

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 of the species composition in the catches of Atlantic Iberian waters fisheries. Mixed-fisheries scenarios are based on central assumptions that fishing patterns and catchability for individual fleets remain the same in 2018 and 2019 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 (Figure 1), taking into account the single-stock advice for fisheries catching hake (hke.27.8c9a), four-spot megrim (ldb.27.8c9a), megrim (meg.27.8c9a), and white anglerfish (mon.27.8c9a). Without specific mixed-fisheries management objectives, ICES cannot recommend any specific scenario(s).

Mixed-fisheries projections for 2019 are presented in terms of catch. The limiting stock for fishing opportunities will be hake, corresponding to an undershoot of the advised catch for the other stocks considered in the mixed-fisheries analysis. Conversely, white anglerfish is the least limiting stock, corresponding to an overshoot of the advised catch for the other considered stocks.

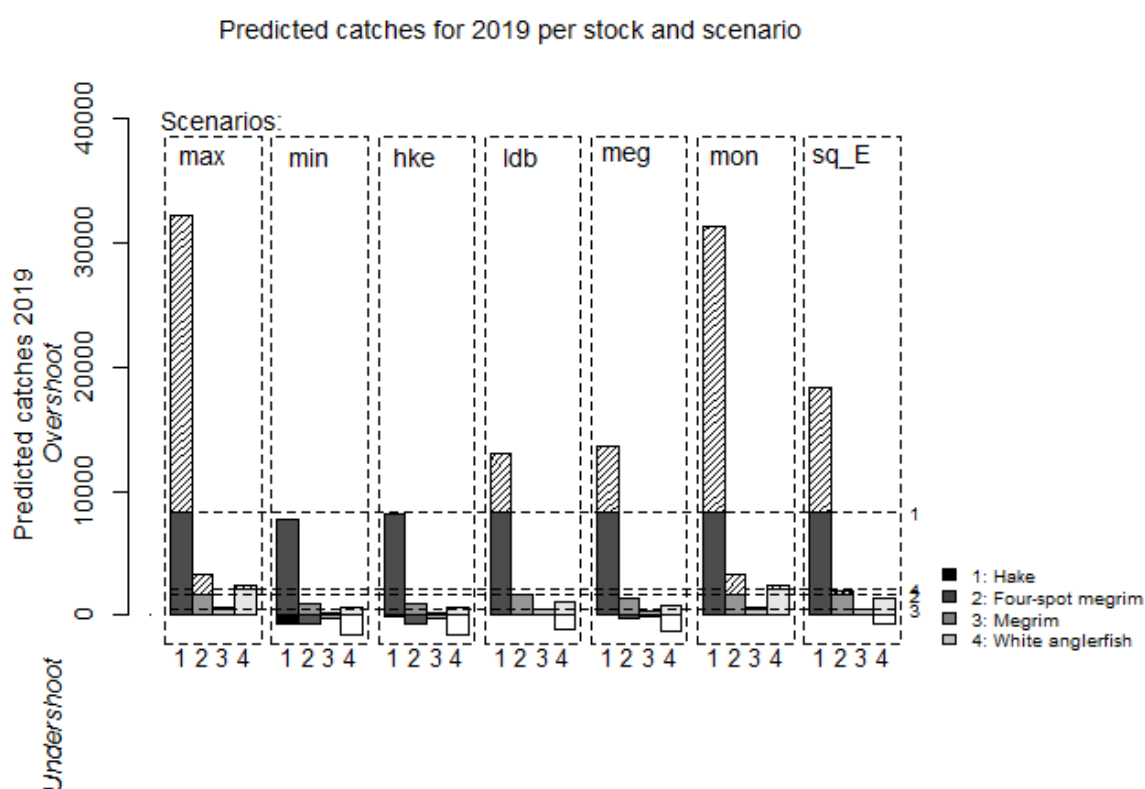


Figure 1 Mixed fisheries for the Bay of Biscay and Atlantic Iberian waters. Projections. Estimates of potential catches (in tonnes) by stock and scenario (described in Table 1). Horizontal lines correspond to the single-stock advice by WGMIXFISH, noting that hake shows differences from the single-species advice for 2019, owing to differences in the applied 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 1 Mixed fisheries for the Bay of Biscay and 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 (2017).

* 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 2019 and the historical proportion of the stock landings taken by the fleet.

Catch scenarios

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, fishing mortality, and spawning-stock biomass for each scenario in Table 1 are presented in Tables 2, 3, and 4, respectively. The "min" scenario is based on the assumption of a strictly implemented discard ban. For 2019, the "min" scenario results are very similar to the "hke" scenario, indicating that hake is the most limiting stock for most fleets. The "max" scenario is included to demonstrate the upper bound of potential fleet effort and stock catches because it assumes all fleets continue fishing until all their stock shares are exhausted, irrespective of the economic viability of such actions. For 2019, 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 2 Mixed fisheries for the Bay of Biscay and Atlantic Iberian waters. Catch scenarios for 2019 for single-stock advice (in tonnes) and mixed-fisheries scenarios (see Figure 1 and Table 1).

Stock	Single-stock catch advice 2019	Catches per mixed-fisheries scenario 2019						
		"max"	"min"	"hke"	"ldb"	"meg"	"mon"	"Sq_E"
hke.27.8c9a	8281	34675	7640	8140	12747	13624	33875	18003
ldb.27.8c9a	1633	3452	916	917	1654	1428	3452	2347
meg.27.8c9a	431	744	256	238	429	371	744	593
mon.27.8c9a	2153	2352	575	579	953	797	2349	1337

Table 3 Mixed fisheries for the Bay of Biscay and Atlantic Iberian waters. TAC year (2019) fishing mortality forecast by scenario (see Figure 1 and Table 1). The F range is averaged across the same ages as those used for the single-stock assessment.

Stock	Single-stock advice F ₂₀₁₉	Basis for the advice	F per mixed-fisheries scenario in 2019						
			"max"	"min"	"hke"	"ldb"	"meg"	"mon"	"Sq_E"
hke.27.8c9a	0.25	MSY approach	1.07	0.24	0.25	0.39	0.42	1.04	0.55
ldb.27.8c9a	0.19	MSY approach	0.40	0.105	0.105	0.190	0.164	0.40	0.27
meg.27.8c9a	0.19	MSY approach	0.38	0.131	0.122	0.22	0.190	0.38	0.30
mon.27.8c9a	0.24	MSY approach	0.24	0.059	0.059	0.097	0.081	0.24	0.137

Table 4 Mixed fisheries for the Bay of Biscay and Atlantic Iberian waters. SSB results from single-stock advice and different mixed-fisheries scenarios (see Figure 1 and Table 1). Weights are in tonnes.

Stock	Single-stock advice SSB 2020	SSB (2020) resulting from mixed-fisheries scenarios applied in 2019						
		"max"	"min"	"hke"	"ldb"	"meg"	"mon"	"Sq_E"
hke.27.8c9a	36104	6603	36142	35576	30625	29559	7403	24848
ldb.27.8c9a	9286	6085	10296	10294	9406	9676	6085	8092
meg.27.8c9a	2129	1105	2370	2388	2028	2228	1105	1462
mon.27.8c9a	11552	9847	11527	11523	11169	11317	9851	10807

There are some differences between the single-stock catch and SSB values, and the values obtained from the mixed-fisheries scenarios, that consider that all fleets set their effort corresponding to their quota shares for each given species. The largest differences were found for white anglerfish; these are to be expected mainly because of the difference between the length-based model used in the stock assessment and the age-based model applied in the mixed-fisheries analysis. In 2020, SSB for all scenarios and for all stocks are above $MSY B_{trigger}$ (Table 4). Forecast SSB resulting from the effort of each of the scenarios is presented in Figure 2, SSB under the maximum, white anglerfish and *status quo* scenarios would be below that estimated for 2019 for all stocks.

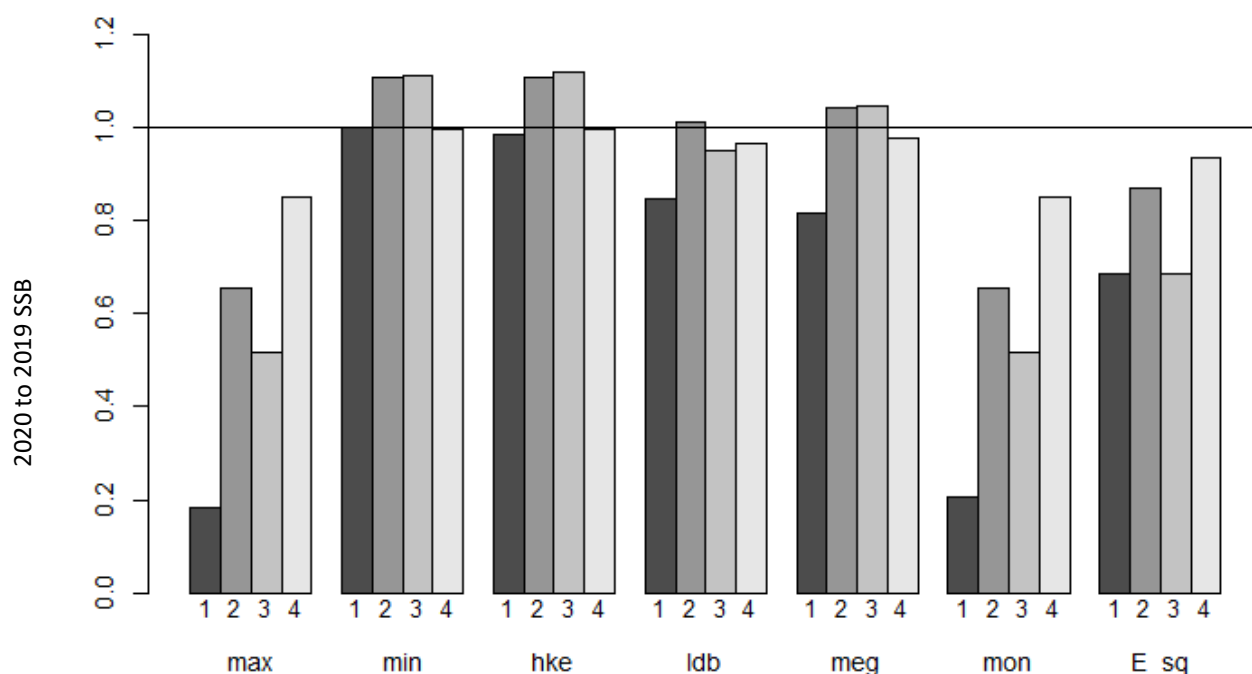


Figure 2 Mixed fisheries for the Bay of Biscay and Atlantic Iberian waters. Estimates of potential SSB at the start of 2020 by stock after applying the mixed-fisheries scenarios, expressed as a ratio to the single-stock advice forecast. The horizontal line corresponds to the SSB (at the start of 2019) resulting from the single-stock advice by WGMIXFISH.

Methods and data

Mixed-fisheries considerations are based on the single-stock assessments combined with knowledge of the species composition in the catches of Atlantic Iberian waters fisheries. Mixed-fisheries scenarios are based on central assumptions that fishing patterns and catchability for individual fleets remain the same in 2018 and 2019 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, 2018a, 2018b, 2018c, 2018d) and the 2017 relative catch distribution is shown in Figure 3 and by métier in Figure 4.

Other demersal stocks were not included because they either lack an analytical assessment or, in the case of black-bellied 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.

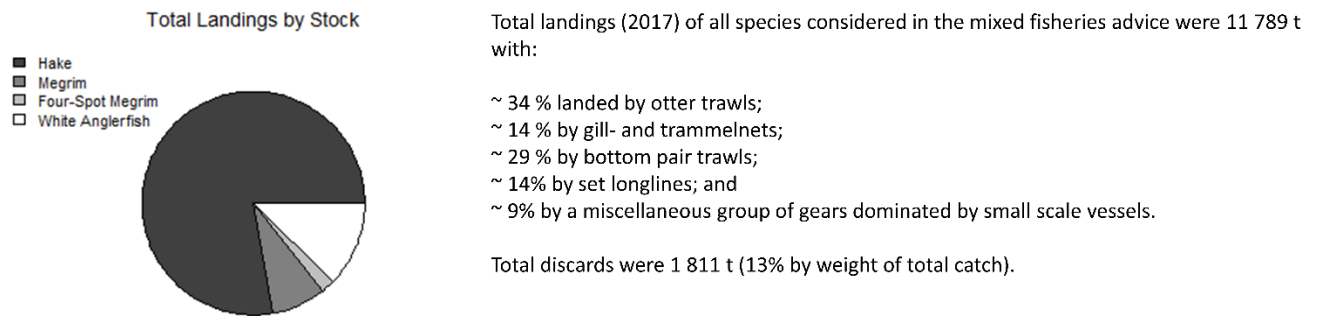


Figure 3 Mixed fisheries for the Bay of Biscay and Atlantic Iberian waters. Catch distribution.

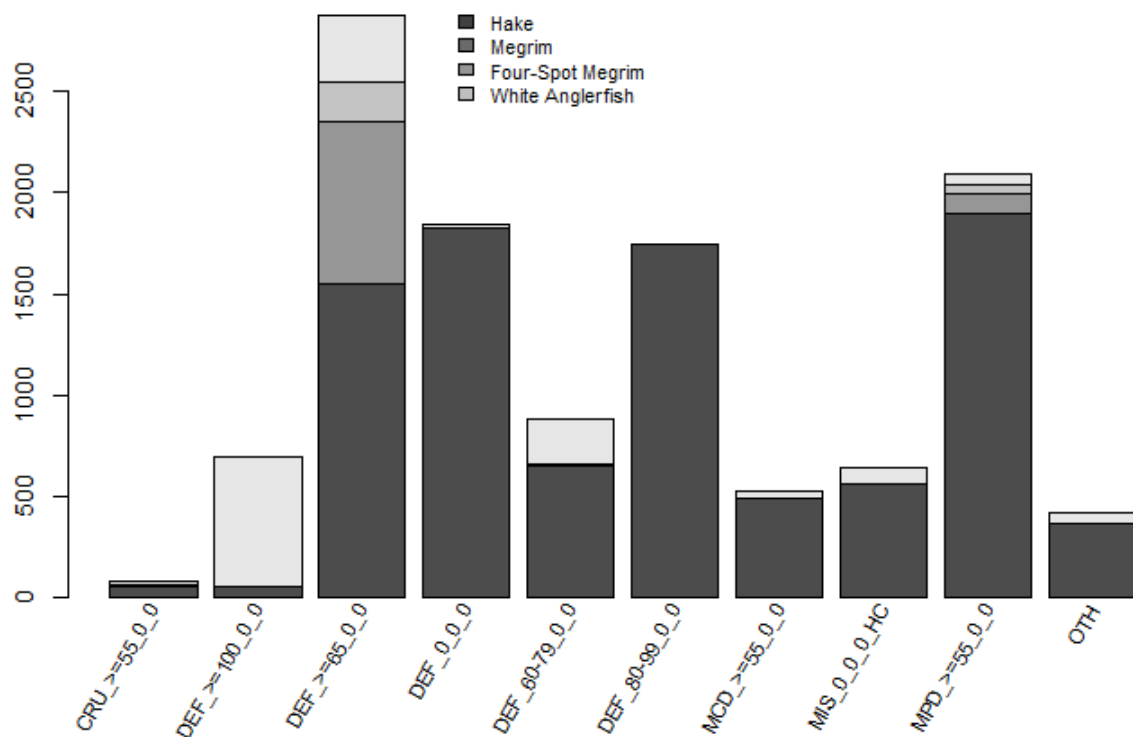


Figure 4 Mixed fisheries for the Bay of Biscay and Atlantic Iberian waters. Description of the landings distribution of species by métier in 2017. The métiers used are the result of regrouping the DCF métiers described in Table 5 according to the group of target species and the technical characteristics of the fishing gear.

Fleet and métier categories used in the mixed-fisheries analysis are based on the EU data collection framework (DCF) level 6 categories (Table 5) provided by Spain and Portugal. These fourteen métiers were regrouped to ten métiers for the mixed-fisheries analysis according to the group of target species and the technical characteristics of the fishing gear. With respect to the fleet segments used in the mixed-fisheries analysis, these were defined combining the country and the fishing gear group.

Table 5 Mixed fisheries for the Bay of Biscay and Atlantic Iberian waters. 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 (“ <i>rasco</i> ”) targeting white anglerfish in ICES Division 8.c with a mesh size of 280 mm
GNS_DEF_0_0_0	Set gillnet targeting demersal fish	Artisanal Portuguese fleet using set gillnets
GNS_DEF_60-79_0_0	Set gillnet targeting demersal fish with mesh sizes within the range of 60–79 mm	Spanish small set gillnet (“ <i>beta</i> ”) 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 of 80–99 mm	Spanish set gillnet (“ <i>volanta</i> ”) targeting hake with nets of 90 mm mesh size in northwestern Spanish waters
GTR_DEF_0_0_0	Trammelnet targeting demersal fish	Artisanal Portuguese fleet using trammelnets
GTR_DEF_60-79_0_0	Trammelnet targeting demersal fish with mesh sizes within the range of 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_HC	Miscellaneous	Portuguese and Spanish artisanal fleet not covered by other métiers
OTB_CRU_>=55_0_0	Bottom otter trawl targeting crustaceans, using mesh sizes larger than 55 mm	Portuguese bottom otter trawl targeting <i>Nephrops</i> and rose shrimp
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 “ <i>baca</i> ” nets of 70 mm mesh size in divisions 8.c and 9.a
OTB_DEF_>=65_0_0	Bottom otter trawl targeting demersal fish, using mesh sizes larger than 65 mm	Portuguese bottom otter trawl targeting demersal fish in Division 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 southwestern 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...) and demersal fish (hake) by using “ <i>jurelera</i> ” 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), using nets of 55 and 70 mm mesh size in northwestern Spanish waters

Table 6 Mixed fisheries for the Bay of Biscay and Atlantic Iberian waters. The basis of the assessment.

ICES stock data category	1 (ICES, 2016)
Assessment type	FLBEIA (FLR) (Garcia <i>et al.</i> , 2017; ICES, 2018e)
Input data	Assessments on the relevant stocks by the Working Group on the Bay of Biscay and Iberian Waters Ecoregion (ICES, 2018f); catch and effort by fleet and métiers.
Discards and bycatch	Included for hake and both megrims as in the respective single-stock assessments.
Indicators	None
Other information	This assessment was presented for the first time in the ICES advice in 2016.
Working groups	Working Group for the Bay of Biscay and the Iberian Waters Ecoregion (WGBIE) and Working Group on Mixed Fisheries Advice (WGMIXFISH-ADVICE)

Quality considerations

There are some differences between the single-stock catch and SSB values, and the values obtained from the mixed-fisheries scenarios, where all fleets are considered to set their effort corresponding to their quota shares for each given species. For catch the difference is around 7% for megrim and around 9% for hake; for white anglerfish and four-spot megrim the difference was lower than 2%. For SSB, the difference for white anglerfish was around 15% and for the rest of the stocks it was lower than 2%. For hake and white anglerfish, differences are to be expected because the length-based seasonal models used in the stock assessments are approximated with annual age-based models in the mixed-fisheries analysis. The reason for the discrepancy is unknown in the case of megrim. This issue could not be fully investigated owing to time constraints.

A key assumption in the projections is that catchability by stock and métier and effort distribution (relative proportion of time spent by each fleet in the various métiers) in 2018 and 2019 remain constant at their 2017 level. In reality, fishing patterns may change over time – particularly in response to significant changes in policy, such as the introduction of the landing obligation and the revision of technical rules. In practice, such changes in catchability would affect the outcomes of mixed-fisheries projections. For example, an increase of catchability would imply that a stock can become more limiting in the “minimum” scenario, as fewer fishing days would be required to fish up the fleets’ catch share.

Issues relevant for the advice

Since initial and final quotas by fleet are not known, the model builds on the important assumption that 2019 catch opportunities by fleet are computed as a fraction of the 2019 single-stock advice split according to last year’s (2017) wanted catch proportion of that fleet over the total wanted catches of the stock. This assumption might not be entirely relevant when a fleet did not catch its 2017 quota of the considered stock. The model could be improved by adding additional considerations on the actual quota by fleet and/or country (final after swaps), provided that such data (from e.g. FIDES database) can be made available in the data call.

Sources and references

Garcia, D., Sánchez, S., Prellezo, R., Urtizberea, A., and Andrés, M. 2017. FLBEIA: A simulation model to conduct Bio-Economic evaluation of fisheries management strategies. *SoftwareX*, 6: 141–147.

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