed; 2. could be trialled; 3. could be implemented | Reference in background document |  | Trawls | Nets |
| Avoidance | 1 and 2 | A.1 | Active sharing of information between operators | x | x |
| 1 | A.2 | Move on rules | x |  |
| 1 | A.3 | Use of side-scan sonar to identify aggregations | x |  |
| 1 | A.4 | Identify and avoid known spawning/nursery areas | x | x |
| Selectivity | 1, 2 | B.1 | Deterrents - making use of sensory organs (lights, magnets) | x | x |
| 1 | B.2 | Behaviour of rays in and around the net | x | x |
| 1, 2 | B.3 | Tow speed & Tow duration | x |  |
| 2, 3 | B.4 | Raised fishing line | x |  |
| 2, 3 | B.5 | Mesh size | **X** | x |
| 2, 3 | B.6 | Selective grid | x |  |
| 2, 3 | B.7 | Escape panel | x |  |
| Survival | 2 & 3 | C.1 | Prompt release after catch | x |  |
| 3 | C.2 | Handle with care (don’t lift by tail) | x | x |
| 3 | C.3 | Keep catch wet before and during sorting | x |  |
| 2 | C.4 | Effects of fishing practice and gears | x | x |

1. **Handling measures to help increase survival**

The following factors are known to effect the survival of skates and rays:

***Prompt release***

Fish that are to be discarded should spend as little time on board as possible, the on board handling should be done in such a way that the discards are disposed as soon as possible. Depending on the type of vessel different strategies can be adopted:

All vessels:

1. Only start gutting the target catch after the discards have been sorted and put back overboard

Cutter with conveyor:

1. Remove skates from the catch in the first stage (directly from hopper on during first stage between hopper and conveyor
	* + Note: this only works if catches of rays are small (less than 10 individuals, otherwise handling time would increase) if there is a lot of ray in the catch it would be better to let them go back at the end of the conveyor belt

***Handling of skates***

Skates should not be lifted or thrown back by the tail but supported in the middle to prevent organ and spine damage and releasing them below the water line decreases the chance of predation.

1. Distributing handling guidelines along with workshops in the harbors on best practices for handling rays
	* + Note: proper handling of specimens is increasingly difficult with larger catch sizes.
2. Use of escape chute (canvas chute) for easy release below the water line for skates
3. Cleaning the gills of skates caught from muddy soils

***Keep the catch wet***

The time the fish is out of the water should be reduced as far as possible, one way to do this is to look for ways to keep the catch wet while on deck. There are large differences in the practical applicability of this method between larger and small vessels.

Cutter with conveyor:

1. Fill the hopper with water so the fish can swim before the sorting starts
	* Note: on a rough sea this would not be possible due to health and safety issues
	* Note: this would require an investment in a waterproof hopper (not collapsible) and extra pumping capacity
2. Spray catch with water on conveyor

***Fishing practice and gears***

One cause of mortality in discarded fish is damage sustained during the catch process or due to crowding in the net.

1. Tickler chains are known to cause damage to skates and increase mortality, reducing the use of these chains would be a positive measure for skates
2. Large mesh panels reduce the amount of debris in the net, even if the panel is not big enough to release skates this can have a positive effect as there is less crowding in the net.
3. Shortening the tow time reduces the time the fish are present in the net and potentially decreases the crowding
4. Reduce soak time for gill nets 🡪 with soak times up to 48 hours a good survival for thornback rays has been documented
5. **Avoidance**

The most efficient way to prevent unwanted mortality is to avoid catching the fish in the first place. Avoidance has featured very little in discard studies that have tended to focus in survival and selectivity. It is none the less the first step towards a selective fishery. Therefore, new methodologies should be trailed and researched to explore that allow fishers to improve their knowledge on where to best deploy their gears. An advantage of spatial management is that control is relatively straight forward because it can make use of VMS data.

***Research on active sharing of information***

Skates and rays are known to form aggregations, but these are hard to predict. Finding ways to avoid these large groups of fish would be a great advantage in preventing unwanted catches.

1. Sharing information on distribution of skates in (semi) real time among fishermen to warn about areas with high skate densities through a digital system.
	1. VisTrek.nl is a new concept that that allows fishermen to log information per haul and directly share information of interest to others within their network
	2. The spurdog avoidance program in the Bristol Channel puts out predictive maps on expected spurdog densities to help fishermen avoid large catches
		* Note: to be of interest to be used on a large scale the safety and privacy would have to be organized in such a way that al actors feel confident to share their data.

***Research on Move on Rules***

This concept of move on rules is currently used to reduce catches of undersized fish but could also be developed for avoiding other unwanted catches.

1. Move on directive when catches of skate are above a certain percentage of the catch
	* Note: Any decision on a move on rule should be validated by at least 2 observations
	* Note: Research is needed on the optimal move on distance as skate aggregations can be highly localized and can move themselves

***Identify and avoid known spawning/nursery areas***

Skates and rays tend to return to the same areas to lay their egg cases during a predictable time of year. Closing these areas to (certain types) of fishing during these periods would protect both the large females and the juveniles.

1. Research project on identifying and mapping spawing / nursery areas and adjust management accordingly.
	* This will be taken up in the Sumaris project over the next 3 years.

***Use of side scan sonar***

In pelagic fisheries the use of side scan sonar is gaining ground, with this method the size and shape of whole schools of fish can be analysed as well as the amount of bycatch species.

1. Research project on the use of innovative scanning and sonar techniques in demersal fisheries.
	* Note: This technique is still too costly now but developments should be monitored for future use in all fisheries.
2. **Selectivity**

Gear-based technical measures can be applied to improve the selectivity towards skates and rays.

***Deterrents – making use of sensory organs (lights, magnets)***

The specific biology of skates and rays means that there could be deterrents that influence their sensory organs.

1. Research project on light as deterrent in towed gear. First results with LED lights to reduce bycatch or increase catch of particular fish or shellfish species appear to be successful for the species studied, but there has not been a trail in a fishery with bycatch of skates and rays.
2. Research project on magnets in fixed gear. A desk study concluded that the use of magnets to deter skates and rays would not work on towed gear, as it would require large magnets and their magnetism would be amplified too much. Smaller magnets could be trailed on fixed gear.
* Note: Although promising, these measures needs more research before it can be considered and it is recommended to develop hypotheses on how the sensory systems may be influenced, prior to testing these in experimental situations.

***Behaviour of rays in or around the net***

1. Research project on behaviour of skates and rays in net. Understanding the behaviour of fish after capture can greatly improve possible selectivity measures such as grids or escape panels.

***Tow speed and Tow duration***

Selectivity survival studies for several fish species have shown that reducing the town speed and town duration greatly influences the composition of the catch as well the survival potential. The main challenge in applying this in fisheries is potential loss of target catch.

1. Research project on optimising tow speed to reduce bycatch as much as possible with acceptable reduction of target catch
2. Research project on optimising tow speed to reduce bycatch as much as possible with acceptable reduction of target catch
	* Note: Decreasing tow duration would only make a lot of difference in shallow water. Both speed and duration of towing is highly dependent on tidal conditions.

***Raised fishing line***

1. Raising the fishing line creates to create an opening for bottom swimming fish to escape.
* Note: preliminary results show that this can lead to up to 80% lower bycatch of skates in a mixed demersal fishery for whiting

***Mesh size***

Increasing mesh size in trawl fisheries on its own might not be a feasible option to exclude skates and rays as they are quite often the largest fish in the catch so a mesh size large enough to release rays would exclude all other fish as well. It can however be used in combination with other selectivity devices (grids etc.) in fisheries for small species.

1. Optimising mesh size in gill net fisheries
	* Note: it can be beneficial to decrease mesh size to prevent catches of large females

***Selective grid***

Grid are used in a number of trawl fisheries to separate small from large species. Grids can be placed in different areas of the net depending on the behaviour of the fish.

1. Grid in combination with two cod-ends or an escape hatch
	* Swedish *Nephrops* fisheries has no upper cod-end and Dutch brown shrimp fisehries uses an escape hatch (zeeflap) to get rid of large individuals
	* Fisheries targeting larger fish, such as turbot and brill, would not benefit from this as they want to retain the larger fish and so would also retain the rays

***Escape panels***

Escape panels at different areas of the net are used in trawl fisheries to reduce unwanted bycatches. There are currently no fisheries that use panels with the specific purpose of excluding rays as the mesh size of the panels would be so large as to exclude most target catch. Future studies on behaviour of skates in trawl nets could potentially yield options for use of panels in specific situations.

**Annex 1 List of the main skate species and stocks in the Celtic Seas ecoregion (Subateas 6-7). See ICES (2017) and EU (2018) for further details**

| **Species (FAO code)** | **Stock unit** | **Status (from ICES) and current EU management** |
| --- | --- | --- |
|
| *Dipturus batis* (RJB) and *D. intermedius* | rjb.27.67a-ce-k[[3]](#footnote-3)   | Assessed by ICES on a quadrennial basis. *D. batis* is locally common in the Celtic Sea, but exact status is uncertain. Status of *D. intermedius* is unknown. Currently both listed as ‘**prohibited species**’ in Union waters of Division 2.a and Subareas 3–4, 6–10. Not subject to the landing obligation in these areas. |
| *Dipturus nidarosiensis* (JAD) | NA | This northerly and deep-water species is not currently assessed by ICES, and its status is unknown. Currently listed as a ‘**prohibited species**’ in Union waters of Divisions 6.a, 6.b, 7.a, 7.b, 7.c, 7.e, 7.f, 7.g, 7.h and 7.k. Not subject to the landing obligation in these areas. |
| *Dipturus oxyrinchus* (RJO) | NA | This northerly and deep-water species is not currently assessed by ICES, and its status is unknown.  |
| *Leucoraja circularis*(RJI) | rji.27.67 | Stock status is uncertain (Category 5 stock)[[4]](#footnote-4). This species is an offshore species and so a minor component of reported landing over the ecoregion as a whole. Some data for this species are confounded with small-eyed ray. |
| *Leucoraja fullonica*(RJF) | rjf.27.67 | Stock status is uncertain (Category 5 stock)[[5]](#footnote-5) |
| *Leucoraja naevus*(RJN) | rjn.27.67 | Important commercial species. The stock size indicator is increasing (Category 3 stock)[[6]](#footnote-6) |
|
| *Raja brachyura* (RJH) | rjh.27.4c7d | Important commercial species. Stock size indicator is increasing (Category 3 stock)[[7]](#footnote-7) |
| rjh.27.7e | Important commercial species. Stock status is uncertain (Category 5 stock)[[8]](#footnote-8) |
| rjh.27.7afg | Important commercial species. Stock status is uncertain (Category 5 stock)[[9]](#footnote-9) |
| rjh.27.4a6 | Important commercial species. Stock status is uncertain (Category 5 stock)[[10]](#footnote-10) |
| *Raja clavata*(RJC) | rjc.27.3a47d | Important commercial species. Stock size indicator is increasing (Category 3 stock)[[11]](#footnote-11) |
| rjc.27.7e | Important commercial species. Stock status is uncertain (Category 5 stock)[[12]](#footnote-12) |
| rjc.27.7afg | Important commercial species. Stock size indicator is increasing (Category 3 stock)[[13]](#footnote-13) |
| rjc.27.6 | Important commercial species. Stock size indicator is decreasing in recent years (albeit with a longer-term increase)[[14]](#footnote-14) |
| *Raja microocellata* (RJE) | rje.27.7fg  | Stock size indicator has decreased slightly in recent years (Category 3 stock)[[15]](#footnote-15) |
| rje.27.7de | Stock status is uncertain (Category 5 stock)[[16]](#footnote-16) |
| *Raja montagui* (RJM) | rjm.27.3a47d | Stock size indicator is increasing (Category 3 stock)[[17]](#footnote-17) |
| rjm.27.7ae-h  | Stock size indicator is increasing (Category 3 stock)[[18]](#footnote-18) |
| rjm.27.67bj  | Stock size indicator is increasing (Category 3 stock)[[19]](#footnote-19) |
| *Raja undulata* (RJU) | rju.27.7bj  | Status uncertain, with ICES advising for zero catch[[20]](#footnote-20) |
| rju.27.7de | Stock size indicator is increasing (Category 3 stock)[[21]](#footnote-21) |
| *Rostroraja alba* (RJA) | rja.27.nea[[22]](#footnote-22) | Depleted species. Currently listed as a ‘prohibited species’ in Union waters of Subareas 6–10. Not subject to the landing obligation in these areas. |

1. <https://www.interreg2seas.eu/nl/sumaris> [↑](#footnote-ref-1)
2. <https://www.wur.nl/nl/project/Overleving-van-platvis-en-rog-in-de-pulsvisserij.htm> [↑](#footnote-ref-2)
3. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rjb-celt.pdf> [↑](#footnote-ref-3)
4. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rji-celt.pdf> [↑](#footnote-ref-4)
5. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rjf-celt.pdf> [↑](#footnote-ref-5)
6. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rjn-678abd.pdf> [↑](#footnote-ref-6)
7. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/rjh.27.4c7d.pdf> [↑](#footnote-ref-7)
8. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rjh-7e.pdf> [↑](#footnote-ref-8)
9. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rjh-7afg.pdf> [↑](#footnote-ref-9)
10. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/rjh.27.4a6.pdf> [↑](#footnote-ref-10)
11. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/rjc.27.3a47d.pdf> [↑](#footnote-ref-11)
12. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rjc-echw.pdf> [↑](#footnote-ref-12)
13. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rjc-7afg.pdf> [↑](#footnote-ref-13)
14. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rjc-VI.pdf> [↑](#footnote-ref-14)
15. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rje-7fg.pdf> [↑](#footnote-ref-15)
16. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rje-ech.pdf> [↑](#footnote-ref-16)
17. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2017/2017/rjm.27.3a47d.pdf> [↑](#footnote-ref-17)
18. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rjm-7aeh.pdf> [↑](#footnote-ref-18)
19. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rjm-67bj.pdf> [↑](#footnote-ref-19)
20. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rju-7bj.pdf> [↑](#footnote-ref-20)
21. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rju-ech.pdf> [↑](#footnote-ref-21)
22. <http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/rja-nea.pdf> [↑](#footnote-ref-22)