Stock Annex: Iberian Waters Mixed Fisheries Annex

Mixed Fisheries Annex

Regional specific documentation of standard assessment procedures used by ICES.

Ecoregion:	South European Atlantic Shelf (G)
Working Group:	Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE)
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A. General

A.1. Area definition

This mixed fisheries advice will consider finfish species in the ICES Division 8.c and Division 9.a.

The species considered are part of the demersal mixed fisheries of the Atlantic Iberian Waters, and include hake, four-spot megrim, megrim, black-bellied anglerfish and white anglerfish.

Figure 1. Area description for advice in Atlantic Iberian Waters.

Table 1. Finfish stocks of Iberian Waters included in the mixed fisheries analyses.

ICES stock code	Species	ICES single stock advice area
ank.27.8c9a	Black-bellied anglerfish	divisions 8.c and 9.a
hke.27.8c9a	Hake	divisions 8.c and 9.a
ldb27.8c9a	Four-spot megrim	divisions 8.c and 9.a
meg. 27.8c9a	Megrim	divisions 8.c and 9.a
mon.27.8c9a	White anglerfish	divisions 8.c and 9.a

Several species (e.g. *Scomber scombrus*, *Trachurus trachurus*, *Nephrops norvegicus*, *Micromesistius poutassou*) are identified to be included in the mixed fisheries advice for Iberian Waters. These species are target species of the demersal fleets and could be considered in the mixed fisheries model as well as other vulnerable and potential choke species for these fleets (e.g. Rays and skates). The introduction of new species will improve the scope and relevance of the mixed fisheries advice and this document should be updated accordingly.

A.2. Fishery

In March 2019, the European Parliament and the Council have published a multiannual management plan (MAP) for the Western Waters (Parliament and Council Regulation (EU) 2019/472) and repealed the previous recovery plan (Council Regulation (EC) No. 2166/2005). This MAP applies to all demersal stocks included in the mixed fisheries advice.

Since 2015, the EU Landing Obligation has been gradually implemented throughout European fisheries. The full implementation of the landing obligation for all commercial fisheries was in January 2019.

Black anglerfish in 8c and 9a

Black anglerfish is caught by bottom otter trawl and trammel and gillnet fisheries. These fisheries also catch hake, megrims and white anglerfish. There is no minimum landing size for anglerfish, but a minimum marketable weight of 500 g was fixed in 1996 to ensure standards of market.

Hake in 8c and 9a

Hake is caught by a multigear fleet (otter trawlers, pair trawlers, gillnetters, longliners, and small-scale artisanal vessels). In the trawl fleet, hake is caught together with megrim, anglerfish, blue whiting, horse mackerel, mackerel, and crustaceans. Discards occur mainly in the trawl fisheries that target smaller fish than gillnetters and longliners.

Four-spot megrim in 8c and 9a

The southern four-spot megrim stock is almost exclusively caught in mixed bottom otter trawl fisheries. Landings of this fleet was traditionally compounded of demersal species as megrim, hake, anglerfish, and *Nephrops*.

Megrim in 8c and 9a

As wells as four-spot megrim, the megrim southern stock is almost exclusively caught in mixed bottom otter trawl fisheries. Landings of this fleet was traditionally compounded of demersal species as four-spot megrim, hake, anglerfish, and *Nephrops*.

White anglerfish in 8c and 9a

White anglerfish is caught by a directed gillnet métier (called "rasco" in Spanish), bottom otter trawl and trammel nets. The last fisheries also catch hake, megrims and black anglerfish. There is no minimum landing size for anglerfish, but a minimum marketable weight of 500 g was fixed in 1996 to ensure standards of mark.

A.3. Ecosystem aspects

These are described in the Bay of Biscay and Atlantic Iberian Waters ecosystem overview in the ICES advisory report.

B. Data

The mixed-fisheries assessment is based on catch and effort data provided by the National laboratories and administrations to ICES under the joined 2019 data call. These fishery data, structured by DCF fleet segments and métiers, are used as inputs together with ICES single-stock data and advice, in the integrated FLBEIA framework.

The assessment data for the different stocks is taken from the ICES Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE. ICES, 2020). For hake and both megrims, total catches (landings and discards) are included in the single-stock assessment. The assessment of white anglerfish and black-bellied anglerfish just include landings as discards are almost negligible for these species.

The white anglerfish assessment is performed by using length-based stochastic assessment models Stock Synthesis (Methot, 2000). Stock Synthesis is an integrated assessment model, which it is capable to use different sources of information, and where all parameters have a set of controls to allow prior constraints, time-varying flexibility, and linkages to environmental data.

Both southern stock of megrims, four-spot megrim and megrim, are assessed by applying the XSA method (Shepherd, 1999).

ICES provides advice for category 3 hake and black-bellied anglerfish stocks, based on the ratio of the mean of the last two index values (Index A) and the mean of the three preceding values (Index B), multiplied by the recent ICES estimated catch (mean of the last three years).

C. Assessment methodology

Definitions

Two basic concepts are of primary importance when dealing with mixed-fisheries, the Fleet (or fleet segment), and the Métier. Their definition has evolved with time, but the most recent official definitions are those from the Data Collection Framework (DCF), established by the Commission Decision 2010/93/EU, which we adopt here:

- ***A Fleet segment*** is a group of vessels with the same length class and predominant fishing gear during the year. Vessels may have different fishing activities during the reference period, but might be classified in only one fleet segment.
- ***A Métier*** is a group of fishing operations targeting a similar (assemblage of) species, using similar gear, during the same period of the year and/or within the same area and which are characterized by a similar exploitation pattern.

Model used

FLBEIA

The FLBEIA simulation model is presented and described in García *et al*. (2017). The aim of this flexible and generic simulation model is to allow conducting Bio-Economic Impact Assessments of harvest control rule based on management strategies under a Management Strategy Evaluation (MSE) framework. The model provides functions that describe the different components of the system (i.e. stocks, fleets and management procedure). Given fishing opportunities available for each fleet (e.g. TAC by stock or effort allocation by fleet), the model estimates the potential future levels of effort for each fleet, based on fleet effort distribution and catchability by métier. Based on this effort level, landings and discards (i.e. catches) by fleet are estimated using standard forecasting procedures.

The selected function to simulate the behaviour of the fleet is the Simple Mixed Fisheries Behaviour model (SMFB), which is a simplified version of the behaviour of fleets that work in a mixed fisheries framework. The assumes that effort share among metiers is given as input parameter. Catchability ($q_{f,mt,st}$) by fleet (*f*), métier (*mt*) and stock (*st*) can be estimated as a mean over the recent observed landings and discards. But the user can also select a specific value of *q*, in case of evidence of changes are expected to occur (e.g. significant technical creep, a change in selectivity due to a change in mesh size…).

Each year, fleet effort (E_f) is restricted by the landing or catch quotas of the stocks captured by the fleet. The effort is calculated following the subsequent steps:

1. Compare the overall quotas ($\sum_f Q_{f,st} \cdot TAC$, where $Q_{f,st}$ is the quota share for fleet *f* and stock *st*) with the abundances of the stocks. If the ratio between the overall quota and the abundance (B_{st}) exceeds the catch threshold (γ_{st}), then the quota share is reduced multiplying by the threshold and the inverse of the ratio. That is,

$$\boldsymbol{Q'}_{f,st} = \begin{cases} \boldsymbol{Q_{fl,st}} & , \quad \boldsymbol{if} \ \dfrac{\sum_f \boldsymbol{Q_{f,st}} \cdot \boldsymbol{TAC}}{\boldsymbol{B_{st}}} \leq \boldsymbol{\gamma_{st}} \\ \boldsymbol{Q_{fl,st}} \cdot \dfrac{\boldsymbol{B_{st}} \cdot \boldsymbol{\gamma_{st}}}{\sum_f \boldsymbol{Q_{f,st}} \cdot \boldsymbol{TAC}} & , \quad \boldsymbol{if} \ \dfrac{\sum_f \boldsymbol{Q_{f,st}} \cdot \boldsymbol{TAC}}{\boldsymbol{B_{st}}} > \boldsymbol{\gamma_{st}} \end{cases} \qquad \textbf{(1)}$$

2. According to the catch production function, Cobb-Douglas in this case, the efforts corresponding to the landing or catch cuotas ($\boldsymbol{Q'_{f,st}} \cdot TAC$) for the *n* individual stocks ($st_i, i = 1, \dots, n$) are calculated, $\{E_{f,st_1}, \dots, E_{f,st_n}\}$ as follows:
$$E_{f,st} = \boldsymbol{Q'_{f,st}} \cdot TAC/(q_{f,st} * B_{st})$$
3. Based on the efforts calculated in the previous step, an unique effort ($\hat{E}_f$) is calculated, based on the following options:
    - *max*: the maximum among possible efforts
    $$\hat{E}_f = max_{j=1,\dots,n}\left(E_{f,st_j}\right)$$
    - *min*: the minimum among possible efforts

$$\hat{E}_f = min_{j=1,\dots,n}\left(E_{f,st_j}\right)$$

- *mean*: the mean of possible efforts

$$\hat{E}_f = mean_{j=1,\dots,n}\left(E_{f,st_j}\right)$$

- previous: the effort selected is the effort most similar to previous year effort in that season

$$\hat{E}_f = \left\{E_{f,st}: \left|1 - \frac{E_{f,st}}{E_{f,y-1}}\right| = \min_{j=1,\dots,n}\left|1 - \frac{E_{f,st_j}}{E_{f,y-1}}\right|\right\}$$

- *stock.name*: the effort corresponding to *stock.name* is selected

$$\hat{E}_f = E_{f,stk.nam}$$

If there is Landing Obligation, instead of using the option chosen by the user, the option to calculate the simulated fleet effort will be the minimum among possible efforts.

4. The selected effort ($\hat{E}_f$) is compared with the capacitiy of the fleet (K_f), so that if the capacity is exceeded, the final effort ($E_{f,s}$) should be reduced.

$$\boldsymbol{E_f = \begin{cases} K_f & , \ if\ K_f < \hat{E}_f \\ \hat{E}_f & , \ if\ K_f \geq \hat{E}_f \end{cases}} \quad \textbf{(2)}$$

The following scenarios are explored. Management (mgmt.) year refers to the year for which the advice is provided:

1) **max**: The underlying assumption is that fishing stops when the last quota species is fully utilised with respect to the upper limit corresponding to single stock exploitation boundary for agreed management plan or in relation to precautionary limits.

2) **min**: The underlying assumption is that fishing stops when the catch for the first quota species meets the upper limit corresponding to single stock exploitation boundary for agreed management plan or in relation to precautionary limits.

3) **ank**: The underlying assumption is that all fleets set their effort in the management year at the level corresponding to their black-bellied anglerfish quota share, regardless of other stocks.

4) **hke**: The underlying assumption is that all fleets set their effort in the management year at the level corresponding to their hake quota share, regardless of other stocks.

5) **ldb**: The underlying assumption is that all fleets set their effort at the level in the management year corresponding to their four-spot megrim quota share, regardless of other stocks.

6) **meg**: The underlying assumption is that all fleets set their effort at the level in the management year corresponding to their megrim quota share, regardless of other stocks.

7) **mon**: The underlying assumption is that all fleets set their effort at the level in the management year corresponding to their white anglerfish quota share, regardless of other stocks.

8) **sq_E**: The effort is set as equal to the effort in the most recently recorded year for which there are landings and discard data.

Software used:

The FLBEIA model has been coded as a method in R (R Development Core Team, 2020), as part of the FLR framework (Kell *et al.*, 2007; www.flr-project.org). Input data are in the form of FLFleetsExt and FLBiols objects inherited from the FLCore 2.2 package objects, and two forecast methods were used, stf() from the FLAssess (version 2.6.2) and fwd() from the Flash (version 2.5.11) packages. Both input parameterisation as well as the stock projections are made using FLBEIA functions and methods (version 1.15.5), that are flexible enough to allow covering different alternatives. Full transparency is assured as all the FLBEIA source code is available at GitHub (https://github.com/flr/FLBEIA). The code, software and versions are part of the ICES Transparent Assessment Framework (TAF) and can be fully reproduced from this repository (see https://github.com/ices-taf/2020_IW_MixedFisheriesAdvice).

D. Short-Term Projection methodology

Model used: Overview of software used by WGBIE.

Species	Assessment	Forecast
BLACK-BELLIED ANGLERFISH	Survey-based trends	NA
HAKE 8c-9a	Survey-based trends	NA
FOUR-SPOT MEGRIM 8c-9a	XSA	MFDP
MEGRIM 8c-9a	XSA	MFDP
WHITE ANGLERFISH 8c-9a	SS3	SS3 (ad hoc R code)

In the mixed-fisheries runs, all forecasts were done with the same FLR forecasts method (see section C).

For every scenario, the following output is generated per stock:

	Description	Landings	F mult	SSB
Baseline forecast for current year	Applying single species forecast assumptions to last year's data (current year – 1)*	Current yr	Current yr	1st Jan mgmt yr
Baseline forecast for TAC year	Applying single species HCRs** to current year results*	mgmt yr	mgmt yr	1st Jan mgmt yr + 1
Current year FLBEIA results	Applying FLBEIA to last year's data	Current yr	Current yr	1st Jan mgmt yr
FLBEIA estimate of catches in TAC year	Applying FLBEIA on current year FLBEIA results	mgmt yr	mgmt yr	1st Jan mgmt yr + 1
TAC advice results (incl mgt plans)	Applying single species HCRs** to current year FLBEIA results	mgmt yr	mgmt yr	1st Jan mgmt yr + 1

*** For the Baseline runs, a forecast was run for each stock separately following the same settings as in the ICES single species forecast.**

**** Harvest Control Rules – either from single species management plans or with reference to the F_{MSY} transition approach. Where HCRs according to these approaches were not available values according to the precautionary approach were used.**

The following overview table will be produced to be able to judge the relevance of the different scenarios:

		ANK	HKE	LDB	MEG	MON
Current year	F_{bar*}					
	F_{mult}					
	Landings					
	SSB					
Current year+1	F_{bar*}					
	F_{mult}					
	Landings					
	SSB					
Current year+2	SSB					

*** Fbar refers to the F in the age/length ranges used in the single stock assessments.**

G. Biological Reference Points

The biological reference points that are used are the same values as referred to in the Stock Annex for each species.

H. Other Issues

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I. References

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