## 7.2.7.2 Mixed-fisheries advice for the Bay of Biscay and Atlantic Iberian waters

**Summary**

Mixed-fisheries considerations are based on the single-stock assessments combined with knowledge on the species composition in catches in Atlantic Iberian waters fisheries. Mixed-fisheries scenarios are based on central assumptions that fishing patterns and catchability for individual fleets remain the same in 2016 and 2017 as in recent years (similar to procedures in single-stock forecasts where growth and selectivity are assumed constant). Seven example scenarios of fishing opportunities considering mixed fisheries are presented, taking into account the single-stock advice for fisheries catching hake, four-spot megrim, megrim, and white anglerfish. Without specific mixed-fisheries management objectives, ICES cannot recommend specific scenario(s).

Mixed-fisheries projections for 2017 are presented in terms of catch. The limiting stocks for fishing opportunities will be the hake and four-spot megrim, corresponding to an undershoot of the advised catch for white anglerfish and megrim. Conversely, white anglerfish is the least limiting stock corresponding to an overshoot of the advised catch for all other species in the mixed-fisheries analysis (Figure 7.2.7.2.1; Table 7.2.7.2.2).
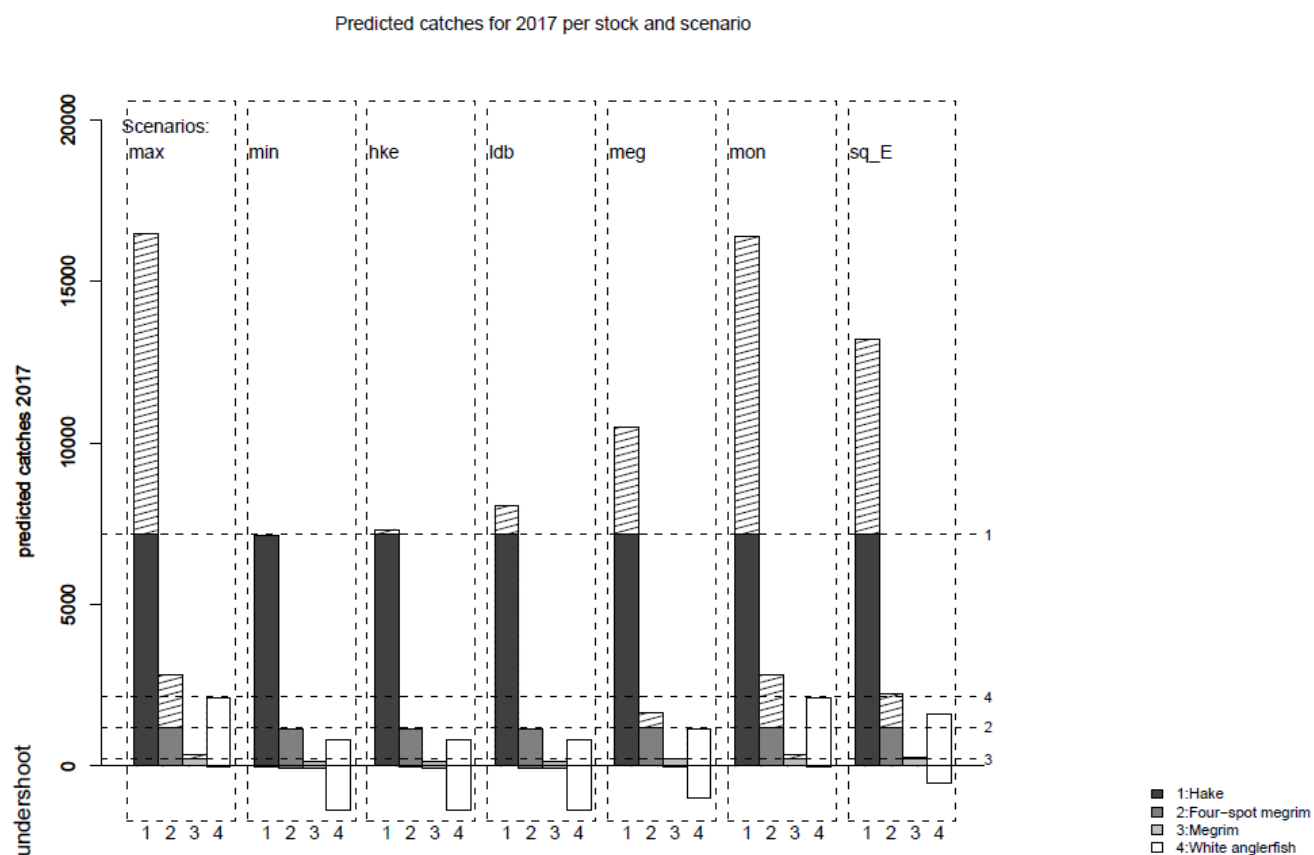
**Figure 7.2.7.2.1** Mixed-fisheries advice in the Atlantic Iberian waters. Projections. Estimates of potential catches (in tonnes) by stock and by scenario (described in Table 7.2.7.2.1). Horizontal lines correspond to the single-stock advice, but hake and white anglerfish show slight differences that are due to differences in the forecast models (see Quality considerations). Bars below the value of zero show undershoot (compared to single-stock advice) where catches are predicted to be lower when applying the scenario. Hatched columns represent catches in overshoot of the single-stock advice.

**The scenarios**

**Table 7.2.7.2.1**    Mixed-fisheries advice in the Atlantic Iberian waters. Scenarios.

| Scenarios | Abbreviation | Explanation |
|---|---|---|
| Maximum | max | For each fleet, fishing stops when all stocks have been caught up to the fleet's stock shares*. This option causes overfishing of the single-stock advice possibilities for most stocks. |
| Minimum | min | For each fleet, fishing stops when the catch for any one of the stocks meets the fleet's stock share. This option is the most precautionary option, causing underutilization of the single-stock advice possibilities of other stocks. |
| Hake | hke | All fleets set their effort corresponding to their hake quota share, regardless of other catches. |
| Four-spot megrim | ldb | All fleets set their effort corresponding to their four-spot megrim quota share, regardless of other catches. |
| Megrim | meg | All fleets set their effort corresponding to their megrim quota share, regardless of other catches. |
| White anglerfish | mon | All fleets set their effort corresponding to their white anglerfish quota share, regardless of other catches. |
| *Status quo* effort | sq_E | The effort is set equal to the effort in the most recently recorded year for which landings and discard data are available (2015). |

**\*** Throughout this document, the term "fleet's stock share" or "stock share" is used to describe the share of the fishing opportunities for each particular fleet, which has been calculated based on the single-stock advice for 2017 and the historical proportion of the stock landings taken by the fleet.

**Catch options**

Mixed-fisheries advice considers the implications of mixed fisheries operating under single-stock catch limits, taking into account the fishing pattern and catchability of the various fleets in recent years. The scenarios therefore do not assume any amount of quota balancing through adaptation of fishing behaviour. Scenarios that result in under- or overutilization are useful in identifying the main points of friction between the fishing opportunities of the various stocks. They indicate the direction in which fleets may have to adapt to fully utilize their catch opportunities.

Catch options are presented in Table 7.2.7.2.2 under the scenarios described in Table 7.2.7.2.1. The "min" scenario is based on the assumption of a strictly implemented discard ban. For 2017, the "min" scenario results are very similar to the "hke" and "ldb" scenarios, indicating that the stocks of hake and four-spot megrim are the most limiting stocks for most fleets. In addition to the "min" scenario a "max" scenario is included. The latter scenario demonstrates the upper bound of potential fleet effort and stock catches in that it assumes all fleets continue fishing until all their stock shares are exhausted, irrespective of the economic viability of such actions. For 2017, the "max" scenario is very similar to the "mon" scenario, indicating that the stock of white anglerfish is the least limiting stock for most fleets.

**Table 7.2.7.2.2**    Mixed-fisheries advice in the Atlantic Iberian waters. Catch options for 2017 for single-stock advice (in tonnes) and mixed-fisheries scenarios.

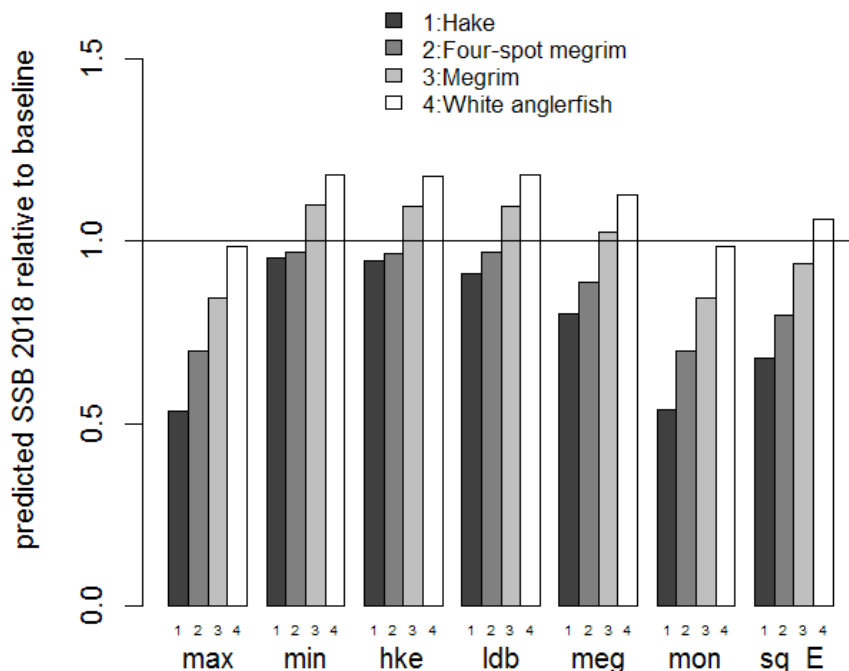| Stock | Single-stock catch advice 2017Single-stock catch advice | Catches per mixed-fisheries scenario 2017 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | "max" | "min" | "hke" | "ldb" | "meg" | "mon" | "Sq_E" |
| Hake in divisions 8.c and 9.a | 8049 | 16452 | 7137 | 7320 | 8060 | 10493 | 16376 | 13206 |
| Four-spot megrim in divisions 8.c and 9.a | 1197 | 2817 | 1148 | 1159 | 1148 | 1647 | 2817 | 2216 |
| Megrim in divisions 8.c and 9.a | 211 | 361 | 145 | 147 | 146 | 208 | 361 | 282 |
| White anglerfish in divisions 8.c and 9.a | 2253 | 2101 | 792 | 800 | 793 | 1161 | 2101 | 1603 |

**Table 7.2.7.2.3**    Mixed-fisheries advice in the Atlantic Iberian waters. TAC year (2017) fishing mortality forecast by scenario. The F range is averaged across the same ages as those used for the single-stock assessment.

| Stock | Single-stock advice $F_{2017}$ | Basis for the advice | F per mixed-fisheries scenario in 2017 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | "max" | "min" | "hke" | "ldb" | "meg" | "mon" | "Sq_E" |
| Hake in divisions 8.c and 9.a | 0.25 | MSY approach | 0.89 | 0.30 | 0.31 | 0.35 | 0.48 | 0.89 | 0.65 |
| Four-spot megrim in divisions 8.c and 9.a | 0.19 | MSY approach | 0.56 | 0.19 | 0.19 | 0.19 | 0.28 | 0.56 | 0.41 |
| Megrim in divisions 8.c and 9.a | 0.19 | MSY approach | 0.36 | 0.12 | 0.12 | 0.12 | 0.18 | 0.36 | 0.26 |
| White anglerfish in divisions 8.c and 9.a | 0.31 | MSY approach | 0.31 | 0.11 | 0.11 | 0.11 | 0.16 | 0.31 | 0.22 |

**Table 7.2.7.2.4**    Mixed-fisheries advice in the Atlantic Iberian waters. SSB results from single-stock advice and different mixed-fisheries scenarios (see Figure 7.2.7.2.1). Weights are in tonnes.

| Stock | Single-stock advice SSB 2018 | SSB (2018) resulting from mixed-fisheries scenarios applied in 2017 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | "max" | "min" | "hke" | "ldb" | "meg" | "mon" | "Sq_E" |
| Hake in divisions 8.c and 9.a | 37110 | 18806 | 33524 | 33227 | 32034 | 28136 | 18922 | 23844 |
| Four-spot megrim in divisions 8.c and 9.a | 7507 | 5242 | 7248 | 7236 | 7248 | 6648 | 5242 | 5963 |
| Megrim in divisions 8.c and 9.a | 1021 | 857 | 1113 | 1110 | 1112 | 1038 | 856 | 950 |
| White anglerfish in divisions 8.c and 9.a | 7303 | 6884 | 8253 | 8245 | 8253 | 7867 | 6884 | 7403 |

| legend | |
|---|---|
| | SSB 2018 $\geq$ MSY $B_{trigger}$ |
| | $B_{pa} \leq$ SSB 2018 < MSY $B_{trigger}$ |
| | $B_{lim} \leq$ SSB 2018 < $B_{pa}$ |
| | SSB 2018 < $B_{lim}$ |

There are some differences between the single-stock catch, F, and SSB values and the values obtained from the mixed fisheries scenarios that consider all fleets set their effort corresponding to their quota shares for each given species. For megrim and four-spot megrim the differences are around 5% or less, whereas they are larger for hake and anglerfish (but not exceeding 10% for catch or SSB). For hake and anglerfish, differences are expected because the length-based models used in the stock assessments are approximated with age-based models in the mixed fisheries analysis. The reason for the discrepancy is unknown in the case of the megrim and four spot megrim.

**Figure 7.2.7.2.2**  Mixed-fisheries advice in Atlantic Iberian waters. Estimates of potential SSB at the start of 2018 by stock after applying the mixed-fisheries scenarios, expressed as a ratio to the single-stock advice forecast. The horizontal line corresponds to the SSB resulting from the single-stock advice (at the start of 2018).
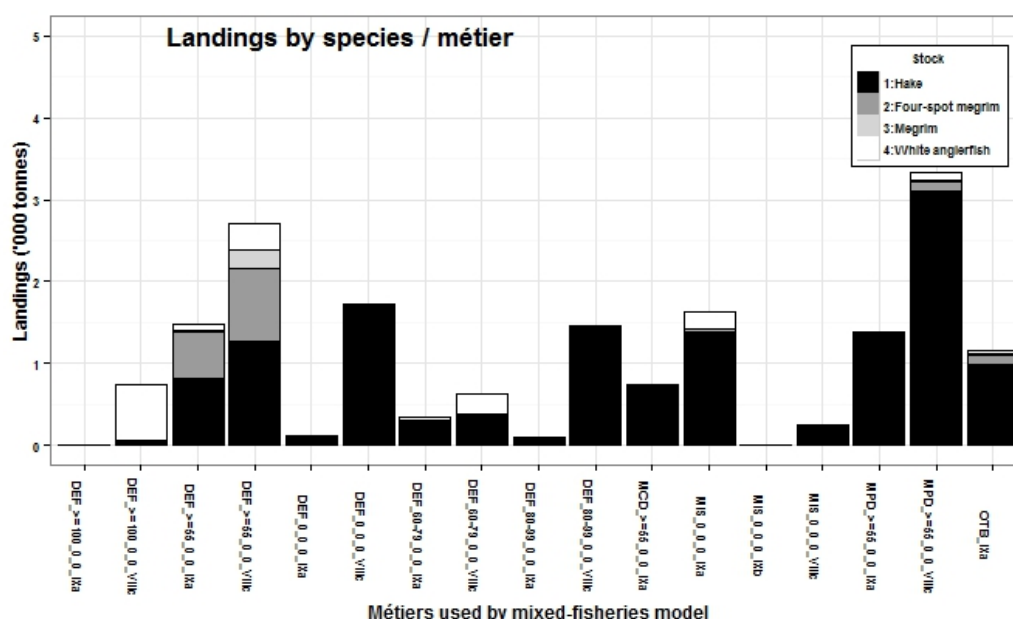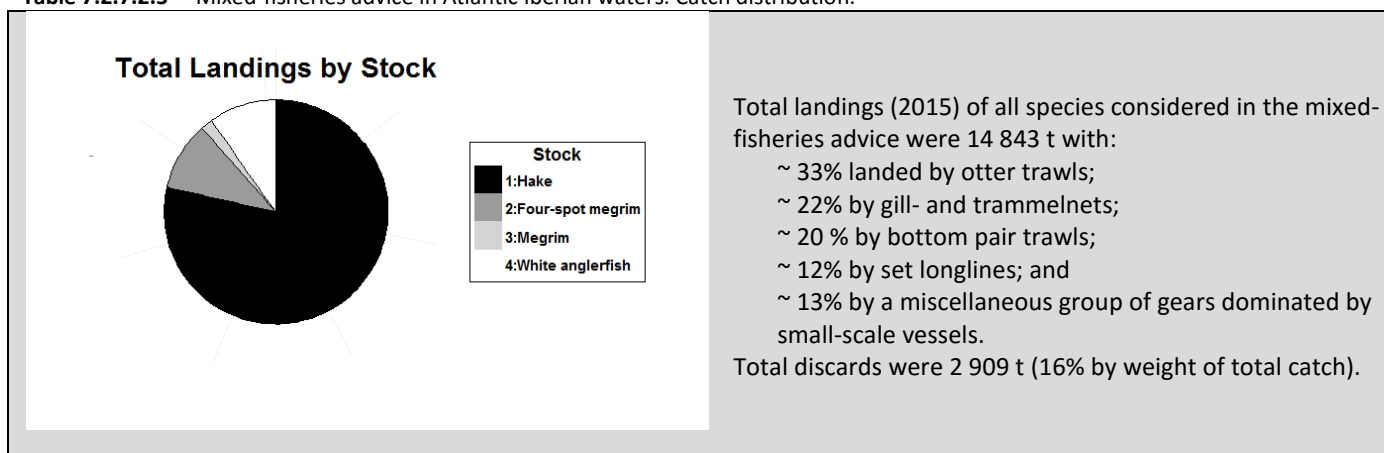
## Methods and data

Mixed-fisheries considerations are based on the single-stock assessments combined with knowledge on the species composition in catches in the Atlantic Iberian fisheries. Mixed-fisheries scenarios are based on central assumptions that the fishing patterns and catchability for individual fleets remain the same in 2016 and 2017 as in recent years.

The species considered here as part of the Atlantic Iberian demersal mixed fisheries are hake, four-spot megrim, megrim, and white anglerfish. Projections are presented in terms of catch. The reference points for the included stocks can be found in the single-stock advice sheets (ICES, 2016a, 2016b, 2016c, 2016d) and the 2015 relative catch distribution is shown in Table 7.2.7.2.5.

Other demersal stocks were not included because they either lack an analytical assessment or, in the case of black anglerfish, the stock assessment is based on an aggregated biomass dynamic model and does not provide the age-structured estimates required by the mixed-fisheries model.

Pelagic stocks are not presently included despite some of them having technical interaction with demersal fisheries in Iberian waters.

**Table 7.2.7.2.5** Mixed-fisheries advice in Atlantic Iberian waters. Catch distribution.

**Total Landings by Stock**

Stock
- 1:Hake
- 2:Four-spot megrim
- 3:Megrim
- 4:White anglerfish

Total landings (2015) of all species considered in the mixed-fisheries advice were 14 843 t with:
- ~ 33% landed by otter trawls;
- ~ 22% by gill- and trammelnets;
- ~ 20 % by bottom pair trawls;
- ~ 12% by set longlines; and
- ~ 13% by a miscellaneous group of gears dominated by small-scale vessels.

Total discards were 2 909 t (16% by weight of total catch).

**Figure 7.2.7.2.3** Mixed-fisheries advice in Atlantic Iberian waters. Description of the landings distribution of species by métier in 2015 (métiers are described in Table 7.2.7.2.6).

Fleet and métier categories used in the mixed-fisheries analysis are based on the EU data collection framework (DCF) levels 5 (Portuguese fleets) and 6 (Spanish fleets) categories (Table 7.2.7.2.6). Fleet categories are based on the DCF fleet segments, but only trawl vessels were provided by size range.

**Table 7.2.7.2.6**    Mixed-fisheries advice for Iberian stocks. Métier categories used in the Iberian waters mixed-fisheries analysis.

| Acronym | DCF definition | Description |
|---|---|---|
| GNS_DEF_>=100_0_0 | Set gillnet targeting demersal fish with mesh sizes larger than 100 mm | Spanish set gillnet ("*rasco*") targeting white anglerfish in ICES Division 8.c with mesh size of 280 mm |
| GNS_DEF_60-79_0_0 | Set gillnet targeting demersal fish with mesh sizes within the range 60–79 mm | Spanish small set gillnet ("*beta*") targeting a variety of demersal fish in northwestern Spanish waters |
| GNS_DEF_80-99_0_0 | Set gillnet targeting demersal fish with mesh sizes within the range 80–99 mm | Spanish set gillnet ("*volanta*") targeting hake with nets of 90 mm mesh size in northwestern Spanish waters |
| GTR_DEF_60-79_0_0 | Trammelnet targeting demersal fish with mesh sizes within the range 60–79 mm | Spanish trammelnet targeting a variety of demersal species in northwestern Spanish waters |
| LLS_DEF_0_0_0 | Set longline targeting demersal fish | Spanish set longline targeting a variety of demersal fish in Spanish Iberian waters |
| MIS_MIS_0_0_0 | Miscellaneous | Portuguese and Spanish artisanal fleet not covered by other metiers |
| OTB | ---- | Portuguese bottom otter trawl |
| OTB_DEF_>=55_0_0 | Bottom otter trawl targeting demersal fish using mesh sizes larger than 55 mm | Spanish bottom otter trawl targeting hake, anglerfish, and megrim using "*baca*" nets of 70 mm mesh size in divisions 8.c and 9.a |
| OTB_MCD_>=55_0_0 | Bottom otter trawl targeting mixed crustaceans and demersal fish using mesh sizes larger than 55 mm | Spanish bottom otter trawl targeting a variety of fish and crustaceans using nets of 55 mm mesh size in south-western Iberian waters (Gulf of Cadiz and southern Portuguese waters) |
| OTB_MPD_>=55_0_0 | Bottom otter trawl targeting mixed pelagic and demersal fish using mesh sizes larger than 55 mm | Spanish bottom otter trawl targeting pelagic (horse mackerel, mackerel, etc.) and demersal fish (hake) by using "*jurelera*" nets of 55 mm mesh size in northwestern Spanish waters |
| PTB_MPD_>=55_0_0 | Bottom pair trawl targeting mixed pelagic and demersal fish using mesh sizes larger than 55 mm | Bottom pair trawl targeting pelagic (blue whiting, mackerel…) and demersal fish (hake) by using nets of 55 and 70 mm mesh size in northwestern Spanish waters |

**Table 7.2.7.2.7**    Mixed-fisheries advice for Iberian stocks. The basis of the assessment.

| | |
|---|---|
| ICES stock data category | 1 (ICES, 2016e) |
| Assessment type | Fcube (FLR) (Ulrich *et al.*, 2011; ICES, 2016f) |
| Input data | Assessments on the relevant stocks by the Working Group on the Bay of Biscay and Iberian waters Ecoregion (WGBIE; ICES, 2016g); catch and effort by fleet and métiers. |
| Discards and bycatch | Included as in the single-stock assessments. |
| Indicators | None |
| Other information | This assessment is presented for the first time in the ICES advice in 2016. |
| Working group | Working Group for the Bay of Biscay and the Iberian waters Ecoregion (WGBIE) and Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE) |

## Quality considerations

Mixed-fisheries projections build on single-stock assessments, most of which are of high quality and precision. Single-stock forecasts are also reproduced independently as part of the mixed-fisheries analyses, allowing additional quality control of both processes. For those stocks assessed by using length-based models such as hake (GADGET) and white anglerfish (SS3) the Fcube baseline runs provide results around 10% lower than the single-stock forecasts at the same fishing mortality rate. Extensive investigation into the causes of this concluded it was a model-based difference rather than an Fcube implementation issue. This does not affect the main conclusions of the mixed-fisheries analyses (most and least limiting stocks).

There are some differences between the single-stock catch, F, and SSB values and the values obtained from the mixed fisheries scenarios that consider all fleets set their effort corresponding to their quota shares for each given species. For megrim and four-spot megrim the differences are around 5% or less, whereas they are larger for hake and anglerfish (but not

exceeding 10% for catch or SSB). For hake and anglerfish, differences are expected because the length-based models used in the stock assessments are approximated with age-based models in the mixed fisheries analysis. The reason for the discrepancy is unknown in the case of the megrim and four spot megrim.

## Sources and references

ICES. 2016a. Four-spot megrim (*Lepidorhombus boscii*) in divisions 8.c and 9.a (Bay of Biscay South and Atlantic Iberian waters East). *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 7, Section 7.3.23.

ICES. 2016b. Hake (*Merluccius merluccius*) in divisions 8.c and 9.a, Southern stock (Cantabrian Sea and Atlantic Iberian waters). *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 5, Section 7.3.21.

ICES. 2016c. Megrim (*Lepidorhombus whiffiagonis*) in divisions 8.c and 9.a (Cantabrian Sea and Atlantic Iberian waters). *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 7, Section 7.3.24.

ICES. 2016d. White anglerfish (*Lophius piscatorius*) in divisions 8.c and 9.a (Cantabrian Sea and Atlantic Iberian waters). *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 7, Section 7.3.4.

ICES. 2016e. Advice basis. *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 1, Section 1.2.

ICES. 2016f. Report of the Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE), 23–27 May 2016, ICES HQ, Copenhagen, Denmark. ICES CM 2016/ACOM:22

ICES. 2016g. Report of the Working Group for the Bay of Biscay and the Iberian waters Ecoregion (WGBIE), 13–19 May 2016, ICES HQ, Copenhagen, Denmark. ICES CM 2016/ACOM:12

Ulrich, C., Reeves, S. A., Vermard, Y., Holmes, S. J., and Vanhee, W. 2011. Reconciling single-species TACs in the North Sea demersal fisheries using the Fcube mixed-fisheries advice framework. ICES Journal of Marine Science, 68: 1535–1547.