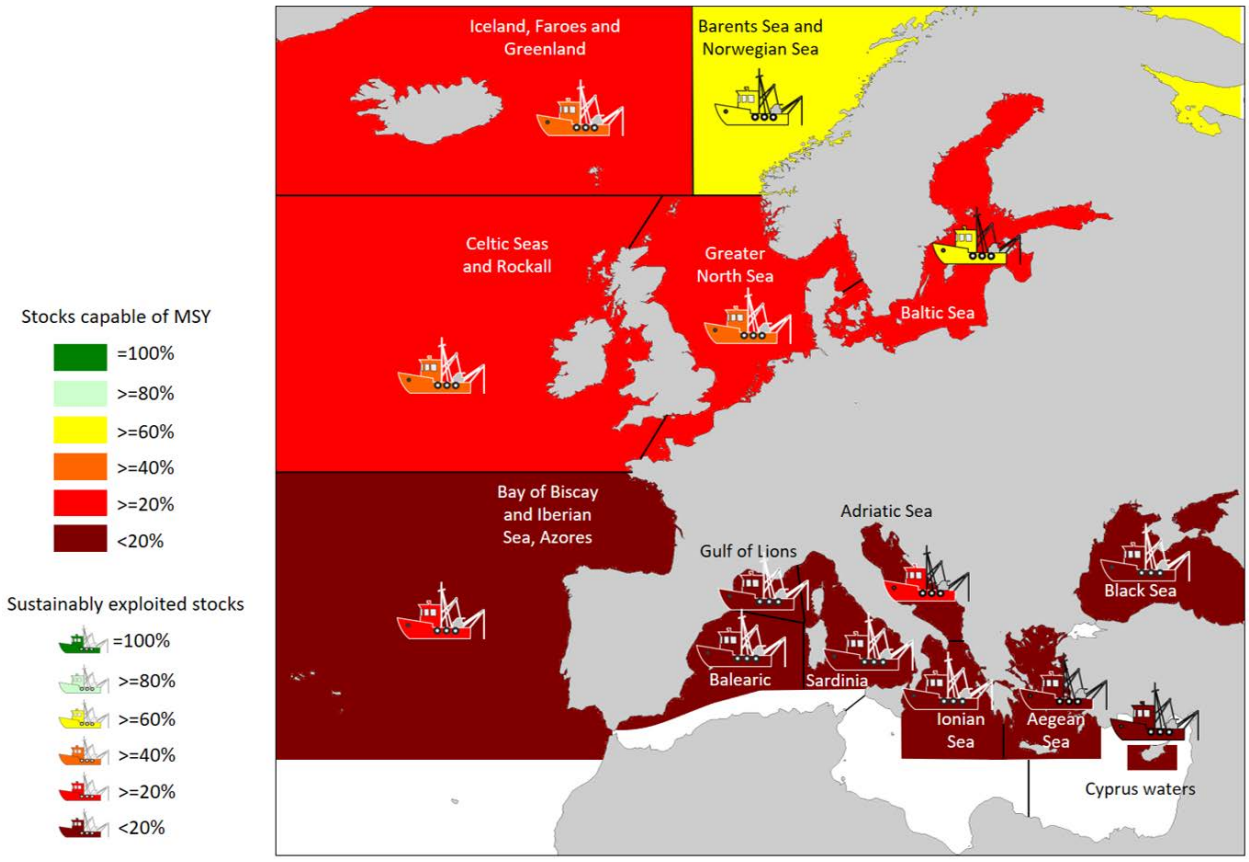
# Exploitation and Status of European Stocks




**Report commissioned by:**

OCEANA

# Exploitation and Status of European Stocks

Report about the outcome of four workshops in 2016, about the assessment of all European stocks. The final version of the report was prepared in October 2016 by

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Cite report as: Froese, R., Garilao, C., Winker, H., Coro, G., Demirel, N., Tsikliras, A., Dimarchopoulou, D., Scarcella, G., Sampang-Reyes, A. (2016) Exploitation and status of European stocks. Updated version. World Wide Web electronic publication, http://oceanrep.geomar.de/34476/

Note: This is an updated version where the map on the title page and in Figure 5 has been replace with a corrected one where the color for the North Sea is red instead of dark red. Also, the equation for rebuilding time on page 11 has been replaced by a more precise one and the respective reference is given.

**Legend for map on title page:** *The map shows the compliance with the Common Fisheries Policy of the EU, for 357 stocks in 12 ecoregions, for the last years (2013-2015) with available data (excluding 40 wide-ranging stocks). The color of the areas indicates the percentage of stocks with sizes that are above the level that can produce maximum sustainable yields and the color of the fishing boats indicates the percentage of stocks that are exploited sustainably.*

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**Executive Summary**

Stock assessments are presented for 397 stocks in 14 European ecoregions, from the Barents Sea to the Black Sea. Surplus production modeling was used to estimate fisheries reference points in a maximum sustainable yield (*MSY*) framework. Fishing pressure and biomass were estimated from 2000 to the last year with available data (2013-2015). Results are presented by ecoregion and by main functional groups (benthic fish & invertebrates, large predators, pelagic plankton feeders). Cumulative biomass of exploited species was well below the level that can produce *MSY* in all ecoregions. Fishing pressure has decreased in some ecoregions but not in others. Barents Sea and Norwegian Sea have the highest percentage (> 60%) of sustainably exploited stocks that are capable of producing *MSY* and which thus fulfill the goals of the Common Fisheries Policy of the European Union. In contrast, in most ecoregions of the Mediterranean fewer than 20% of the stocks are exploited sustainably or are capable of producing *MSY*. Especially large predators have low biomass and were subject to strong overfishing in all ecoregions. In the last year with available data, 64% of the 397 stocks were subject to ongoing overfishing and 51% of the stocks were outside of safe biological limits, potentially suffering from impaired reproduction. Only 12% of the stocks fulfilled the requirement of the Common Fisheries Policy of Europe as being not subject to overexploitation and having a biomass above the level that can produce maximum sustainable yields.

Biomass in the ecoregions of the Mediterranean and Black Sea was on average less than half (44%) of the level that can produce *MSY*, whereas in the northern ecoregions (Barents Sea to Iberian coastal) biomass was about ¾ (73%) of that level. Rebuilding of biomass above the *MSY* level would require only a few years in most stocks, depending on the depletion level of the stocks and how far exploitation is reduced below the *MSY*-level during the rebuilding phase. For example, exploitation at half the *MSY*-level would rebuild most stocks in the northern ecoregions in 1-5 years whereas in the more depleted Mediterranean rebuilding of stocks would take 2-7 years.

Total catches across all stocks and regions were 8.8 million tonnes whereas the maximum sustainable yield (*MSY*) was estimated at 15.4 million tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but after rebuilding of the stocks and assuming a precautionary target of 90% of *MSY*, substantial increases in catches could be possible. These potential increases differ widely between ecoregions, from 25% in the Baltic Sea to over 200% in some Mediterranean ecoregions. Across all stocks and ecoregions, potential increases in catch of over 50% could be possible.

Independent assessments of exploitation status were available for 93 (23%) of the examined stocks. For the stocks with different classifications, this study tended to underestimate exploitation.

**Introduction**

The Marine Strategy Framework Directive (MSFD 2008) and the reformed Common Fisheries Policy of the European Union (CFP 2013) demand that fishing pressure ($F$) on European stocks does not exceed the one ($F_{msy}$) that can produce maximum sustainable yields ($MSY$), generally in 2015 and under special circumstances latest in 2020. Also, the biomass ($B$) of European stocks has to be rebuilt above the level ($B_{msy}$) that can produce $MSY$. The purpose of this study was to examine all European stocks for which at least catch data are available and to determine status ($B/B_{msy}$) and exploitation ($F/F_{msy}$) in the context of the legal requirements.

More specifically, this study had the following terms of reference:

1.1 Estimation of total current fish biomass (in weight) in European waters, if possible differentiated between EU and non-EU waters. The biomass estimation will be differentiated, whenever feasible, by stocks in order to be able to provide the information also by species and/or main fishing areas independently.

1.2 Estimation of total current catches (in weight) in European waters by vessels of European countries and non-European countries. The catch data will be, whenever possible, differentiated by stocks in order to provide the information, by species and main fishing areas independently. Estimates of non-reported illegal catches and discards, will be included when available in peer reviewed literature or official reports. Note: For reporting the information of biomass and catches, select the last common reference year for which this information is accurate and available, and a time series of years when available) showing the evolution in the medium term.

1.3 Estimation of total potential fish biomass that can produce the maximum sustainable yield, if possible differentiate between EU and non-EU waters. Information of potential biomass will be presented, whenever possible, by stocks in order to be able to provide the information also by species and/or main areas independently.

1.4 Calculation of the difference between current biomass and potential biomass (recover ability) by stocks, species, main fishing areas and total. Selection of relevant case studies in terms of absolute (weight) and relative (%) recovery potential.

1.5 Estimation of total potential catches that can produce the maximum sustainable yield. Information of potential catches will be presented, whenever possible, by stocks in order to be able to provide the information also by species and for main areas independently.

1.6 Calculation of the difference between current catches and potential catches and biomass by stocks, species, main fishing areas, and total. Selection of relevant case studies in terms of absolute (weight) and relative (%) catches. Note: Stocks for which MSY levels are not determined other MSY proxy or precautionary reference point will be used.

1.7 It is understood that the findings of this project will be summarized in a scientific publication, to be submitted to a peer-reviewed Journal after the end of the project.

Four workshops were convened in Kiel, Germany (18-22 April, 4-8 July and 14-16 September 2016) and in Kavala, Greece (6-7 October 2016) where most of the authors met, improved the assessment tools, and analyzed the stocks. This report presents the outcomes of the exercise.

**Material and Methods**

The assessments presented in this report are based on the most recent data as available in August 2016. For the Northeast Atlantic, the advice documents published by the International Council for the Exploration of the Seas (ICES) and the International Commission for the Conservation of Atlantic Tunas (ICCAT) were used. For the Mediterranean, the landings were acquired from the Food and Agriculture Organization-General Fisheries Commission for the Mediterranean (FAO-GFCM) database (1970-2013) for each ecoregion (western Mediterranean, Adriatic Sea, Ionian Sea and central Mediterranean, Aegean Sea, Levantine Sea) and the biomass or abundance data from Data Collection Framework (DCF) reports. Data from the regular assessments of the Joint Research Center-Scientific, Technical and Economic Committee for Fisheries (JRC-STECF) were also used in some cases. For the Black Sea, latest stock assessment reports published by the JRC-STECF were used.

The sources are indicated in the respective Appendices for every stock. If catch and abundance data were available, these were analyzed with an advanced Bayesian implementation of a state-space surplus production model (BSM). Surplus production models are regularly used by assessment bodies such as ICES, ICCAT or GFCM if no information about age structure is available. The advantage of BSM over other implementations of surplus production models is its use of informative priors derived from population dynamics theory and its acceptance of incomplete and interrupted time series for abundance. Also, a simple stock-recruitment model was incorporated in the surplus production modeling to account for reduced productivity at severely depleted stock sizes (Froese et al. 2016).

If no abundance data were available or if these data were deemed unreliable, the CMSY method of Froese et al. (2016) was applied, using catch data and priors for productivity and stock status as inputs. The source code in R together with a short description and user's guide for CMSY and BSM is available in Appendix 4.

All files submitted with this report are listed in Table 1, each with a short desciption of its contents and its directory location.

*Table 1. List of supplementary files submitted with this report, with a short description of its content and its directory location.*

| File | Content | Directory |
|---|---|---|
| StockStatusReport.pdf | Exploitation and Status of European Stocks | / |
| Appendix_1.pdf | Detailed results for stocks in the ICES area | / |
| Appendix_2.pdf | Detailed results for Mediterranean stocks | / |
| Appendix_3.pdf | Detailed results for wide-ranging stocks | / |
| Appendix_4.pdf | User's Guide to CMSY and BSM | / |
| BlackSea_Catch.csv | Catch and abundance data for Black Sea stocks | /R-Code&Data |
| BlackSea_ID.csv | Settings for analysis of Black Sea stocks | /R-Code&Data |
| CMSY_O_7m.R | Version of R-code used in Appendices | /R-Code&Data |
| CMSY_O_7q.R | Version of R-code in User's Guide | /R-Code&Data |

| File | Content | Directory |
|---|---|---|
| O_ICES_Catches_13.csv | Catch and abundance data for ICES stocks | /R-Code&Data |
| O_ICES_ID_17.csv | Settings for analysis of ICES stocks | /R-Code&Data |
| O_Stocks_Catch_15_Med.csv | Catch and abundance data for MED stocks | /R-Code&Data |
| O_Stocks_ID_18_Med.csv | Settings for analysis of MED stocks | /R-Code&Data |
| Adriatic_Oct14_16.xlsx | Analyses and graphs for stocks in the Adreatic Sea | /Spreadsheets |
| AegeanSea_Oct04_16.xlsx | Analyses and graphs for stocks in the Aegean Sea | /Spreadsheets |
| AllStocks_Oct14_16.xlsx | Analyses and graphs across all ecoregions and stocks | /Spreadsheets |
| Balearic_Oct12_16.xlsx | Analyses and graphs for stocks in the Balearic Sea | /Spreadsheets |
| Baltic_Sep21_2016_4.xlsx | Analyses and graphs for stocks in the Baltic Sea | /Spreadsheets |
| BarentsSea_Sep26_2016.xlsx | Analyses and graphs for stocks in the Barents and Norwegian Seas | /Spreadsheets |
| BlackSea_Oct14_16.xlsx | Analyses and graphs for stocks in the Black Sea | /Spreadsheets |
| CelticSeas_Sep27_2016.xlsx | Analyses and graphs for stocks in the Celtic Seas and Rockall | /Spreadsheets |
| Cyprus_Oct13_16.xlsx | Analyses and graphs for stocks around Cyprus | /Spreadsheets |
| Iberian_Sep28_2016.xlsx | Analyses and graphs for stocks in the Iberian Sea and Azores | /Spreadsheets |
| ICCAT_Oct05_16.xlsx | Analyses and graphs for ICCAT stocks in European Seas | /Spreadsheets |
| Iceland_Sep27_2016.xlsx | Analyses and graphs for stocks in the Icelandic and Greenland Seas | /Spreadsheets |
| Ionian_Oct13_16.xlsx | Analyses and graphs for stocks in the Ionian Seas | /Spreadsheets |
| Lions_Gulf_Oct12_16.xlsx | Analyses and graphs for stocks in the Gulf of Lions | /Spreadsheets |
| NorthSea_Sep23_2016.xlsx | Analyses and graphs for stocks in the Greater North Sea | /Spreadsheets |
| Sardinia_Oct14_16.xlsx | Analyses and graphs for stocks around Sardinia | /Spreadsheets |
| Wide_Sep29_16.xlsx | Analyses and graphs for wide-ranging stocks in the ICES area | /Spreadsheets |
| CMSY_UserGuide_27Oct16.pdf | CMSY/BSM User's Guide version of 27 October 2016 | /UserGuide |
| CMSY_O_7q.R | Version of R_code referred to in the User's Guide | /UserGuide |
| O_Stocks_ID_18_Med.csv | Example settings for User's Guide | /UserGuide |
| O_Stocks_Catch_15_Med.csv | Example catch and abundance data for User's Guide | /UserGuide |

**Getting continuous priors for r**

A new tool was developed to derive prior estimates for the probability distribution of the intrinsic rate of population increase from life history traits in FishBase (www.fishbase.org). The tool uses the empirical relations proposed in Froese et al. (2016), namely

$$r \approx 2M \approx 3\,K \approx 3.3/t_{gen} \approx 9/t_{max}$$

where $r$ (year$^{-1}$) is the maximum intrinsic rate of population increase, $M$ (year$^{-1}$) is the rate of natural mortality, $K$ (year$^{-1}$) is the von Bertalanffy growth parameter indicating how fast asymptotic length is reached, $t_{gen}$ (years) is the mean age of spawners or generation time, and $t_{max}$ (years) is maximum age. These relationships work because $r$ is a function of generation time, which is highly correlated with maximum age, which in turn is determined by the mortality rate. In species with indeterminate growth, such as all species treated in this study, maximum age coincides with asymptotic length, and since $K$ determines how fast that length is reached, it is related to maximum age as ($t_{max}$ = 3/$K$; Taylor 1958). But $r$ is also a function of annual fecundity, which can act as a bottleneck to population growth if, e.g., only few pups are produced every other year, such as in some sharks. A simple preliminary function was therefore fitted to $r$ and fecundity data presented in Musick (1999).

$$r \approx 0.5\, e^{-4.6/Fec^{0.3}}$$

This equation will be improved once more estimates of $r$ and fecundity are available.

To give more influence to life history traits which may act as bottleneck for population increase (Musick 1999), $r$ values were sorted from highest to lowest and weighted by their rank, so that the lowest estimate got the highest weight.

If no life history information was available for a species, the resilience classification in FishBase was used to apply the default $r$-ranges suggested in Froese et al. (2016). Similarly, for invertebrates, $r$-ranges were derived from assumed resilience of the species.

The priors derived in this manner for the species examined in this study are shown in Table 2.

*Table 2. List of 120 species examined in this study, arranged by functional group and alphabetically within groups, including scientific name, common name, and their priors for r based on life history traits recorded in FishBase (www.fishbase.ca, accessed 14 October 2016). Where r is NA, the 2 SD range values represent the defaults used for resilience categories in Froese et al. (2016), see also O_ICES_ID_15.csv and O_Stocks_ID_17_Med.csv.*

| Functional Group | Common Name | Species | r | 2 SD Range | | | Based on |
|---|---|---|---|---|---|---|---|
| Benthic fish & inv. | Small sandeel | *Ammodytes tobianus* | 1.26 | 0.80 | - | 1.98 | 3 M, 8 K, 6 tgen, 2 tmax |
| | European eel | *Anguilla anguilla* | 0.32 | 0.16 | - | 0.65 | 23 K, 12 tgen, 8 tmax, 2 Fec |
| | Black scabbardfish | *Aphanopus carbo* | NA | 0.05 | - | 0.50 | Low resilience |
| | Greater argentine | *Argentina silus* | 0.29 | 0.13 | - | 0.67 | 18 K, 13 tgen, 1 tmax, 1 Fec |
| | Giant red shrimp | *Aristeomorpha foliacea* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Blue and red shrimp | *Aristeus antennatus* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Alfonsino (Redfish) | *Beryx* spp. | NA | 0.05 | - | 0.50 | Low resilience |
| | Purple dye murex | *Bolinus brandaris* | NA | 0.60 | - | 1.50 | High resilience |
| | Tusk | *Brosme brosme* | 0.36 | 0.21 | - | 0.62 | 1 M, 9 K, 3 tgen, 1 tmax, 7 Fec |
| | Boarfish | *Capros aper* | 0.55 | 0.18 | - | 1.69 | 3 K, 4 tgen, 3 tmax |
| | Leafscale gulper shark | *Centrophorus squamosus* | NA | 0.05 | - | 0.50 | Low resilience |
| | Portuguese dogfish | *Centroscymnus coelolepis* | NA | 0.015 | - | 0.10 | Very low resilience |
| | Striped Venus clam | *Chamelea gallina* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Red gurnard | *Chelidonichthys cuculus* | 0.65 | 0.28 | - | 1.51 | 6 K, 5 tgen, 3 tmax |
| | European conger | *Conger conger* | 0.27 | 0.16 | - | 0.46 | 2 K, 2 tgen, 2 Fec |
| | Roundnose grenadier | *Coryphaenoides rupestris* | 0.28 | 0.11 | - | 0.71 | 3 K, 4 tgen, 1 tmax, 15 Fec |
| | Kitefin shark | *Dalatias licha* | NA | 0.05 | - | 0.50 | Low resilience |
| | Common dentex | *Dentex dentex* | 0.33 | 0.15 | - | 0.73 | 3 K, 5 tgen, 1 tmax |
| | Large-eye dentex | *Dentex macrophthalmus* | 0.71 | 0.38 | - | 1.34 | 1 M, 6 K, 2 tgen, 1 tmax |
| | Annular seabream | *Diplodus annularis* | 0.68 | 0.38 | - | 1.22 | 2 M, 16 K, 9 tgen, 1 tmax, 3 Fec |
| | White seabream | *Diplodus sargus* | 0.44 | 0.23 | - | 0.85 | 5 K, 8 tgen, 2 tmax, 4 Fec |
| | Horned octopus | *Eledone cirrosa* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Musky octopus | *Eledone moschata* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Witch flounder | *Glyptocephalus cynoglossus* | 0.33 | 0.18 | - | 0.62 | 10 K, 16 tgen, 1 tmax, 2 Fec |
| | Euopean lobster | *Homarus gammarus* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Orange roughy | *Hoplostethus atlanticus* | 0.20 | 0.05 | - | 0.80 | 4 K, 13 tgen, 1 tmax, 20 Fec |

| Functional Group | Common Name | Species | r | 2 SD Range | | | Based on |
|---|---|---|---|---|---|---|---|
| Benthic fish & inv. | Shortfin squid | *Illex coindetii* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Four-spot megrim | *Lepidorhombus boscii* | NA | 0.05 | - | 0.50 | Low resilience |
| | Megrims | *Lepidorhombus* spp. | NA | 0.2 | - | 0.8 | Medium resilience |
| | Megrim | *Lepidorhombus whiffiagonis* | 0.58 | 0.34 | - | 1.00 | 24 K, 5 tgen, 7 tmax |
| | Cuckoo ray | *Leucoraja naevus* | 0.26 | 0.09 | - | 0.71 | 1 M, 3 K, 2 tgen, 1 tmax, 5 Fec |
| | Common dab | *Limanda limanda* | 0.49 | 0.24 | - | 0.98 | 2 M, 13 K, 13 tgen, 4 tmax, 14 Fec |
| | European squid | *Loligo vulgaris* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Blackbellied angler | *Lophius budegassa* | 0.33 | 0.20 | - | 0.54 | 8 K, 5 tgen, 2 tmax, 3 Fec |
| | Angler | *Lophius piscatorius* | 0.31 | 0.15 | - | 0.64 | 10 K, 3 tgen, 2 tmax, 1 Fec |
| | Anglerfishes | *Lophius* spp. | NA | 0.05 | - | 0.50 | Low resilience |
| | Roughhead grenadier | *Macrourus berglax* | 0.20 | 0.08 | - | 0.51 | 1 K, 2 tgen, 1 tmax, 8 Fec |
| | Lemon sole | *Microstomus kitt* | 0.42 | 0.20 | - | 0.86 | 7 K, 4 tgen, 1 tmax, 4 Fec |
| | Blue ling | *Molva dypterygia* | 0.31 | 0.20 | - | 0.48 | 1 M, 3 K, 12 tgen, 1 tmax |
| | Ling | *Molva molva* | 0.38 | 0.22 | - | 0.66 | 1 M, 8 K, 4 tgen, 1 tmax, 3 Fec |
| | Red mullet | *Mullus barbatus (barbatus)* | 0.52 | 0.22 | - | 1.25 | 1 M, 50 K, 3 tgen, 7 tmax, 8 Fec |
| | Surmullet | *Mullus surmuletus* | 0.85 | 0.46 | - | 1.58 | 2 M, 25 K, 9 tgen, 7 tmax |
| | Norway lobster | *Nephrops norvegicus* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Saddled seabream | *Oblada melanura* | 0.78 | 0.68 | - | 0.88 | 1 M, 3 K, 2 tgen |
| | Common octopus | *Octopus vulgaris* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Axillary seabream | *Pagellus acarne* | 0.55 | 0.28 | - | 1.08 | 1 M, 8 K, 8 tgen, 2 tmax, 10 Fec |
| | Blackspot seabream | *Pagellus bogaraveo* | 0.45 | 0.26 | - | 0.76 | 13 K, 2 tgen, 3 tmax, 2 Fec |
| | Common pandora | *Pagellus erythrinus* | 0.46 | 0.22 | - | 0.97 | 1 M, 17 K, 9 tgen, 6 Fec |
| | Red porgy | *Pagrus pagrus* | 0.48 | 0.27 | - | 0.86 | 1 M, 12 K, 5 tgen, 1 tmax, 2 Fec |
| | Common spiny lobster | *Palinurus elephas* | NA | 0.05 | - | 0.50 | Low resilience |
| | Northern shrimp | *Pandalus borealis* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Deep-water rose shrimp | *Parapenaeus longirostris* | NA | 0.60 | - | 1.50 | High resilience |
| | Great Mediterranean scallop | *Pecten jacobeus* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Caramote prawn | *Penaeus kerathurus* | NA | 0.60 | - | 1.50 | High resilience |

| Functional Group | Common Name | Species | r | 2 SD Range | | | Based on |
|---|---|---|---|---|---|---|---|
| Benthic fish & inv. | Greater forkbeard | *Phycis blennoides* | 0.46 | 0.28 | - | 0.76 | 1 M, 2 K, 2 tgen, 1 tmax |
| | European flounder | *Platichthys flesus* | 0.47 | 0.22 | - | 0.97 | 2 M, 9 K, 29 tgen, 1 tmax, 16 Fec |
| | European plaice | *Pleuronectes platessa* | 0.39 | 0.20 | - | 0.77 | 4 M, 15 K, 42 tgen, 3 tmax, 26 Fec |
| | Blonde ray | *Raja brachyura* | 0.21 | 0.05 | - | 0.85 | 1 M, 2 K, 1 tgen, 1 tmax, 3 Fec |
| | Thornback ray | *Raja clavata* | 0.15 | 0.02 | - | 0.90 | 1 M, 9 K, 8 tgen, 2 tmax, 8 Fec |
| | Spotted ray | *Raja montagui* | 0.26 | 0.08 | - | 0.85 | 1 M, 4 K, 3 tgen, 3 tmax, 2 Fec |
| | Greenland halibut | *Reinhardtius hippoglossoides* | 0.33 | 0.16 | - | 0.68 | 5 K, 14 tgen, 1 tmax, 18 Fec |
| | Salema | *Sarpa salpa* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Turbot | *Scophthalmus maximus* | 0.45 | 0.25 | - | 0.82 | 16 K, 3 tgen, 1 tmax, 2 Fec |
| | Brill | *Scophthalmus rhombus* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Lesser spotted dogfish | *Scyliorhinus canicula* | 0.11 | 0.01 | - | 1.05 | 2 K, 3 tgen, 1 tmax, 10 Fec |
| | Beaked redfish | *Sebastes mentella* | 0.21 | 0.11 | - | 0.43 | 9 K, 3 tgen, 2 tmax, 10 Fec |
| | Golden redfish | *Sebastes norvegicus* | 0.25 | 0.13 | - | 0.48 | 5 K, 6 tgen, 2 tmax, 9 Fec |
| | Common cuttlefish | *Sepia officinalis* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Common sole | *Solea solea* | 0.46 | 0.21 | - | 1.02 | 2 M, 26 K, 17 tgen, 2 tmax, 13 Fec |
| | Soles | *Solea* spp. | NA | 0.20 | - | 0.80 | Medium resilience |
| | Black seabream | *Spondyliosoma cantharus* | 0.50 | 0.24 | - | 1.05 | 9 K, 9 tgen, 6 tmax, 6 Fec |
| | Picked dogfish | *Squalus acanthias* | NA | 0.05 | - | 0.50 | Low resilience |
| | Angelshark | *Squatina squatina* | NA | 0.05 | - | 0.50 | Low resilience |
| | Spottail mantis shrimp | *Squilla mantis* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Poor cod | *Trisopterus minutus* | 0.77 | 0.37 | - | 1.59 | 2 M, 10 K, 6 tgen, 1 tmax, 2 Fec |
| | Shi drum | *Umbrina cirrosa* | NA | 0.20 | - | 0.80 | Medium resilience |
| Large predators | Garfish | *Belone belone* | 0.44 | 0.19 | - | 1.00 | 2 K, 2 tgen, 10 Fec |
| | Common dolphinfish | *Coryphaena hippurus* | 0.77 | 0.39 | - | 1.54 | 11 K, 9 tgen, 3 tmax, 8 Fec |
| | European seabass | *Dicentrarchus labrax* | 0.38 | 0.17 | - | 0.88 | 1 M, 16 K, 11 tgen, 9 tmax, 2 Fec |
| | Dusky grouper | *Epinephelus marginatus* | 0.25 | 0.11 | - | 0.57 | 1 M, 4 K, 7 tgen, 2 tmax, 4 Fec |
| | Little tunny | *Euthynnus alletteratus* | 0.64 | 0.36 | - | 1.14 | 1 M, 7 K, 2 tgen, 2 tmax, 2 Fec |
| | Atlantic cod | *Gadus morhua* | 0.47 | 0.23 | - | 0.96 | 15 M, 56 K, 98 tgen, 2 tmax, 37 Fec |

| Functional Group | Common Name | Species | r | 2 SD Range | | | Based on |
|---|---|---|---|---|---|---|---|
| Large predators | Tope shark | *Galeorhinus galeus* | NA | 0.015 | - | 0.10 | Very low resilience |
| | Shortfin mako | *Isurus oxyrinchus* | 0.11 | 0.02 | - | 0.55 | 1 M, 6 K, 12 tgen, 3 tmax, 2 Fec |
| | Porbeagle | *Lamna nasus* | NA | 0.015 | - | 0.10 | Very low resilience |
| | Haddock | *Melanogrammus aeglefinus* | 0.48 | 0.23 | - | 1.00 | 2 M, 33 K, 47 tgen, 4 tmax, 29 Fec |
| | Whiting | *Merlangius merlangus* | 0.51 | 0.25 | - | 1.01 | 1 M, 83 K, 13 tgen, 1 tmax, 11 Fec |
| | European hake | *Merluccius merluccius* | 0.46 | 0.22 | - | 0.95 | 3 M, 76 K, 24 tgen, 7 tmax, 38 Fec |
| | Blue whiting | *Micromesistius poutassou* | 0.48 | 0.21 | - | 1.09 | 1 M, 23 K, 11 tgen, 3 tmax, 8 Fec |
| | Smoothhounds | *Mustelus* spp. | NA | 0.05 | - | 0.50 | Low resilience |
| | Pollack | *Pollachius pollachius* | 0.71 | 0.50 | - | 1.01 | 1 M, 1 K, 3 tgen, 1 tmax |
| | Saithe | *Pollachius virens* | 0.40 | 0.21 | - | 0.75 | 2 M, 11 K, 19 tgen, 3 tmax, 4 Fec |
| | Bluefish | *Pomatomus saltatrix* | 0.58 | 0.37 | - | 0.90 | 1 M, 6 K, 3 tgen, 2 tmax, 3 Fec |
| | Blue shark | *Prionace glauca* | NA | 0.015 | - | 0.10 | Very low resilience |
| | Atlantic salmon | *Salmo salar* | 0.37 | 0.13 | - | 1.03 | 4 K, 30 tgen, 1 tmax, 20 Fec |
| | Sea trout | *Salmo trutta* | 0.27 | 0.06 | - | 1.17 | 14 K, 78 tgen, 2 tmax, 16 Fec |
| | Atlantic bonito | *Sarda sarda* | 1.62 | 0.84 | - | 3.11 | 1 M, 13 K, 4 tgen, 4 tmax, questionable, too high |
| | Greater amberjack | *Seriola dumerili* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Albacore | *Thunnus alalunga* | 0.46 | 0.26 | - | 0.80 | 4 M, 35 K, 6 tgen, 3 tmax, 8 Fec |
| | Atlantic bluefin tuna | *Thunnus thynnus* | 0.36 | 0.21 | - | 0.64 | 4 M, 23 K, 7 tgen, 6 tmax, 5 Fec |
| | Swordfish | *Xiphias gladius* | 0.43 | 0.24 | - | 0.77 | 12 K, 2 tgen, 3 tmax, 4 Fec |
| | John dory | *Zeus faber* | 0.54 | 0.29 | - | 1.00 | 3 K, 8 tgen, 2 tmax |
| Pelagic plankton feeders | Big-scale sand smelt | *Atherina boyeri* | 0.76 | 0.33 | - | 1.74 | 6 K, 2 tgen, 1 tmax, 2 Fec |
| | Bogue | *Boops boops* | 0.59 | 0.31 | - | 1.10 | 1 M, 18 K, 6 tgen, 1 tmax, 3 Fec |
| | Basking shark | *Cetorhinus maximus* | NA | 0.015 | - | 0.10 | Very low resilience |
| | Atlantic herring | *Clupea harengus* | 0.39 | 0.16 | - | 1.00 | 11 M, 100 K, 71 tgen, 28 tmax, 46 Fec |
| | European anchovy | *Engraulis encrasicolus* | 0.55 | 0.26 | - | 1.16 | 3 M, 43 K, 15 tgen, 8 tmax, 25 Fec |
| | Capelin | *Mallotus villosus* | 0.43 | 0.17 | - | 1.11 | 1 M, 2 K, 13 tgen, 3 tmax, 21 Fec |
| | European pilchard | *Sardina pilchardus* | 0.54 | 0.27 | - | 1.10 | 3 M, 50 K, 5 tgen, 5 tmax, 11 Fec |

| Functional Group | Common Name | Species | r | 2 SD Range | | | Based on |
|---|---|---|---|---|---|---|---|
| Pelagic plankton feeders | Round sardinella | *Sardinella aurita* | 0.55 | 0.24 | - | 1.26 | 30 K, 8 tgen, 2 tmax, 9 Fec |
| | Atlantic chub mackerel | *Scomber colias* | NA | 0.60 | - | 1.50 | High resilience |
| | Atlantic mackerel | *Scomber scombrus* | 0.48 | 0.23 | - | 1.00 | 1 M, 16 K, 13 tgen, 1 tmax, 25 Fec |
| | Blotched picarel | *Spicara maena* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Picarel | *Spicara smaris* | NA | 0.20 | - | 0.80 | Medium resilience |
| | European sprat | *Sprattus sprattus* | 0.49 | 0.21 | - | 1.11 | 2 M, 19 K, 9 tgen, 3 tmax, 23 Fec |
| | Mediterranean horse mackerel | *Trachurus mediterraneus* | NA | 0.20 | - | 0.80 | Medium resilience |
| | Blue jack mackerel | *Trachurus picturatus* | 0.51 | 0.27 | - | 0.96 | 8 K, 4 tgen, 1 tmax |
| | Horse mackerels | *Trachurus* spp. | NA | 0.20 | - | 0.80 | Medium resilience |
| | Atlantic horse mackerel | *Trachurus trachurus* | 0.47 | 0.22 | - | 0.98 | 25 K, 17 tgen, 19 Fec |
| | Norway pout | *Trisopterus esmarkii* | 0.88 | 0.48 | - | 1.60 | 2 M, 6 K, 7 tgen, 1 tmax, 3 Fec |

**Estimation of rebuilding time**

For stocks that are not suffering from impaired recruitment, and assuming a logistic curve of population increase, the average time needed to reach the biomass level ($B_{msy}$) that can produce *MSY* is a function of depletion ($B/B_{msy}$), of the intrinsic rate of population increase *r* and of remaining exploitation *F* (Quinn and Deriso 1999)

$$\Delta t = \frac{1}{r - F}\, LN\left(\frac{\frac{B_{msy}}{B}\, 2\left(1 - \frac{F}{r}\right) - 1}{2\left(1 - \frac{F}{r}\right) - 1}\right.$$

For example, if depletion is 0.75 $B_{msy}$, $F_{msy}$ = 0.3 and remaining exploitation is *F* = 0.15, then the time needed by the population to reach $B_{msy}$ is 1.5 years. If depletion is 0.5 $B_{msy}$, $F_{msy}$ = 0.2 and remaining exploitation is *F* = 0.1, then the time needed by the population to reach $B_{msy}$ is 4.6 years. These two examples bracket the typical depletion levels and $F_{msy}$ values for many stocks in northern European ecoregions (Barents Sea to Iberian Sea).

If depletion is 0.25 $B_{msy}$, $F_{msy}$ = 0.3 and remaining exploitation is *F* = 0.15, then the time needed by the population to reach $B_{msy}$ is 5.1 years. This example reflects the higher depletion but also higher productivity in Mediterranean stocks. But note that recruitement and thus productivity may be impaired at 0.25 $B_{msy}$ and in such cases stock recovery may take much longer and may require much stronger reduction of exploitation. [AllStocks_Oct14_16.xlsx, TAB Exploitation scenarios]

## Results

### Results across all ecoregions and stocks

ICES, GFCM and ICCAT assessment reports with data until 2015 were analyzed for 397 stocks in European waters, from the Barents Sea to the Black Sea. Results are presented by ecoregion below. The graphs in this chapter summarize the status and exploitation level of all 397 stocks within an MSY-framework. Detailed assessments for every stock are available in Appendix 1 for the ICES area, Appendix 2 for the Mediterranean and Black Sea, and Appendix 3 for ICCAT stocks and wide-ranging ICES stocks. The numbers and graphs presented in this chapter were created with spreadsheet AllStocks_Nov09_16b.xlsx, which is part of the supplementary material.

Of the 397 stocks, 254 (64%) were subject to ongoing overfishing ($F > F_{msy}$) and 202 stocks (51%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). In 45 stocks (11%) catches exceeded the maximum sustainable yield ($C/MSY > 1$). Two hundred eight stocks (52%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing or severely depleted ($B < 0.2\ B_{msy}$) and still subject to exploitation. Altogether, 267 stocks (67%) were subject to unsustainable exploitation ($C/MSY > 1$ or $F > F_{msy}$ or $B < 0.2\ B_{msy}$). In contrast, only 47 stocks (12%) could be considered as being well managed and in good condition sensu CFP (2013), defined by not being subject to overfishing ($F > F_{msy}$ or Catch > *MSY*) and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 397 stocks of 51 million tonnes in the last year with available data was below (80%) the biomass level of 64 million tonnes that can produce maximum yields. Summed catches of 8.8 million tonnes were well below the summed maximum sustainable yield of 15.4 million tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above $B_{msy}$. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

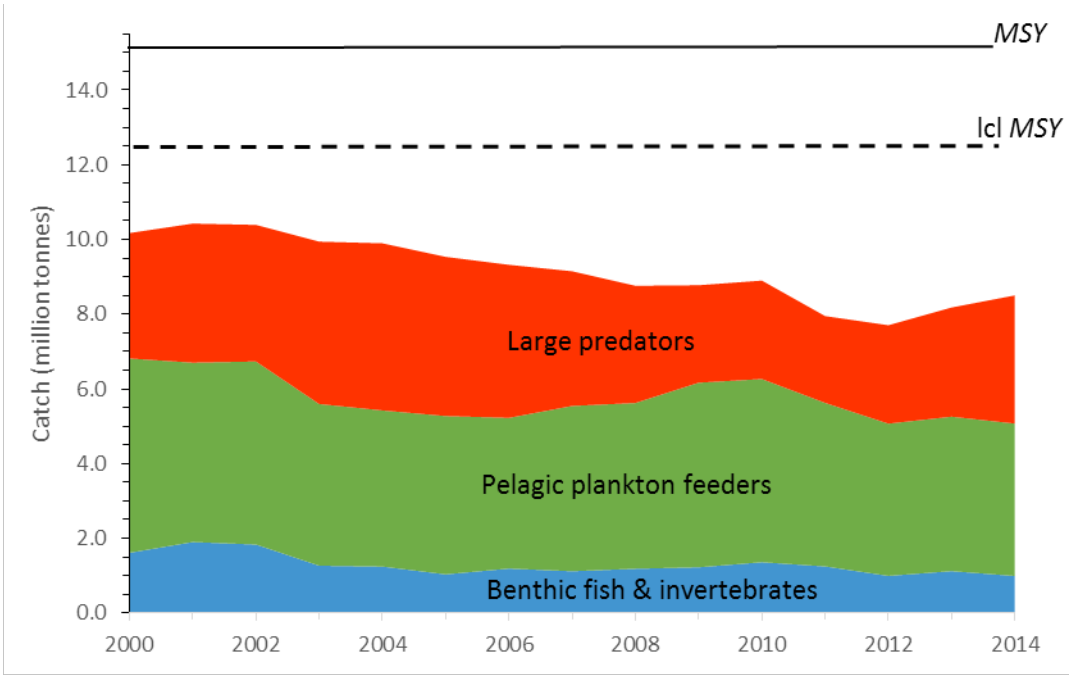



*Figure 1. Cumulative catches for 397 stocks in European Seas, with indication of main functional groups. The black line indicates the cumulative maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. Total catches have been declining since 2000, but large predators had increasing catches since 2012 [AllStocks_Nov09_16b.xlsx]*

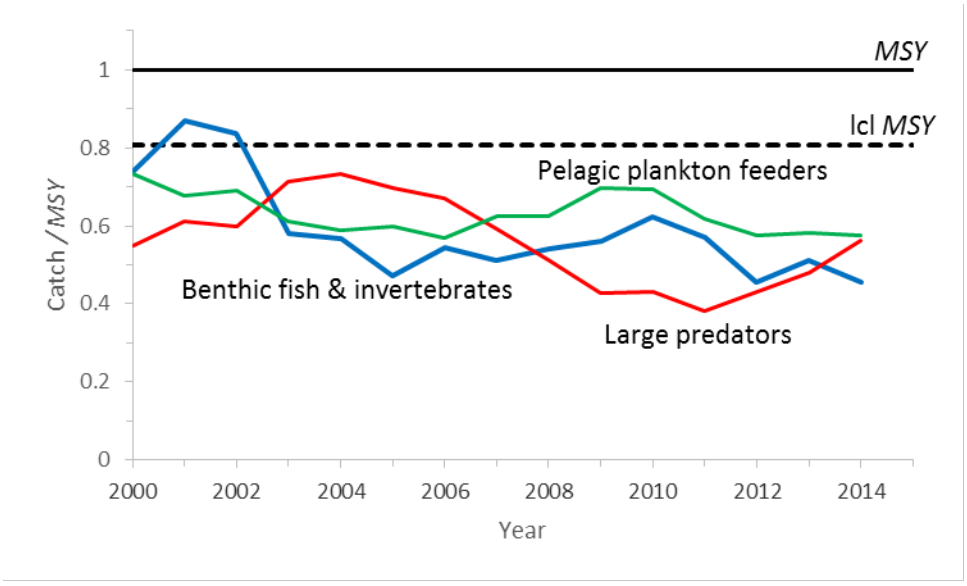



*Figure 2. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 397 stocks in the European Seas. All catches are well below the precautionary level since 2003, but are taken mostly with high effort from too small stocks (see biomass graphs below). [AllStocks_Nov09_16b.xlsx]*

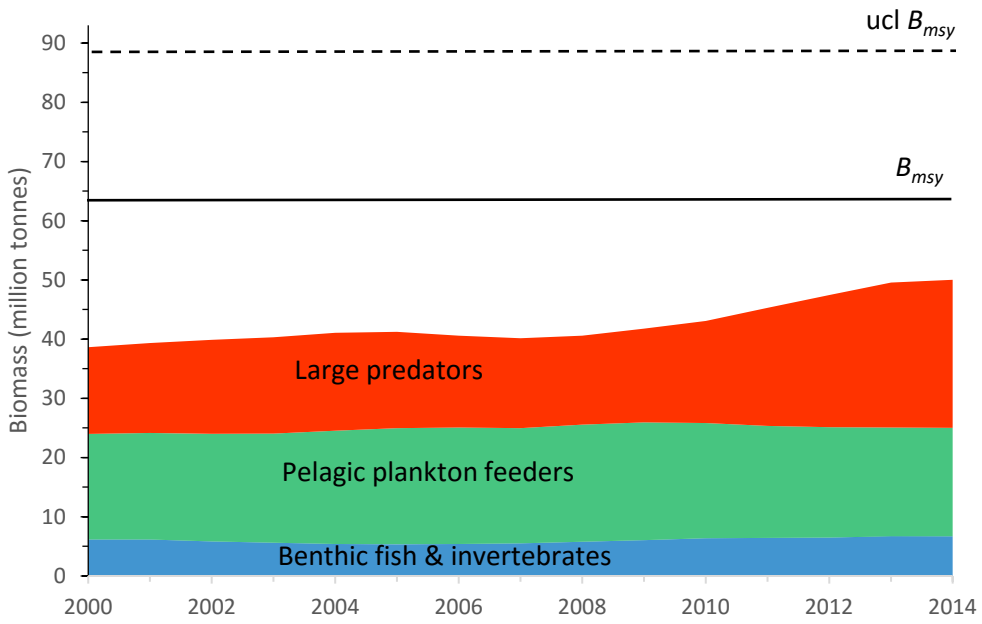



*Figure 3. Cumulative total biomass of 397 stocks in the European Seas relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of Bmsy (dashed line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. The functional groups of large predators (red), pelagic plankton feeders (green), and benthic organisms (blue) are indicated. Summed biomass of large predators has increased in recent years. [AllStocks_Nov09_16b.xlsx]*

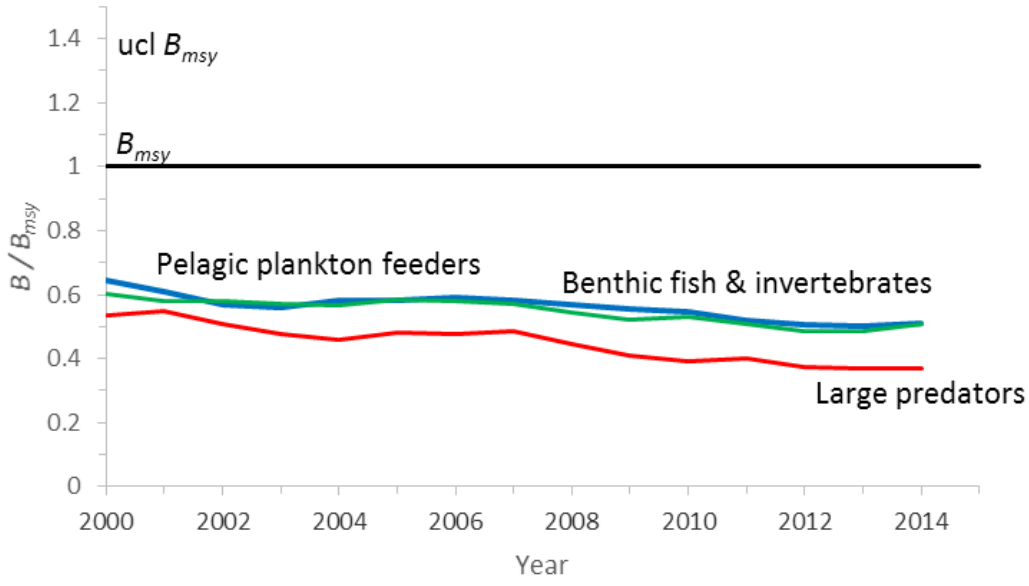



*Figure 4. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 397 stocks in the European Seas assigned to main functional groups. Note that median biomass of large predators has not increased, in contrast to the summed biomass across all stocks. This suggests that the increase stems only from few stocks. [AllStocks_Nov09_16b.xlsx]*

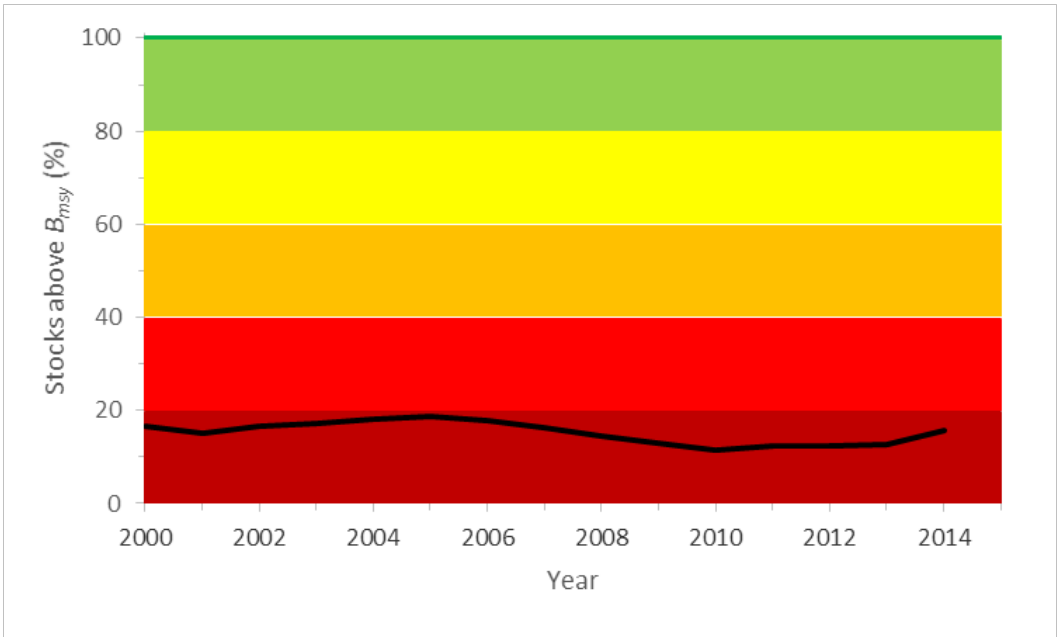



*Figure 5. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 397 stocks in the European Seas (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2014, only 16% of the stocks fulfilled that requirement. [AllStocks_Nov09_16b.xlsx]*

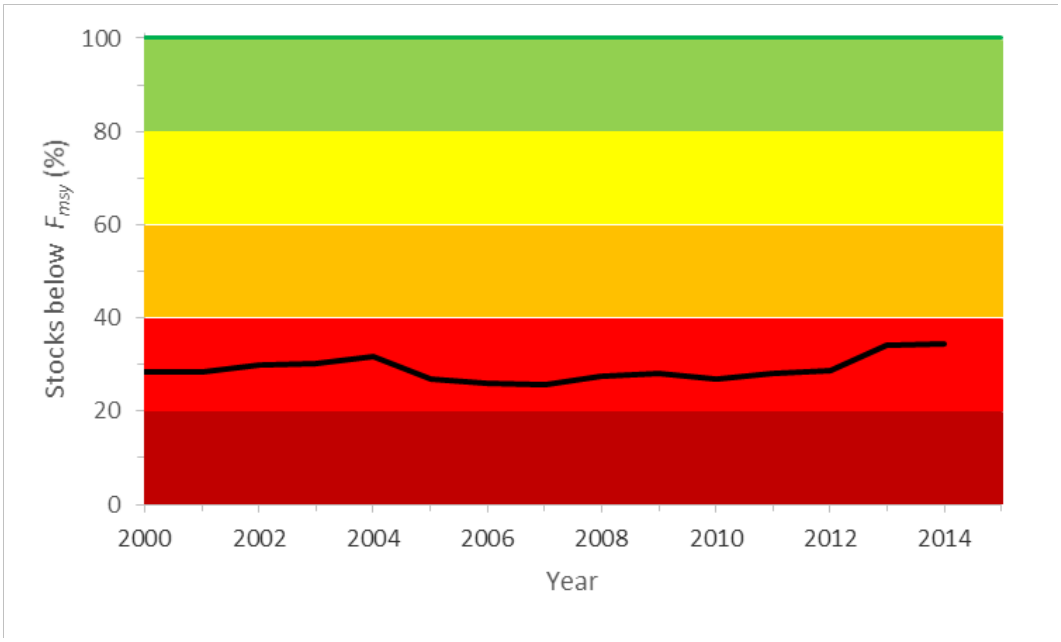



*Figure 6. Percentage of stocks where fishing mortality F is at or below the level that can produce the maximum sustainable yield ($F_{msy}$) for 397 stocks in the European Seas (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be at or below $F_{msy}$ in 2015, latest in 2020. In 2014, only 34% of the stocks fulfilled that requirement. [AllStocks_Nov09_16b.xlsx]*

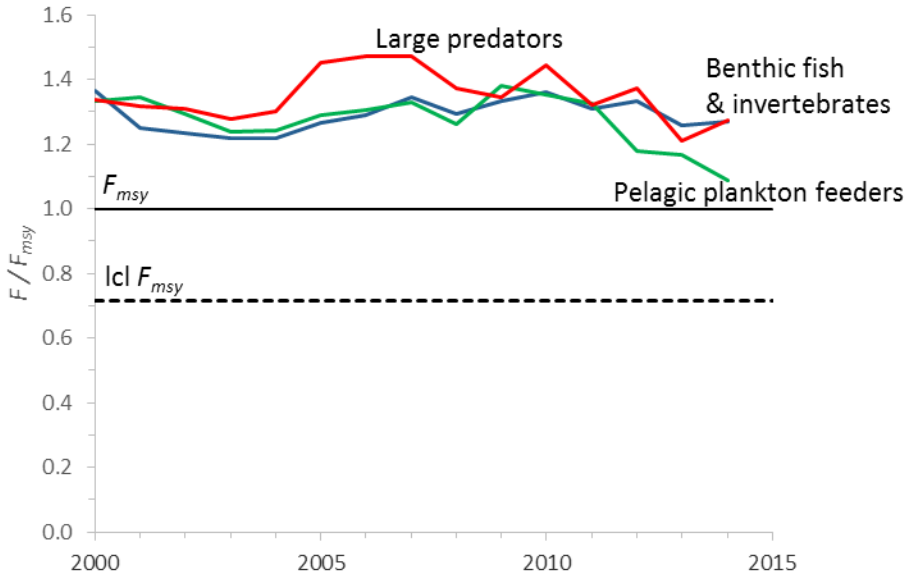



*Figure 7. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 397 stocks in the European Seas assigned to main functional groups. Median fishing pressure is above the maximum sustainable level in all groups, with plankton feeders showing a decreasing trend in recent years. [AllStocks_Nov09_16b.xlsx]*

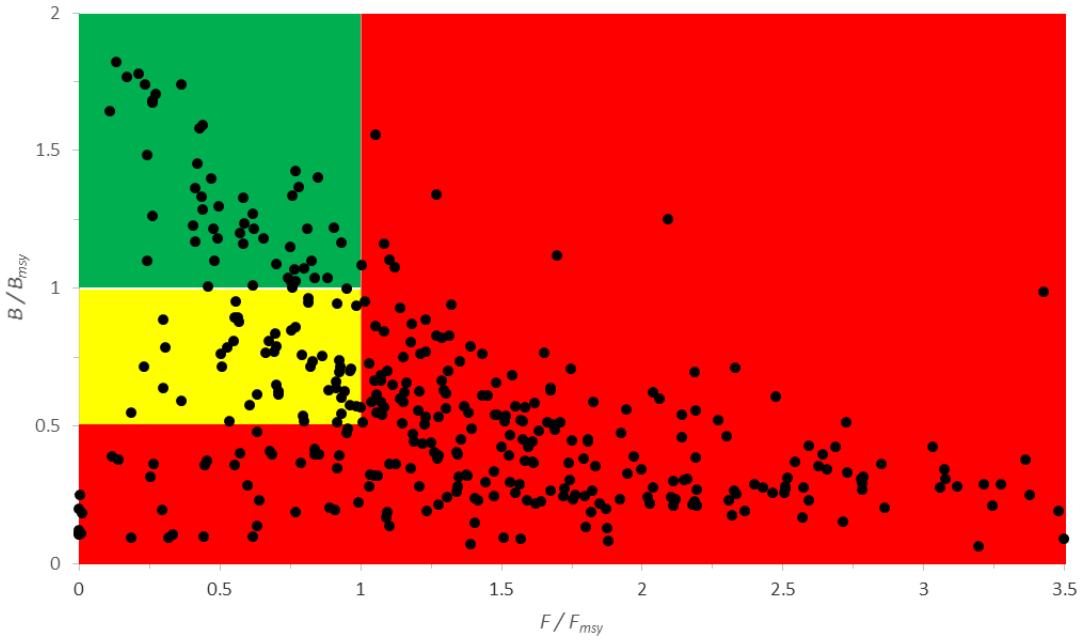



*Figure 8. Presentation of 397 stocks in European Seas in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Several stocks are not shown because their fishing pressure was beyond the upper end of the X-axis. Note that several depleted stocks are not recovering despite zero commercial catches (lower left corner). [AllStocks_Nov09_16b.xlsx]*

The results are summarized by ecoregion in Table 3. The number of stocks with available data in an ecoregion ranges from 7 in the Black Sea to 47 in the Celtic Seas. Barents Sea and Norwegian Sea have the highest percentage (50%) of stocks that comply with the goals of the Common Fisheries Policy (CFP 2013) by having a biomass above the level that can produce *MSY* and being subject to sustainable exploitation. Biomass and catches are also highest in this ecoregion, followed by wide-ranging stocks and by the Greater North Sea. The Mediterranean and Black Sea are still far away from the goals of the CFP, with only 2 out of 176 stocks in compliance.

Biomass in the ecoregions of the Mediterranean and Black Sea was on average less than half (44%) of the level that can produce *MSY*, whereas in the northern ecoregions (Barents Sea to Iberian Sea) biomass was about ¾ (73%) of that level. Consequently, rebuilding of biomass above the *MSY* level will require only 1-6 years in many stocks in the northern region, depending on the depletion level of the stocks and how far *F* is reduced below $F_{msy}$ during the rebuilding phase. For example, $F = 0.5\ F_{msy}$ should lead to rebuilding in 1-5 years in most stocks. In contrast, rebuilding in the Mediterranean and Black Sea may take 1-7 years under similar conditions. Note that with $F = F_{msy}$ no rebuilding above *MSY* levels is possible because with such fishing pressure, by definition, $B_{msy}$ is approached asymptotically in infinite time.

Detailed assessments by ecoregion are given in the next chapter.

*Table 3. Stock numbers, stocks subject to sustainable exploitation ($F <= F_{msy}$), stock size above the level capable of producing MSY ($B > B_{msy}$), stocks outside of safe biological limits ($B < 0.5\ B_{msy}$), severely depleted stocks ($B < 0.2\ B_{msy}$), number and percentage of stocks that are sustainably exploited ($F <= F_{msy}$, catch < MSY, $B > 0.2\ B_{msy}$), total biomass, total biomass level capable of producing MSY, total catch, total MSY level, and compliance with CFP targets, for 397 stocks in 14 European ecoregions and two wide-ranging regions. Note that totals of columns in this table may be different from totals mentioned in the text because of rounding. [AllStocks_Nov09_16b.xlsx]*

| **Ecoregion** | **Stocks n** | ***F* <= $F_{msy}$ n (%)** | ***B* > $B_{msy}$ n (%)** | ***B* < 0.5 $B_{msy}$ n (%)** | ***B* < 0.2 $B_{msy}$ n (%)** | **Sustainable n (%)** | **Biomass million tonnes** | **$B_{msy}$ million tonnes** | **Catch million tonnes** | ***MSY* million tonnes** | **CFP conform n (%)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Barents Sea and Norwegian Sea | 12 | 10 (83) | 8 (67) | 2 (17) | 1 (8) | 8 (67) | 19 | 21 | 1.9 | 4.6 | 6 (50) |
| Iceland, Faroes and Greenland | 26 | 15 (58) | 5 (23) | 11 (42) | 5 (19) | 12 (50) | 3.7 | 6.8 | 0.6 | 1.6 | 4 (15) |
| Greater North Sea | 45 | 25 (56) | 9 (20) | 21 (47) | 6 (13) | 23 (51) | 9.9 | 11 | 1.6 | 3.4 | 9 (20) |
| Baltic Sea | 20 | 12 (60) | 6 (30) | 9 (45) | 1 (5) | 12 (60) | 3.1 | 4.0 | 0.69 | 0.96 | 5 (25) |
| Celtic Seas and Rockall | 47 | 25 (53) | 11 (23) | 19 (40) | 7 (15) | 22 (47) | 1.3 | 2.1 | 0.23 | 0.48 | 10 (21) |
| Bay of Biscay, Iberian Coast and Azores | 31 | 13 (42) | 5 (16) | 7 (23) | 3 (10) | 12 (39) | 0.86 | 1.3 | 0.20 | 0.34 | 4 (13) |
| Gulf of Lions | 15 | 2 (13) | 0 (0) | 13 (87) | 0 (0) | 2 (13) | 0.044 | 0.11 | 0.009 | 0.033 | 0 (0) |
| Balearic Sea | 22 | 1 (5) | 0 (0) | 14 (64) | 0 (0) | 1 (5) | 0.36 | 0.72 | 0.13 | 0.21 | 0 (0) |
| Sardinia | 19 | 1 (5) | 0 (0) | 13 (68) | 4 (21) | 0 (0) | 0.075 | 0.17 | 0.015 | 0.057 | 0 (0) |
| Adriatic Sea | 30 | 11 (37) | 4 (13) | 20 (67) | 4 (13) | 7 (23) | 0.41 | 0.77 | 0.14 | 0.19 | 1 (3) |
| Ionian Sea | 31 | 5 (16) | 0 (0) | 19 (61) | 4 (13) | 5 (16) | 0.14 | 0.36 | 0.046 | 0.099 | 0 (0) |
| Aegean Sea | 42 | 5 (12) | 0 (0) | 23 (55) | 3 (7) | 5 (12) | 0.19 | 0.38 | 0.070 | 0.112 | 0 (0) |
| Cyprus | 10 | 0 (0) | 0 (0) | 9 (90) | 1 (10) | 0 (0) | 0.0013 | 0.0052 | 0.00037 | 0.0015 | 0 (0) |
| Black Sea | 7 | 1 (14) | 1 (14) | 3 (43) | 2 (29) | 1 (14) | 0.68 | 1.3 | 0.24 | 0.40 | 1 (14) |
| Wide-ranging ICCAT | 10 | 5 (50) | 5 (50) | 1 (10) | 1 (10) | 5 (50) | 1.0 | 0.96 | 0.13 | 0.19 | 4 (40) |
| Wide-ranging ICES | 30 | 13 (43) | 5 (17) | 18 (60) | 8 (27) | 8 (27) | 10.6 | 11.9 | 2.8 | 2.7 | 2 (7) |

**Comparison of independent $F/F_{msy}$ estimates with those obtained in this study**

Out of the 397 stocks examined in this study, 93 (23%) had independent stock assessment estimates of $F_{msy}$ and $F$ in in the final year with available data (Table 4). A comparison with the estimates derived in this study shows that 62 (67%) were less than 50% different from the independent stock assessment estimates. More importantly, in 76 stocks (82%) the $F/F_{msy}$ estimates derived in this study came to the same classification of overfishing ($F$ larger than $F_{msy}$) than the independent estimates. In 14 of the 17 diverging cases (82%), the independent stock assessments diagnosed overfishing while this study proposed sustainable exploitation levels. These differences often occurred in severely depleted stocks, where the surplus production models applied in this study slightly overestimated final biomass and thus underestimated exploitation. Also, the independent assessments often used the fishing mortality of higher age groups to determine the $F/F_{msy}$ ratio, whereas surplus production models do not know about age structure and instead derive the $F/F_{msy}$ ratio across all age groups, weighted by their contribution to the catch. Since lower age groups are not yet fully selected by the gear, their fishing mortality is lower than that of higher age groups, and hence the $F/F_{msy}$ ratio estimated by surplus production models may be lower than that of age-structured assessments. In summary, with regard to exploitation there is good agreement between the estimates done in this study and the estimates derived by independent stock assessment groups, with the caveat that the $F/F_{msy}$ estimates in this study may underestimate the exploitation of severely depleted stocks or of stocks with many age classes.

*Table 4. Comparison of exploitation estimates obtained in this study with 93 estimates in independent stock assessment documents. See respective Appendix for the ecoregion for indication of sources. Cases where estimates from this study deviate more than 50% from the "official" estimates are marked in bold in the $F/F_{msy}$ cur column. Cases where the independent classification of overfishing is different from this study are marked bold in the $F/F_{msy}$ indep column.*

| Region | Species | Stock | $F/F_{msy}$ cur | $F/F_{msy}$ indep |
|---|---|---|---|---|
| Barents Sea and Norwegian Sea | *Gadus morhua* | cod-arct | 0.58 | 0.96 |
| | *Melanogrammus aeglefinus* | had-arct | **0.24** | 0.59 |
| | *Clupea harengus* | her-noss | 0.66 | 0.73 |
| Iceland, Faroes and Greenland | *Argentina silus* | arg-icel | 0.70 | 0.77 |
| | *Molva molva* | lin-icel | 0.59 | **1.17** |
| | *Sebastes norvegicus* | smr-5614 | 0.74 | 0.99 |
| | *Brosme brosme* | usk-icel | 0.58 | **1.1** |
| | *Gadus morhua* | cod-farp | 1.38 | 1.44 |
| | *Melanogrammus aeglefinus* | had-faro | 1.34 | 1.02 |
| | *Pollachius virens* | sai-faro | 0.75 | 0.84 |
| | *Clupea harengus* | her-vasu | 0.92 | 1.0 |
| Greater North Sea | *Solea solea* | sol-eche | **0.81** | **1.73** |
| | | sol-kask | 0.30 | 0.49 |
| | | sol-nsea | 0.69 | **1.01** |
| | *Gadus morhua* | cod-347d | **0.30** | **1.17** |
| | *Melanogrammus aeglefinus* | had-346a | **2.11** | 0.65 |

| Region | Species | Stock | $F/F_{msy}$ cur | $F/F_{msy}$ indep |
|---|---|---|---|---|
| Greater North Sea | *Merlangius merlangus* | whg-47d | 1.18 | 1.51 |
| | *Clupea harengus* | her-47d3 | 0.43 | 0.73 |
| | *Sprattus sprattus* | spr-nsea | **0.75** | **1.81** |
| Baltic Sea | *Gadus morhua* | cod-2224 | **1.67** | 3.37 |
| | *Clupea harengus* | her-2532-gor | 0.82 | 0.83 |
| | | her-30 | 1.05 | **0.97** |
| | | her-3a22 | 0.63 | 0.80 |
| | | her-riga | 1.14 | 1.32 |
| | *Sprattus sprattus* | spr-2232 | 1.29 | 1.03 |
| Celtic Seas and Rockall | *Molva dypterygia* | bli-5b67 | 0.31 | 0.28 |
| | *Lepidorhombus whiffiagonis* | mgw-78 | 0.57 | **1.13** |
| | *Pleuronectes platessa* | ple-7h-k | 4.95 | 4.44 |
| | | ple-echw | 0.44 | 0.62 |
| | | ple-iris | **0.21** | 0.55 |
| | *Solea solea* | sol-7h-k | **0.55** | **2.88** |
| | | sol-celt | **3.70** | 1.13 |
| | | sol-echw | 0.70 | 0.68 |
| | | sol-iris | **0.63** | 0.38 |
| | *Gadus morhua* | cod-7e-k | 1.35 | 1.51 |
| | | cod-iris | **0.14** | **2.91** |
| | | cod-scow | **8.16** | 4.69 |
| | *Melanogrammus aeglefinus* | had-7b-k | 0.88 | 1.30 |
| | | had-rock | 1.47 | 1.07 |
| | *Merlangius merlangus* | whg-7e-k | 0.62 | 0.73 |
| | | whg-scow | **0.91** | 0.32 |
| | *Clupea harengus* | her-67bc | 0.36 | 0.44 |
| | | her-irls | 0.65 | 0.73 |
| | | her-nirs | 0.63 | **1.01** |
| Bay of Biscay and Iberian Sea, including Azores | *Lophius piscatorius* | anp-8c9a | **0.24** | 0.68 |
| | *Lepidorhombus boscii* | mgb-8c9a | **0.98** | **2.14** |
| | *Lepidorhombus whiffiagonis* | mgw-8c9a | 1.28 | 1.38 |
| | *Solea solea* | sol-bisc | 1.05 | 1.34 |
| | *Merluccius merluccius* | hke-soth | **0.77** | **2.10** |
| | *Trachurus trachurus* | hom-soth | **0.78** | 0.40 |
| Gulf of Lions | *Merluccius merluccius* | MERLMER_LI | **2.54** | 14.9 |
| | *Engraulis encrasicolus* | ENGRENC_LI | **0.53** | 0.21 |
| Balearic Sea | *Aristeus antennatus* | ARITANT_BA | **1.71** | 4.2 |
| | *Mullus barbatus* | MULLBAR_BA | 1.48 | 2.78 |
| | *Mullus surmuletus* | MULLSUR_BA | **2.16** | **0.63** |
| | *Nephrops norvegicus* | NEPRNOR_BA | **1.23** | 3.46 |

| Region | Species | Stock | $F/F_{msy}$ cur | $F/F_{msy}$ indep |
|---|---|---|---|---|
| Balearic Sea | *Parapenaeus longirostris* | PAPELON_BA | 3.38 | 3.06 |
| | *Merluccius merluccius* | MERLMER_BA | 4.79 | 7.47 |
| | *Micromesistius poutassou* | MICMPOU_BA | **2.12** | 3.28 |
| | *Engraulis encrasicolus* | ENGRENC_BA | **1.20** | 2.54 |
| Sardinia | *Mullus barbatus* | MULLBAR_SA | 2.33 | 3.19 |
| | *Nephrops norvegicus* | NEPRNOR_SA | **2.50** | 1.38 |
| | *Pagellus erythrinus* | PAGEERY_SA | 2.59 | 2.38 |
| | *Parapenaeus longirostris* | PAPELON_SA | 1.32 | 1.06 |
| | *Merluccius merluccius* | MERLMER_SA | **1.66** | 7 |
| | *Micromesistius poutassou* | MICMPOU_SA | 1.62 | 2.11 |
| | *Engraulis encrasicolus* | ENGRENC_SA | 1.69 | 2.6 |
| Adriatic Sea | *Mullus barbatus* | Mull_bar_AD | 1.68 | 1.32 |
| | *Solea solea* | Sole_sol_AD | 2.06 | 1.42 |
| | *Squilla mantis* | Squi_man_AD | 1.09 | 1.23 |
| | *Merluccius merluccius* | Merl_mer_AD | 4.05 | 5.56 |
| | *Engraulis encrasicolus* | Engr_enc_AD | **1.31** | 2.9 |
| | *Sardina pilchardus* | Sard_pil_AD | 1.58 | 1.47 |
| Ionian Sea | *Aristeomorpha foliacea* | ARISFOL_IS | 1.67 | 2.28 |
| | *Mullus barbatus* | MULLBAR_IS | **3.48** | 2.2 |
| Ionian Sea | *Parapeneaus longirostris* | PARELON_IS | 0.91 | **1.63** |
| | *Merluccius merluccius* | MERLMER_IS | 3.24 | 4.83 |
| | *Mullus barbatus* | MULLBAR_AL | **1.97** | 1.08 |
| | *Nephrops norvegicus* | NEPRNOR_AL | 4.01 | 2.67 |
| Cyprus | *Mullus barbatus* | MULLBAR_CY | 1.53 | 2.09 |
| | *Mullus surmuletus* | MULLSUR_CY | 2.19 | 2.13 |
| | *Boops boops* | BOOPBOO_CY | 2.00 | 1.54 |
| | *Spicara smaris* | SPICSMA_CY | 1.59 | 1.54 |
| Black Sea | *Mullus barbatus barbatus* | RMullet_BS | 2.19 | 1.67 |
| | *Squalus acanthias* | PDogfish_BS | **1.51** | 3.0 |
| | *Scophthalmus maximus* | Tur_BS | 5.31 | 5.38 |
| | *Merlangius merlangus* | Whiting_BS | 1.49 | 1.37 |
| | *Sprattus sprattus* | Spr_BS | 0.83 | 0.95 |
| | *Trachurus mediterraneus* | MHMackerel_BS | 7.57 | 5.56 |
| | *Engraulis encrasicolus* | BS_anch | **1.23** | 2.65 |
| Wide-ranging ICES Stocks | *Merluccius merluccius* | hke-nrtn | 1.12 | **0.79** |
| | *Micromesistius poutassou* | whb-comb | 0.77 | **1.43** |
| | *Scomber scombrus* | mac-nea | 1.70 | 1.54 |

**Results by ecoregion**

**Northeast Atlantic**

**Barents Sea and Norwegian Sea**

The following paragraph describing the Barents Sea was taken from the ICES Advice 2016, Book 9,

http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/Barents_Sea_Ecoregion-Ecosystem_overview.pdf.

"The Barents Sea is one of the shelf seas surrounding the Polar basin. It connects with the deeper Norwegian Sea to the west, the Arctic Ocean to the north, and the Kara Sea to the east, and borders the Norwegian and Russian coasts to the south. The 500 m depth contour is used to delineate the continental slope to the west and the north. To the east the Novaya Zemlya archipelago separates the Barents Sea and the Kara Sea. The Barents Sea covers an area of approximately 1.6 million $km^2$, has an average depth of ca. 230 m, and a maximum depth of about 500 m at the western end of Bear Island Trough. Its topography is characterized by troughs and basins, separated by shallow bank areas. The three largest banks are Central Bank, Great Bank, and Spitsbergen Bank. Several troughs over 300 m deep run from the central Barents Sea to the northern (e.g. Franz Victoria Trough) and western (e.g. Bear Island Trough) continental shelf break. These western troughs allow influx of Atlantic waters to the central Barents Sea. Atlantic waters enter the Arctic Basin through the Barents Sea and the Fram Strait. Large-scale atmospheric pressure systems influence the volume flux, temperature, and salinity of Atlantic waters, in turn affecting oceanographic conditions both in the Barents Sea and in the Arctic Ocean."

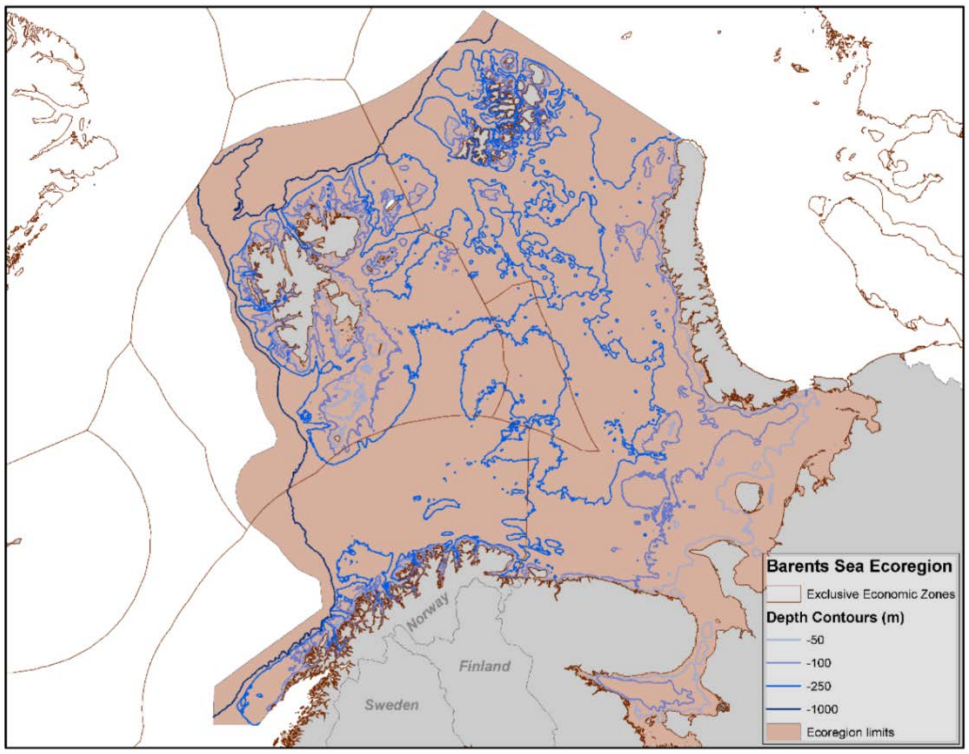



*Figure 9. The Barents Sea ecoregion with EEZ delineations. Source: ICES Advice 2016, Book 9.*

The following paragraph describing the Norwegian Sea was taken from the ICES Advice 2009, Book 3,

http://www.ices.dk/sites/pub/Publication%20Reports/ICES%20Advice/2009/ICES%20ADVICE%202009%20Book%203.pdf.

"The Norwegian Sea is traditionally defined as the ocean bounded by a line drawn from the Norwegian Coast at about 62°N to Shetland, farther to the Faroes-East Iceland-Jan Mayen-the southern tip of Spitsbergen-the Vesterålen at the Norwegian coast and the along the coast. In addition a wedge shaped strip along the western coast of Spitsbergen is included. The offshore boundaries follow in large part the mid Atlantic subsurface ridges. The Norwegian Sea has an area of 1.1 million $km^2$ and a volume of more than 2 million $km^3$, i.e. an average depth of about 2000 m. The Norwegian Sea is divided into two separate basins (the Lofoten Basin to the south and the Norwegian Basin in the north) of 3000 m to 4000 m depth, with a maximum depth 4020 m. Along the Norwegian coast there is a relatively narrow continental shelf, between 40 and 200 km wide with varied topography and geology. It has a relatively level sea bottom with depths between 100 and 400 m. The shelf is crossed by several troughs deeper than 300. Moraine deposits dominate the bottom substratum on the shelf, but soft layered clay is commonly found in the deeper parts. Gravelly and sandy bottoms are found near the shelf break and on ridges where the currents are strong and the sedimentation rates low."

ICES assessment reports with data until 2015 were analyzed for 12 stocks in the Barents Sea and Norwegian Sea. The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 5. Detailed assessments for every stock are available in Appendix 1 and in the spreadsheet BarentsSea_Sep26_2016.xlsx.

Of the 12 stocks, 2 (17%) were subject to ongoing overfishing ($F > F_{msy}$) and 2 stocks (17%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). In two stocks (17%) catches exceeded the maximum sustainable yield ($C/MSY > 1$). One stock of redfish (smr-arct) was in critical condition, defined by being outside of safe biological limits and subject to overfishing (marked red in Table 5). Altogether, 4 stocks (33%) were subject to unsustainable exploitation (catch > *MSY* or $F > F_{msy}$ or $B < 0.2\ B_{msy}$), with the too high catches marked red in Table 5. Six stocks (50%) could be considered as being well managed and in good condition sensu CFP (2013), defined by not being subject to overfishing ($F > F_{msy}$ or Catch > *MSY*) and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 12 stocks of 19 million tonnes in the last year with available data was below but close to the biomass level of 21 million tonnes that can produce maximum yields. Summed catches of 1.9 million tonnes were well below the summed maximum sustainable yield of 4.6 million tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above $B_{msy}$. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 5. Analysis of 12 stocks in the Barents Sea and Norwegian Sea, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$), $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red) and pelagic plankton feeders (green). [BarentsSea_Sep26_2016.xlsx]*

| **Scientific name** | **Stock** | **Year** | ***MSY*** | **Catch** | ***C/MSY*** | $F_{msy}$ | $F_{msy\ cur}$ | ***F*** | $F/F_{msy\ cur}$ | $B_{msy}$ | ***B*** | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Reinhardtius hippoglossoides* | ghl-arct | 2014 | 18,674 | 22,244 | **1.19** | 0.19 | 0.19 | 0.16 | 0.85 | 97,494 | 136,757 | 1.40 |
| *Molva molva* | lin-arct | 2014 | 9,516 | 9,606 | **1.01** | 0.16 | 0.16 | 0.12 | 0.76 | 58,857 | 78,612 | 1.34 |
| *Pandalus borealis* | pand-barn | 2014 | 62,740 | 16,671 | 0.27 | 0.37 | 0.37 | 0.09 | 0.24 | 168,188 | 185,115 | 1.10 |
| *Sebastes mentella* | smn-arct | 2013 | 30,923 | 9,297 | 0.30 | 0.25 | 0.25 | 0.04 | 0.17 | 123,181 | 217,555 | 1.77 |
| *Sebastes norvegicus* | smr-arct | 2015 | 18,619 | 3,630 | 0.19 | 0.15 | 0.03 | 0.29 | **9.37** | 124,272 | 12,678 | **0.10** |
| *Brosme brosme* | usk-arct | 2014 | 13,965 | 8,734 | 0.63 | 0.28 | 0.28 | 0.17 | 0.62 | 50,642 | 51,223 | 1.01 |
| *Gadus morhua* | cod-arct | 2015 | 1,116,189 | 864,384 | 0.77 | 0.23 | 0.23 | 0.13 | 0.58 | 4,857,246 | 6,451,009 | 1.33 |
| *Gadus morhua* | cod-coas | 2015 | 64,205 | 52,154 | 0.81 | 0.28 | 0.28 | 0.43 | **1.52** | 226,986 | 121,657 | 0.54 |
| *Melanogrammus aeglefinus* | had-arct | 2015 | 474,993 | 194,756 | 0.41 | 0.21 | 0.21 | 0.05 | 0.24 | 2,311,421 | 4,020,476 | 1.74 |
| *Pollachius virens* | sai-arct | 2015 | 227,311 | 131,765 | 0.58 | 0.27 | 0.27 | 0.13 | 0.48 | 849,200 | 1,032,863 | 1.22 |
| *Mallotus villosus* | cap-bars | 2015 | 1,670,405 | 115,000 | 0.07 | 0.21 | 0.15 | 0.04 | 0.26 | 8,098,440 | 2,920,786 | **0.36** |
| *Clupea harengus* | her-noss | 2014 | 905,483 | 461,306 | 0.51 | 0.20 | 0.20 | 0.13 | 0.66 | 4,487,167 | 3,442,750 | 0.77 |

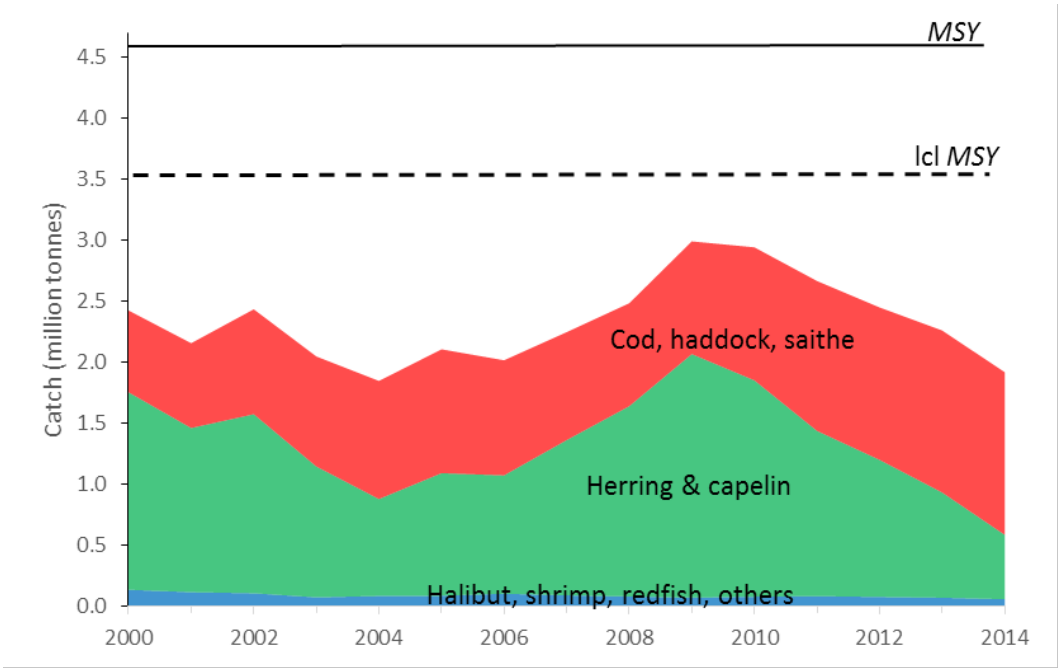



*Figure 10. Cumulative catches for 12 stocks in the Barents Sea and Norwegian Sea, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [BarentsSea_Sep26_2016.xlsx]*

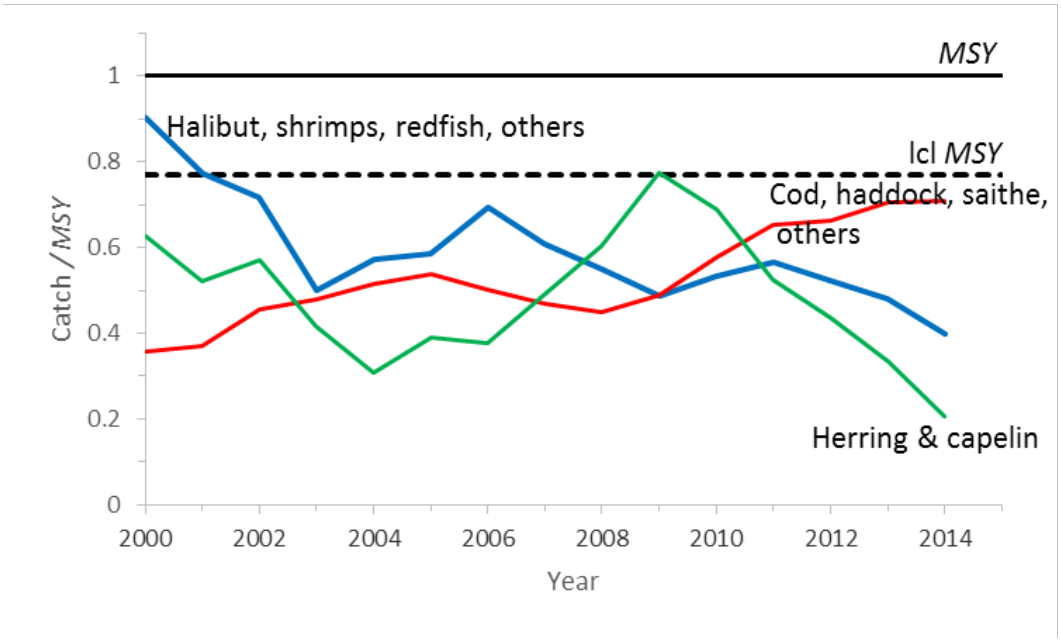



*Figure 11. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 12 stocks in the Barents Sea and Norwegian Sea. Catches for large predators (red curve) are near the precautionary maximum. Catches for pelagic plankton feeders (green curve) can be increased after the stocks have been rebuilt. [BarentsSea_Sep26_2016.xlsx]*

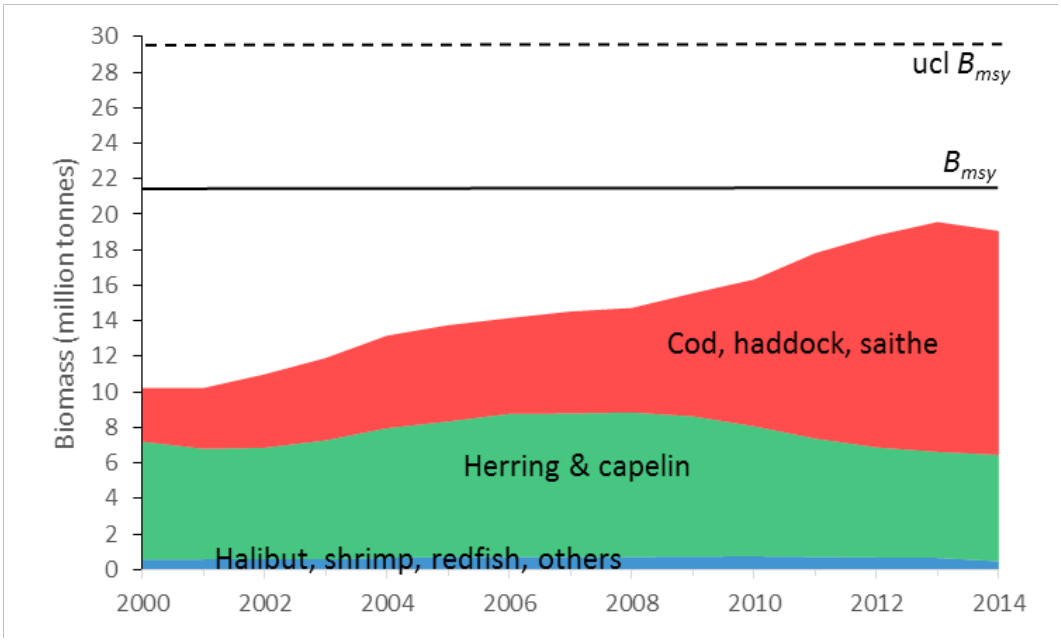



*Figure 12. Cumulative total biomass of 12 stocks in the Barents Sea and Norwegian Sea relative to the biomass that can produce the maximum sustainable yield (Bmsy = black line). The upper 95% confidence limit of Bmsy (dashed line) would present a precautionary target biomass above Bmsy. This is also the area where the maximum economic yield could be obtained. The functional groups of large predators (red), pelagic plankton feeders (green), and benthic organisms (blue) are indicated, with listing of main species. [BarentsSea_Sep26_2016.xlsx]*

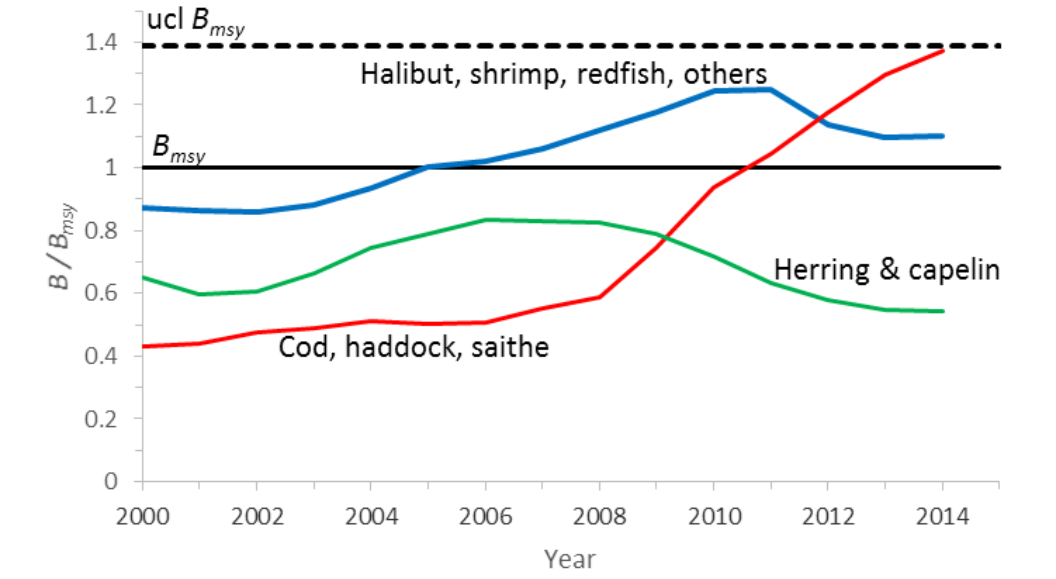



*Figure 13. Median biomass relative to the level that can produce the maximum sustainable yield (B/Bmsy) for 12 stocks in the Barents Sea and Norwegian Sea assigned to main functional groups. Biomass of pelagic plankton feeders (green curve) needs rebuilding. [BarentsSea_Sep26_2016.xlsx]*

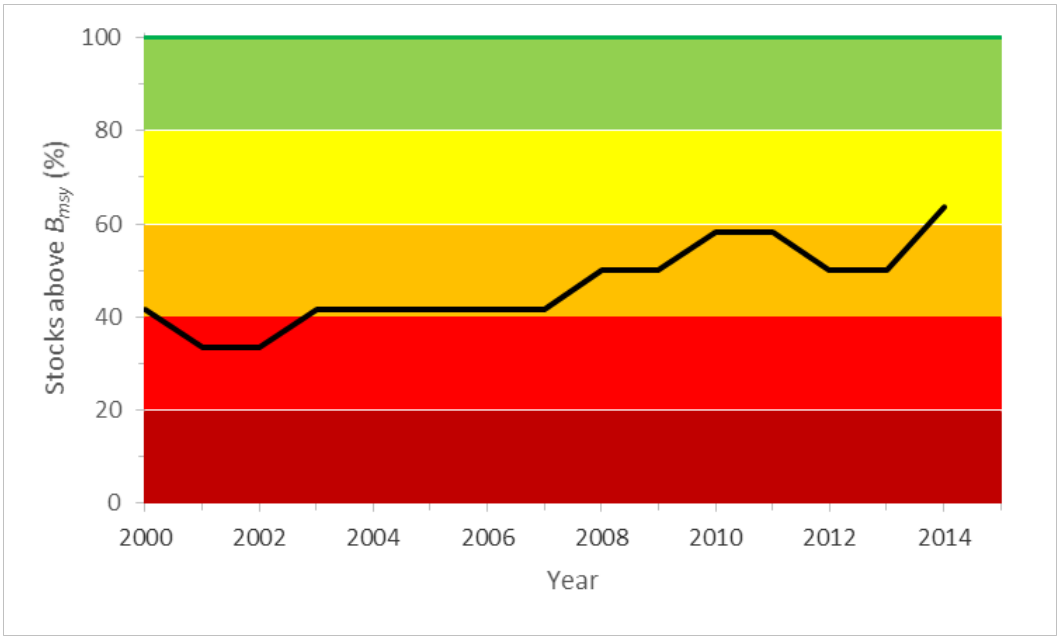



*Figure 14. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 12 stocks in the Barents Sea and Norwegian Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2014, only 64% of the stocks fulfilled that requirement. [BarentsSea_Sep26_2016.xlsx]*

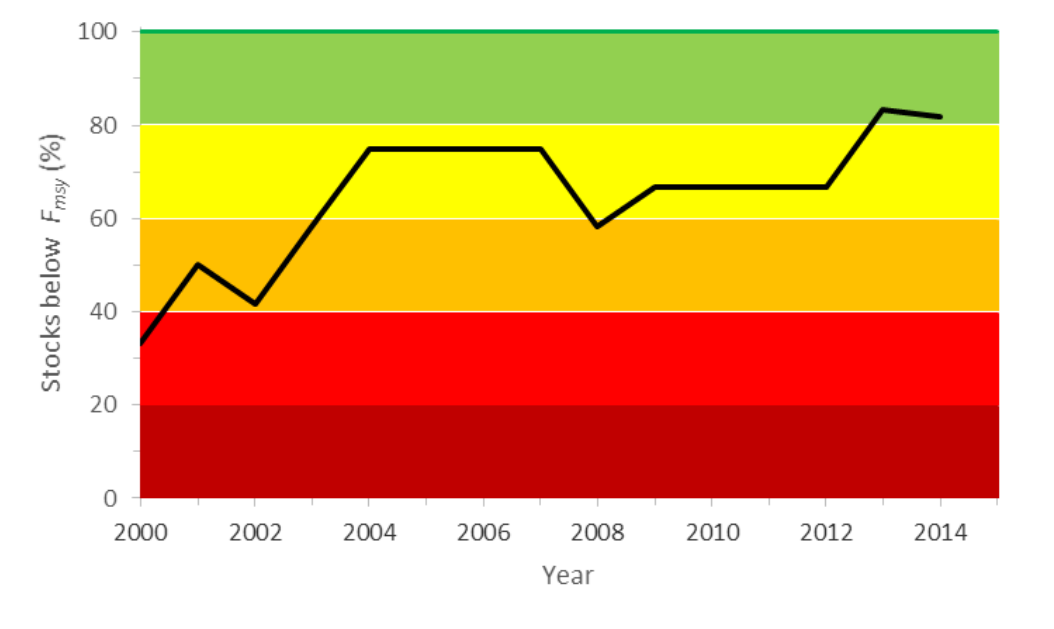



*Figure 15. Percentage of stocks where fishing mortality F is at or below the level that can produce the maximum sustainable yield ($F_{msy}$) for 12 stocks in the Barents Sea and Norwegian Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be at or below $F_{msy}$ in 2015, latest in 2020. In 2014, already 82% of the stocks fulfilled that requirement. [BarentsSea_Sep26_2016.xlsx]*

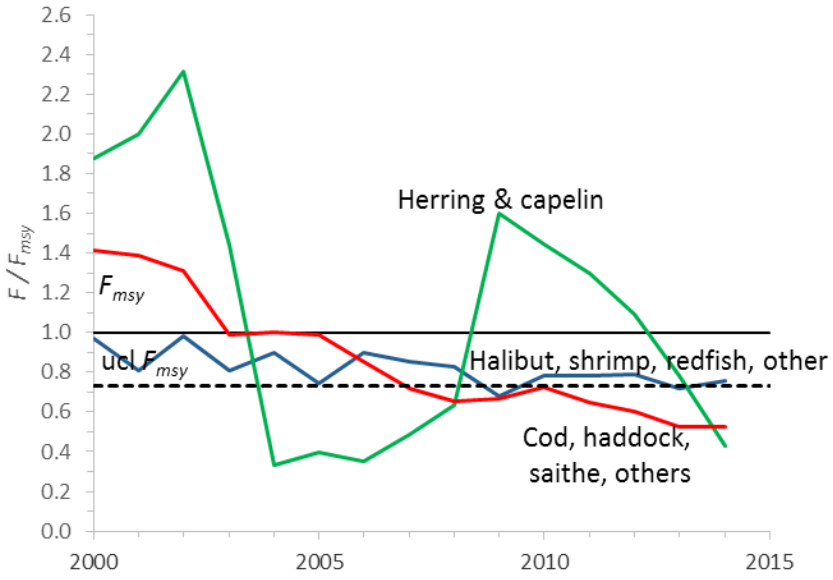



*Figure 16. Fishing pressure relative to the maximum sustainable level (F/Fmsy) for 12 stocks in the Barents Sea and Norwegian Sea assigned to main functional groups. Median exploitation level of the functional groups seems adequate. [BarentsSea_Sep26_2016.xlsx]*

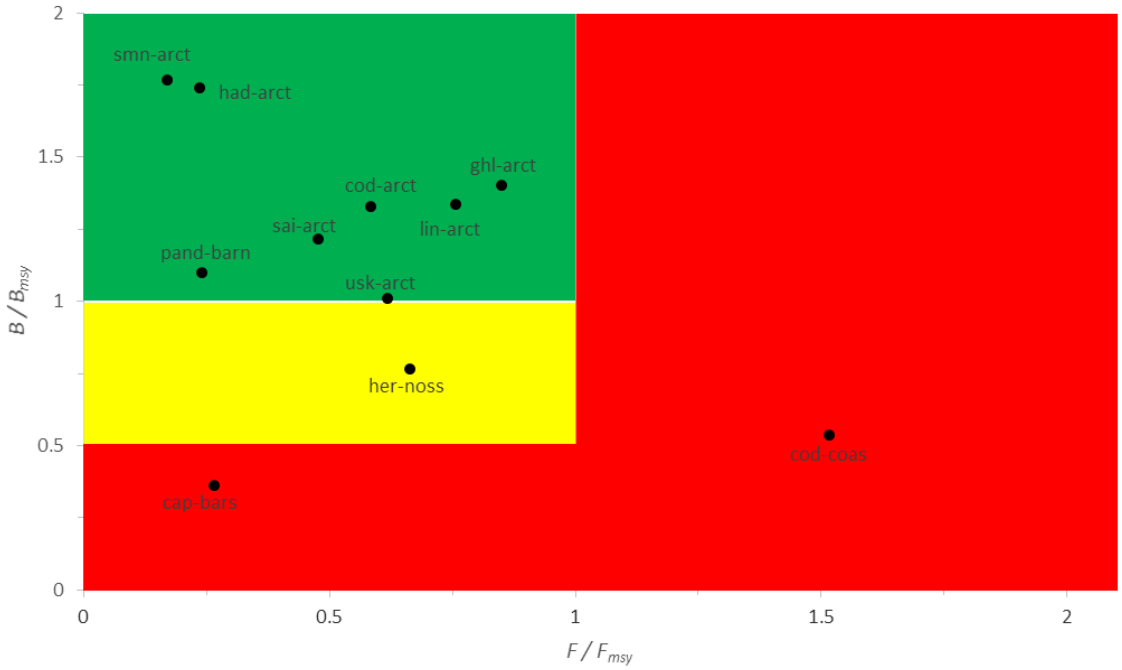



*Figure 17. Presentation of 12 Barents Sea and Norwegian Sea stocks in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. [BarentsSea_Sep26_2016.xlsx]*

**Iceland, Faroes and Greenland**

The following paragraph describing Iceland was- taken from the ICES Advice 2008, Book 2,

http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2008/2008/2.1-2.2%20Greenland%20and%20Iceland%20ecosystem%20overview.pdf.

"Iceland is located at the junction of the Mid-Atlantic Ridge and the Greenland-Scotland Ridge just south of the Arctic Circle. Bottom topography in this region is generally irregular, with hard rocky bottom prevailing in most areas. The shelf around Iceland is cut by many sub-sea canyons. It is narrowest off the south coast where in places it extends out only a few km. From there, the continental slope falls away to over 1000 m. Off the west, north, and east coasts, however, the shelf is relatively broad and extends often over 150 km from the coast."

The next three paragraphs describing the Faroes were taken from the ICES Advice 2008, Book 4,

http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2008/2008/4.1-4.2%20Faroe%20plateau%20ecosystem%20overview.pdf.

"The upper layers of the waters surrounding the Faroes are dominated by 'Modified North Atlantic Water' which derives from the North Atlantic Current flowing towards the east and northeast. This water is typically around 8°C with salinities around 35.25. Deeper than 500–600 m, the water in most areas is dominated by cold water (T<0°C) with salinities close to 34.9, flowing out of the Nordic Seas through the deepest passages.

In shallow regions, there are strong tidal currents, which mix the shelf water very efficiently. This results in homogeneous water masses in the shallow shelf areas. The well-mixed shelf water is separated relatively well from the offshore water by a persistent tidal front, which surrounds the shelf at about the 100–130 m bottom depth. In addition, residual currents have a persistent clockwise circulation around the islands.

The shelf-front provides a fair, although variable, degree of isolation between the on-shelf and the off-shelf areas. This allows the on-shelf areas to support a relatively uniform shelf ecosystem, which in many ways is distinct from off-shelf waters. This ecosystem has distinct planktonic communities, benthic fauna, and several fish stocks. Furthermore, about 1.7 million pairs of seabirds breed on the Faroe Islands and take most of their food from the shelf water."

The following two paragraphs describing Greenland were taken from the ICES Advice 2008, Book 2,

http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2008/2008/2.1-2.2%20Greenland%20and%20Iceland%20ecosystem%20overview.pdf.

"The seafloor drops rapidly from the Greenland coast to depths over 1000 m. In the areas seasonally ice free, the shelf area is rarely more than 75 km wide. The coastline and sub-sea topography are heavily serrated with canyons, and the bottom topography is generally rough with hard bottom types.

The strong, cold East Greenland Current dominates the hydrographic conditions along the coast of Greenland. In some years, the warmer Irminger Current extends somewhat further west, transporting heat and organisms from Iceland into Greenland waters."

ICES assessment reports with data until 2015 were analyzed for 26 stocks in Iceland, Faroe and Greenland. The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 6 Detailed assessments for every stock are available in the Appendix 1 and in the spreadsheet Iceland_Sep27_2016.xlsx.

Of the 26 stocks, 11 (42%) were subject to ongoing overfishing ($F > F_{msy}$) and 11 stocks (42%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). In one stock (lin-faro, 4%) catches exceeded the maximum sustainable yield ($C/MSY > 1$). Nine stocks were in critical condition, defined by being outside of safe biological limits and subject to overfishing (marked red in Table 6). Altogether, 14 stocks (54%) were subject to unsustainable exploitation (catch > *MSY* or $F > F_{msy}$ or $B < 0.2\ B_{msy}$), with the too high catches marked red in Table 6. Four stocks (15%) could be considered as being well managed and in good condition sensu CFP (2013), defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 26 stocks of 3.7 million tonnes in the last year with available data was below the summed biomass level of 6.8 million tonnes that can produce maximum yields. Summed catches of 0.6 million tonnes were well below the summed maximum sustainable yield of 1.6 million tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above *Bmsy*. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 6. Analysis of 26 stocks in Iceland, Faroes and Greenland, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$) , $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red) and pelagic plankton feeders (green). [Iceland_Sep27_2016.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Argentina silus* | arg-5b6a | 2014 | 15,790 | 15,642 | 0.99 | 0.16 | 0.15 | 0.35 | **2.30** | 97,278 | 45,132 | **0.46** |
| *Argentina silus* | arg-icel | 2015 | 10,975 | 6,056 | 0.55 | 0.27 | 0.27 | 0.19 | 0.70 | 40,551 | 31,934 | 0.79 |
| *Molva dypterygia* | bli-5a14 | 2015 | 4,096 | 1,813 | 0.44 | 0.20 | 0.20 | 0.14 | 0.71 | 20,732 | 12,942 | 0.62 |
| *Reinhardtius hippoglossoides* | ghl-grn | 2015 | 33,487 | 25,677 | 0.77 | 0.19 | 0.19 | 0.22 | **1.16** | 180,692 | 119,017 | 0.66 |
| *Molva molva* | lin-faro | 2014 | 6,098 | 6,684 | **1.10** | 0.17 | 0.17 | 0.13 | 0.77 | 35,220 | 50,217 | 1.43 |
| *Molva molva* | lin-icel | 2015 | 17,703 | 12,862 | 0.73 | 0.31 | 0.31 | 0.18 | 0.59 | 57,006 | 70,493 | 1.24 |
| *Pandalus borealis* | Pan_bor_1 | 2013 | 686 | 201 | 0.29 | 0.30 | 0.22 | 0.24 | **1.12** | 2,290 | 827 | **0.36** |
| *Pandalus borealis* | Pan_bor_2 | 2013 | 2,129 | 1,128 | 0.53 | 0.39 | 0.23 | 0.73 | **3.21** | 5,400 | 1,551 | **0.29** |
| *Sebastes mentella* | smn-con | 2015 | 20,511 | 9,311 | 0.45 | 0.14 | 0.14 | 0.10 | 0.70 | 144,371 | 93,744 | 0.65 |
| *Sebastes mentella* | smn-dp | 2014 | 49,284 | 23,755 | 0.48 | 0.09 | 0.06 | 0.15 | **2.52** | 528,467 | 163,536 | **0.31** |
| *Sebastes mentella* | smn-grl | 2015 | 15,898 | 5,977 | 0.38 | 0.08 | 0.01 | 0.74 | **> 10** | 191,446 | 8,043 | **0.04** |
| *Sebastes mentella* | smn-sp | 2015 | 42,617 | 5,595 | 0.13 | 0.08 | 0.01 | 0.34 | **> 10** | 521,252 | 16,419 | **0.03** |
| *Sebastes norvegicus* | smr-5614 | 2015 | 67,027 | 51,601 | 0.77 | 0.18 | 0.18 | 0.13 | 0.74 | 372,227 | 385,982 | 1.04 |
| *Brosme brosme* | usk-icel | 2015 | 7,121 | 4,822 | 0.68 | 0.26 | 0.26 | 0.15 | 0.58 | 27,108 | 31,502 | 1.16 |
| *Gadus morhua* | cod-farb | 2015 | 2,056 | 17 | 0.01 | 0.28 | 0.06 | 0.02 | 0.44 | 7,221 | 699 | **0.10** |
| *Gadus morhua* | cod-farp | 2015 | 26,148 | 7,394 | 0.28 | 0.36 | 0.23 | 0.32 | **1.38** | 71,927 | 23,035 | **0.32** |
| *Gadus morhua* | cod-iceg | 2015 | 465,538 | 230,225 | 0.49 | 0.36 | 0.36 | 0.14 | 0.40 | 1,296,232 | 1,589,240 | 1.23 |
| *Gadus morhua* | cod-ingr | 2015 | 34,388 | 25,272 | 0.73 | 0.39 | 0.39 | 0.42 | **1.07** | 88,321 | 60,592 | 0.69 |
| *Gadus morhua* | cod-segr | 2015 | 36,777 | 15,755 | 0.43 | 0.22 | 0.05 | 0.80 | **> 10** | 166,528 | 19,687 | **0.12** |
| *Gadus morhua* | cod-wgr | 2015 | 423,139 | 4,860 | 0.01 | 0.23 | 0.04 | 0.03 | 0.62 | 1,818,646 | 175,517 | **0.10** |

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Melanogrammus aeglefinus* | had-faro | 2015 | 18,461 | 3,395 | 0.18 | 0.33 | 0.17 | 0.23 | **1.34** | 56,333 | 14,744 | **0.26** |
| *Melanogrammus aeglefinus* | had-iceg | 2015 | 65,240 | 39,646 | 0.61 | 0.34 | 0.34 | 0.28 | 0.83 | 190,631 | 139,702 | 0.73 |
| *Pollachius virens* | sai-faro | 2015 | 39,389 | 25,128 | 0.64 | 0.22 | 0.22 | 0.17 | 0.75 | 175,104 | 148,482 | 0.85 |
| *Pollachius virens* | sai-icel | 2015 | 63,763 | 48,476 | 0.76 | 0.29 | 0.29 | 0.22 | 0.76 | 217,589 | 217,909 | 1.00 |
| *Mallotus villosus* | cap-icel | 2016 | 1,053 | 174 | 0.17 | 0.36 | 0.36 | 0.08 | 0.23 | 2,954 | 2,111 | 0.71 |
| *Clupea harengus* | her-vasu | 2015 | 108,626 | 69,729 | 0.64 | 0.24 | 0.24 | 0.22 | 0.92 | 447,668 | 310,874 | 0.69 |

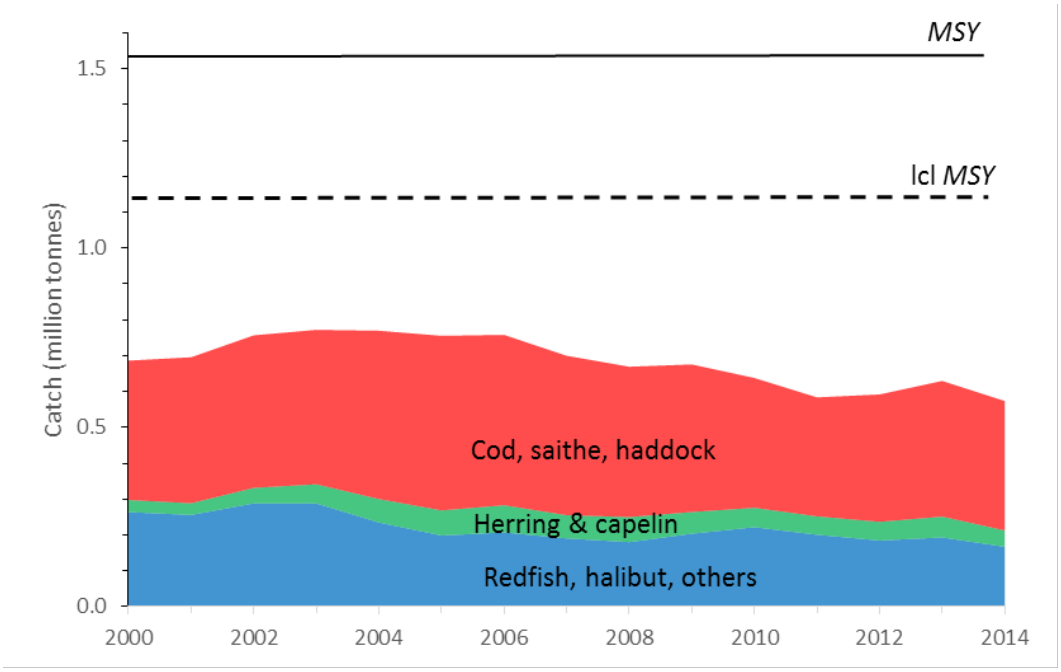



*Figure 18. Cumulative catches for 26 stocks in Iceland, Faroes and Greenland, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [Iceland_Sep27_2016.xlsx]*

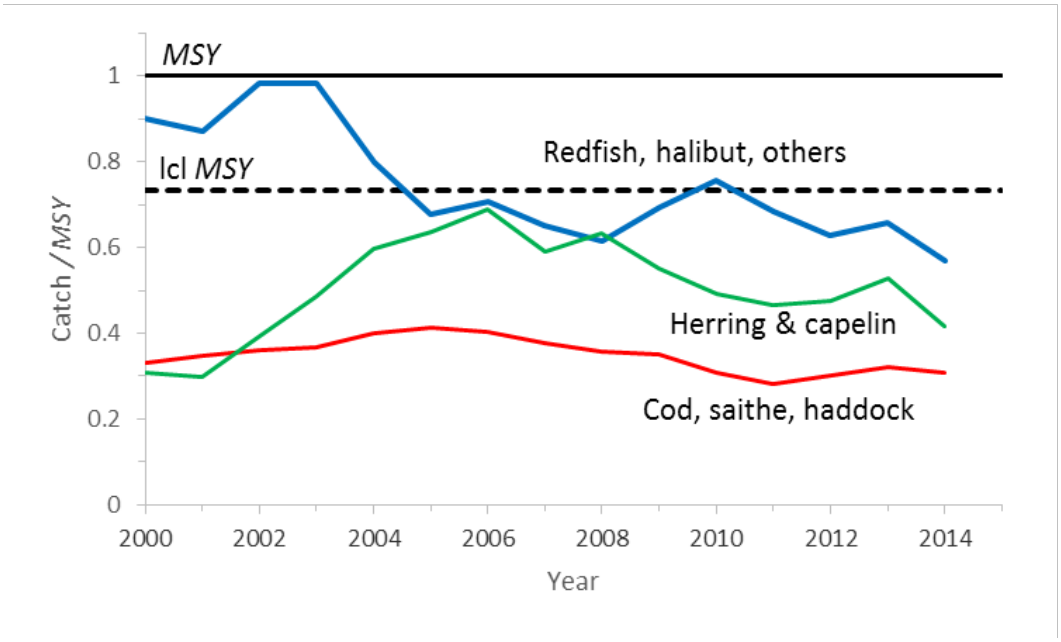



*Figure 19. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 26 stocks in Iceland, Faroes and Greenland. Catches of large predators (red curve) could be increased after stocks have been rebuilt. [Iceland_Sep27_2016.xlsx]*

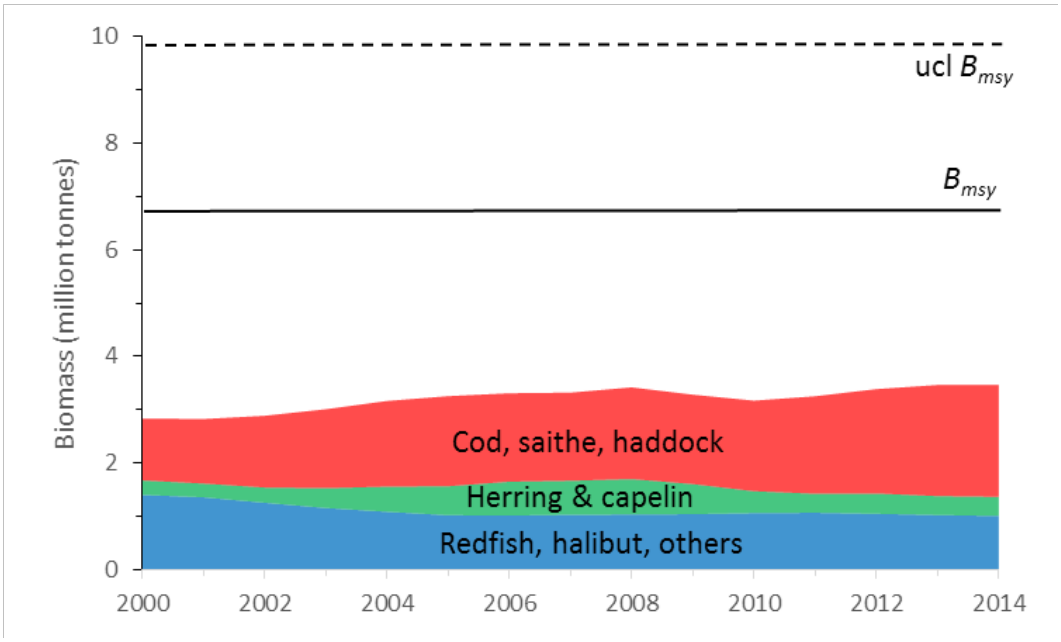



*Figure 20. Cumulative total biomass of 26 stocks in Iceland, Faroes and Greenland relative to the biomass that can produce the maximum sustainable yield (Bmsy = black line). The upper 95% confidence limit of Bmsy (dashed line) would present a precautionary target biomass above Bmsy. This is also the area where the maximum economic yield could be obtained. The functional groups of large predators (red), pelagic plankton feeders (green), and benthic organisms (blue) are indicated, with listing of main species. Overall biomass of commercial species is much too low. [Iceland_Sep27_2016.xlsx]*

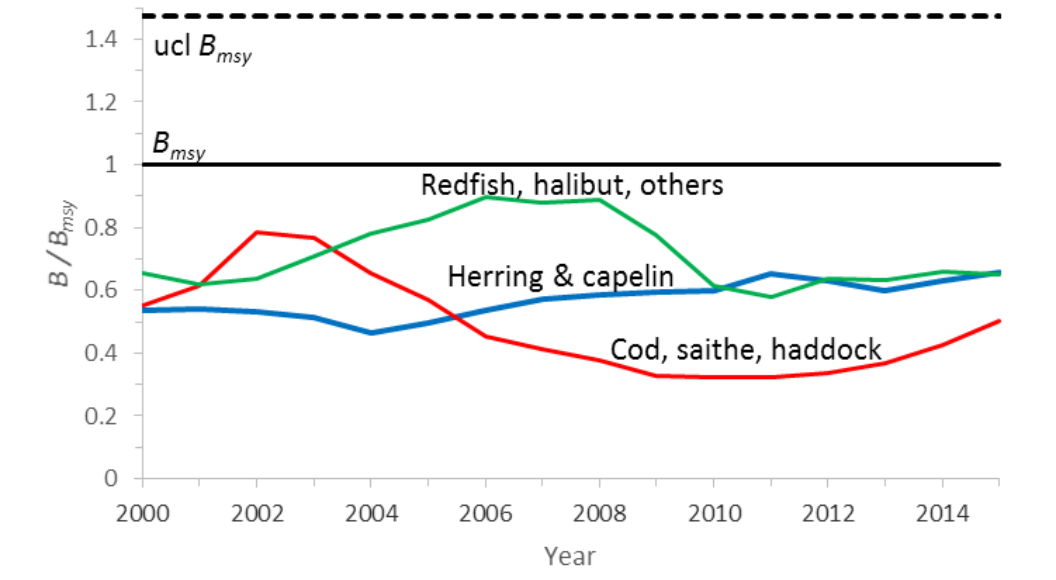



*Figure 21. Median biomass relative to the level that can produce the maximum sustainable yield (B/Bmsy) for 26 stocks in Iceland, Faroes and Greenland assigned to main functional groups. Biomass of all functional groups is too low. Large predators (red curve) were even outside of safe biological limits in recent years. [Iceland_Sep27_2016.xlsx]*

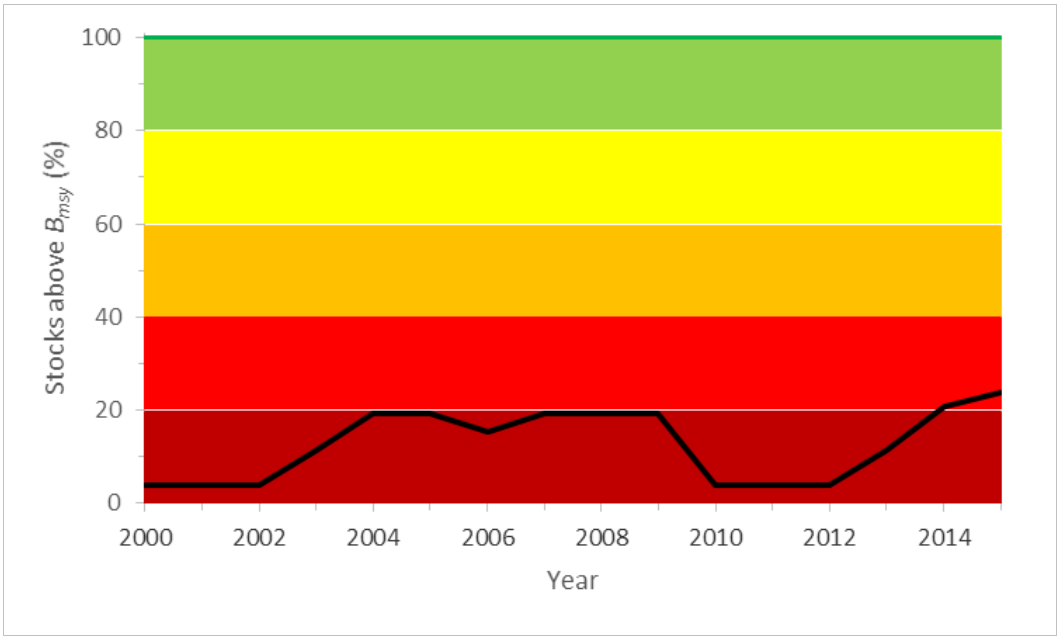



*Figure 22. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 26 stocks in Iceland, Faroes and Greenland (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2015, only 24% of the stocks fulfilled that requirement. [Iceland_Sep27_2016.xlsx]*

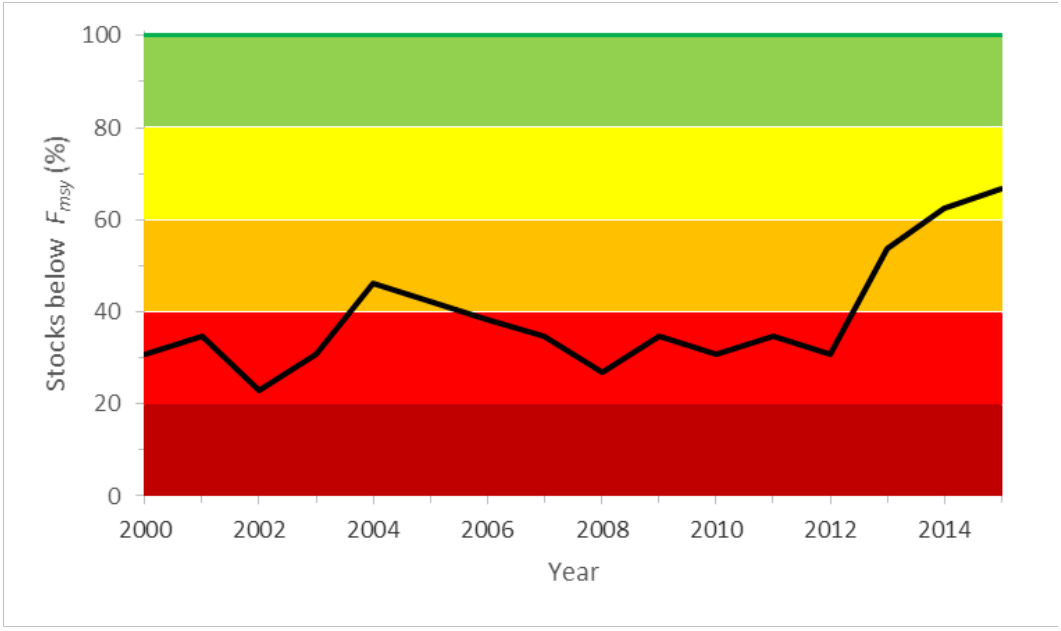



*Figure 23. Percentage of stocks where fishing mortality F is at or below the level that can produce the maximum sustainable yield ($F_{msy}$) for 26 stocks in Iceland, Faroes and Greenland (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be at or below $F_{msy}$ in 2015, latest in 2020. In 2015, only 67% of the stocks fulfilled that requirement. [Iceland_Sep27_2016.xlsx]*

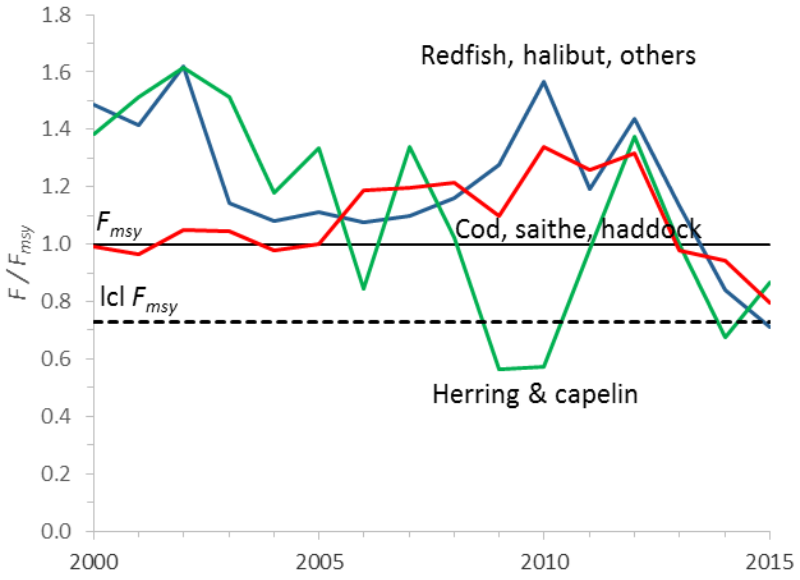



*Figure 24. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 26 stocks in Iceland, Faroes and Greenland assigned to main functional groups. Median fishing pressure for the functional groups has decreased in recent years. [Iceland_Sep27_2016.xlsx]*

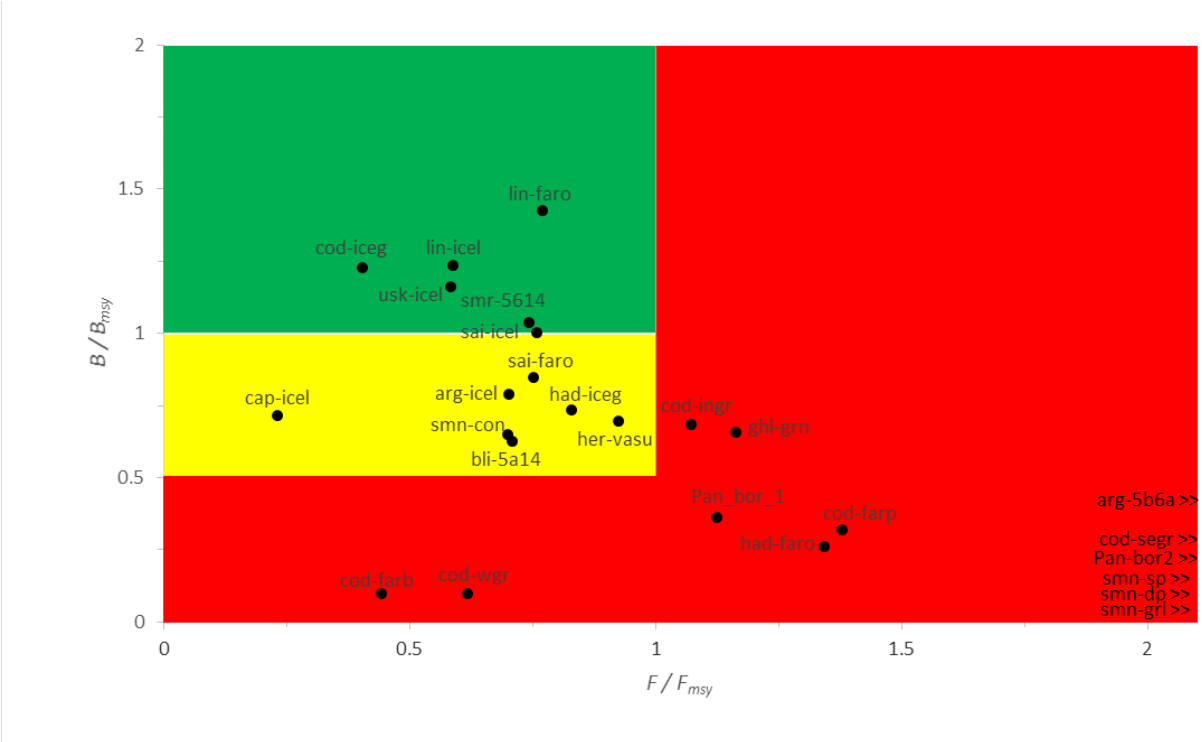



*Figure 25. Presentation of 26 stocks in Iceland, Faroes and Greenland in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Several stocks (some indicated by ->>) are exploited beyond the upper limit of the X-axis. [Iceland_Sep27_2016.xlsx]*

**Greater North Sea**

The following paragraph was taken from the ICES Advice 2016, Book 6,

http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/Greater_North_Sea_Ecoregion-Ecosystem_overview.pdf.

"The Greater North Sea ecoregion includes the North Sea, English Channel, Skagerrak, and Kattegat. It is a temperate coastal shelf sea with a deep channel in the northwest, a permanently thermally mixed water column in the south and east, and seasonal stratification in the north."

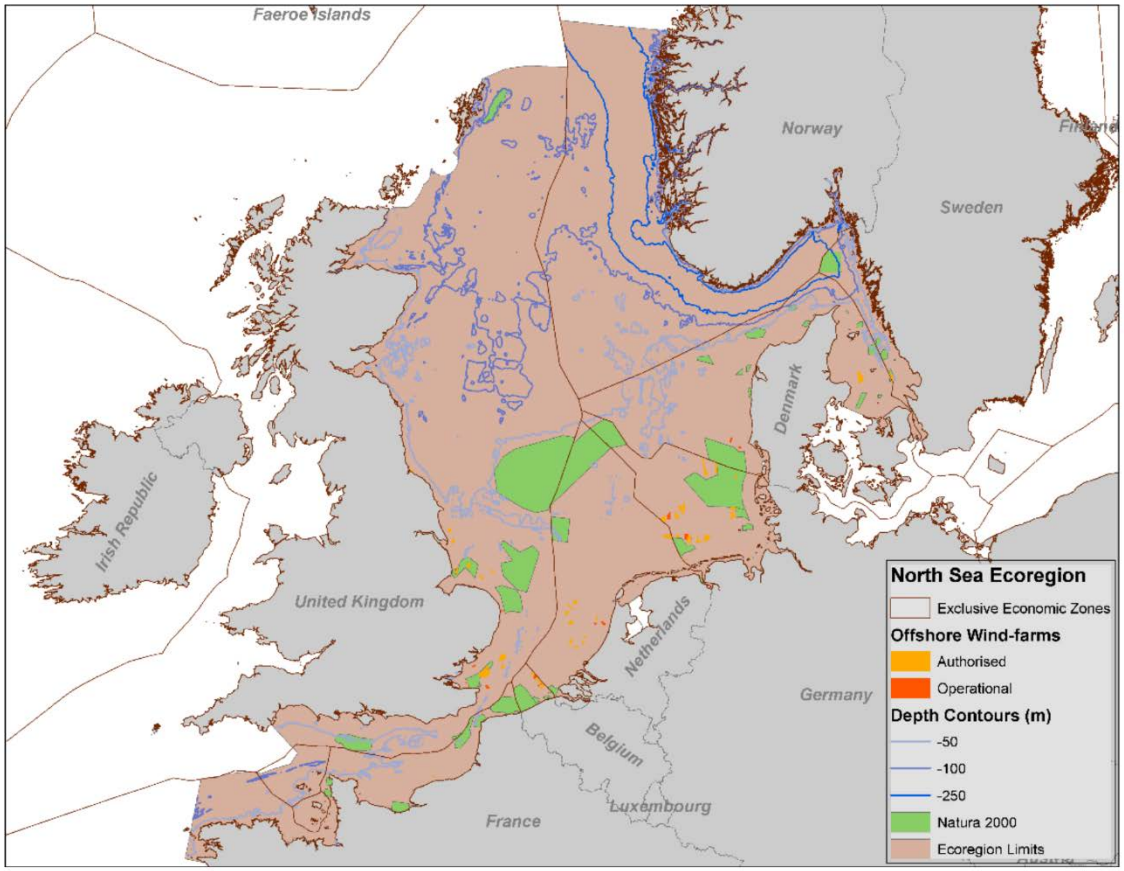



*Figure 26. Greater North Sea ecoregion, showing EEZs, larger offshore Natura 2000 sites, and operational and authorized wind farms. Source: ICES Advice 2016, Book 6.*

ICES assessment reports with data mostly until 2015 were analyzed for 45 stocks in the Greater North Sea. The graphs below summarize their status and exploitation level within an MSY-framework. Wide ranging species such as European eel (*Anguilla anguilla*) or Atlantic mackerel (*Scomber scombrus*) are not included and are analyzed separately. The list of species and their current exploitation and status is summarized in Table 7. Detailed assessments for every stock are available in Appendix 1 and in the spreadsheet NorthSea_Sep23_2016.xlsx.

Of the 45 stocks, 20 (44%) were subject to ongoing overfishing ($F > F_{msy}$) in the last year with available data and 21 stocks (47%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). In two stocks (4%) catches exceeded the maximum sustainable yield ($C/MSY > 1$). Fifteen stocks (33%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing (scientific names marked red in Table 7). Altogether, 22 stocks (49%) were subject to unsustainable exploitation (catch > *MSY* or $F > F_{msy}$ or $B < 0.2\ B_{msy}$), with the too high catches marked red in Table 7. Only nine stocks (20%) could be considered as being well managed and in good condition sensu CFP (2013), defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield (scientific names marked green in Table 7).

Summed biomass of the 45 stocks of 9.9 million tonnes in the last year with available data was below the summed biomass level of 11 million tonnes that can produce maximum yields. Summed catches of 1.6 million tonnes were well below (47%) the summed maximum sustainable yield of 3.4 million tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above $B_{msy}$. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 7. Analysis of 45 stocks in the Greater North Sea, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$), $F_{msy\ cur}$ applicable for current stock size, relative $F/F_{msy\ cur}$ for current stock size, biomass that can produce MSY ($B_{msy}$), and relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where $F/F_{msy\ cur} < 1$ and $B/B_{msy} > 1$ are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Unsustainable catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy\ cur} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red) and pelagic plankton feeders (green). [NorthSea_Sep23_2016.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Scophthalmus rhombus* | bll-nsea | 2014 | 2,142 | 1,942 | 0.91 | 0.32 | 0.32 | 0.34 | **1.05** | 6,707 | 5,777 | 0.86 |
| *Limanda limanda* | dab-nsea | 2014 | 11,260 | 4,955 | 0.44 | 0.29 | 0.29 | 0.08 | 0.26 | 39,172 | 65,830 | 1.68 |
| *Platichthys flesus* | fle-nsea | 2014 | 4,134 | 2,062 | 0.50 | 0.44 | 0.44 | 0.25 | 0.57 | 9,502 | 8,359 | 0.88 |
| *Microstomus kitt* | lem-nsea | 2014 | 6,773 | 3,689 | 0.54 | 0.36 | 0.36 | 0.24 | 0.67 | 18,972 | 15,353 | 0.81 |
| *Lepidorhombus* spp. | meg-4a6a | 2014 | 4,829 | 2,809 | 0.58 | 0.32 | 0.32 | 0.16 | 0.49 | 15,262 | 18,005 | 1.18 |
| *Mullus surmuletus* | mur-347d | 2014 | 3,270 | 1,732 | 0.53 | 0.41 | 0.25 | 0.70 | **2.78** | 8,062 | 2,489 | **0.31** |
| *Nephrops norvegicus* | nep-10 | 2015 | 237 | 15 | 0.06 | 0.26 | 0.08 | 0.11 | **1.41** | 916 | 138 | **0.15** |
| *Nephrops norvegicus* | nep-32 | 2015 | 852 | 192 | 0.23 | 0.18 | 0.15 | 0.10 | 0.68 | 4,692 | 1,913 | **0.41** |
| *Nephrops norvegicus* | nep-33 | 2015 | 924 | 1,003 | **1.09** | 0.28 | 0.28 | 0.55 | **1.94** | 3,252 | 1,815 | 0.56 |
| *Nephrops norvegicus* | nep-34 | 2015 | 541 | 439 | 0.81 | 0.28 | 0.28 | 0.44 | **1.57** | 1,926 | 994 | 0.52 |
| *Nephrops norvegicus* | nep-3-4 | 2015 | 8,719 | 4,388 | 0.50 | 0.31 | 0.31 | 0.17 | 0.56 | 28,224 | 25,186 | 0.89 |
| *Nephrops norvegicus* | nep-5 | 2015 | 1,051 | 3,551 | **3.38** | 0.28 | 0.28 | 0.97 | **3.42** | 3,717 | 3,667 | 0.99 |
| *Nephrops norvegicus* | nep-6 | 2015 | 3,324 | 1,561 | 0.47 | 0.26 | 0.19 | 0.34 | **1.74** | 12,550 | 4,612 | **0.37** |
| *Nephrops norvegicus* | nep-7 | 2015 | 9,657 | 1,786 | 0.18 | 0.24 | 0.19 | 0.11 | 0.57 | 40,152 | 16,166 | **0.40** |

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Nephrops norvegicus* | nep-8 | 2015 | 2,205 | 1,892 | 0.86 | 0.36 | 0.36 | 0.29 | 0.80 | 6,100 | 6,537 | 1.07 |
| *Nephrops norvegicus* | nep-9 | 2015 | 1,412 | 830 | 0.59 | 0.26 | 0.26 | 0.22 | 0.82 | 5,381 | 3,858 | 0.72 |
| *Pandalus borealis* | pand-sknd | 2014 | 12,769 | 12,340 | 0.97 | 0.31 | 0.26 | 0.70 | **2.69** | 41,307 | 17,519 | **0.42** |
| *Pleuronectes platessa* | ple-eche | 2015 | 12,417 | 5,787 | 0.47 | 0.28 | 0.28 | 0.08 | 0.27 | 44,363 | 75,710 | 1.71 |
| *Pleuronectes platessa* | ple-nsea | 2015 | 211,567 | 134,460 | 0.64 | 0.14 | 0.14 | 0.05 | 0.36 | 1,543,865 | 2,688,623 | 1.74 |
| *Coryphaenoides rupestris* | rng-kask | 2015 | 5,397 | 1 | 0.00 | 0.19 | 0.04 | 0.00 | 0.01 | 28,310 | 3,093 | **0.11** |
| *Ammodytes tobianus* | san-ns1 | 2015 | 379,740 | 162,054 | 0.43 | 0.48 | 0.38 | 0.51 | **1.34** | 796,105 | 317,334 | **0.40** |
| *Ammodytes tobianus* | san-ns3 | 2015 | 326,408 | 118,541 | 0.36 | 0.50 | 0.50 | 0.25 | 0.51 | 654,448 | 468,803 | 0.72 |
| *Ammodytes tobianus* | san-ns4 | 2015 | 78,217 | 4,384 | 0.06 | 0.44 | 0.08 | 0.27 | **3.50** | 178,960 | 16,019 | **0.09** |
| *Ammodytes tobianus* | san-ns6 | 2015 | 2,380 | 229 | 0.10 | 0.50 | 0.28 | 0.17 | 0.60 | 4,807 | 1,365 | **0.28** |
| *Ammodytes tobianus* | san-ns7 | 2015 | 3,044 | 0 | 0.00 | 0.77 | 0.18 | 0.00 | 0.00 | 3,941 | 471 | **0.12** |
| *Solea solea* | sol-eche | 2015 | 4,449 | 3,441 | 0.77 | 0.41 | 0.41 | 0.33 | 0.81 | 10,828 | 10,284 | 0.95 |
| *Solea solea* | sol-kask | 2015 | 850 | 224 | 0.26 | 0.34 | 0.34 | 0.10 | 0.30 | 2,531 | 2,243 | 0.89 |
| *Solea solea* | sol-nsea | 2015 | 26,788 | 14,293 | 0.53 | 0.35 | 0.35 | 0.24 | 0.69 | 76,948 | 59,119 | 0.77 |
| *Scyliorhinus canicula* | syc-347d | 2014 | 4,669 | 2,704 | 0.58 | 0.18 | 0.18 | 0.08 | 0.43 | 26,648 | 35,507 | 1.33 |
| *Scophthalmus maximus* | tur-kask | 2014 | 177 | 120 | 0.68 | 0.27 | 0.27 | 0.34 | **1.28** | 655 | 349 | 0.53 |
| *Scophthalmus maximus* | tur-nsea | 2014 | 4,376 | 2,834 | 0.65 | 0.23 | 0.18 | 0.38 | **2.19** | 19,156 | 7,364 | **0.38** |

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Glyptocephalus cynoglossus* | wit-nsea | 2014 | 3,234 | 2,646 | 0.82 | 0.24 | 0.24 | 0.19 | 0.77 | 13,265 | 14,171 | 1.07 |
| *Dicentrarchus labrax* | Bss-47 | 2015 | 4,427 | 2,839 | 0.64 | 0.21 | 0.19 | 0.29 | **1.57** | 21,576 | 9,739 | **0.45** |
| *Gadus morhua* | cod-347d | 2015 | 275,129 | 52,313 | 0.19 | 0.22 | 0.22 | 0.07 | 0.30 | 1,243,858 | 793,185 | 0.64 |
| *Gadus morhua* | cod-kat | 2015 | 14,268 | 508 | 0.04 | 0.26 | 0.20 | 0.02 | 0.12 | 54,347 | 21,117 | **0.39** |
| *Melanogrammus aeglefinus* | had-346a | 2014 | 250,593 | 46,320 | 0.18 | 0.22 | 0.09 | 0.19 | **2.11** | 1,145,354 | 239,806 | **0.21** |
| *Pollachius pollachius* | pol-nsea | 2015 | 4,226 | 1,980 | 0.47 | 0.31 | 0.24 | 0.37 | **1.53** | 13,796 | 5,403 | **0.39** |
| *Pollachius virens* | sai-3a46 | 2015 | 201,609 | 83,310 | 0.41 | 0.26 | 0.26 | 0.14 | 0.53 | 773,953 | 607,491 | 0.78 |
| *Merlangius merlangus* | whg-47d | 2015 | 116,483 | 33,188 | 0.28 | 0.37 | 0.26 | 0.30 | **1.18** | 314,073 | 109,250 | **0.35** |
| *Merlangius merlangus* | whg-kask | 2014 | 25,254 | 1,018 | 0.04 | 0.23 | 0.06 | 0.07 | **1.10** | 109,631 | 14,830 | **0.14** |
| *Clupea harengus* | her-47d3 | 2015 | 728,525 | 494,099 | 0.68 | 0.49 | 0.49 | 0.21 | 0.43 | 1,487,603 | 2,352,568 | 1.58 |
| *Trachurus trachurus* | hom-nsea | 2014 | 28,197 | 13,388 | 0.47 | 0.24 | 0.14 | 0.39 | **2.78** | 118,403 | 34,588 | **0.29** |
| *Trisopterus esmarkii* | nop-34-oct | 2014 | 203,852 | 44,200 | 0.22 | 0.45 | 0.29 | 0.31 | **1.06** | 452,751 | 144,669 | **0.32** |
| *Sprattus sprattus* | spr-kask | 2015 | 67,260 | 13,276 | 0.20 | 0.23 | 0.05 | 0.43 | **9.14** | 295,039 | 30,653 | **0.10** |
| *Sprattus sprattus* | spr-nsea | 2015 | 336,761 | 290,380 | 0.86 | 0.23 | 0.23 | 0.17 | 0.75 | 1,454,168 | 1,671,853 | 1.15 |

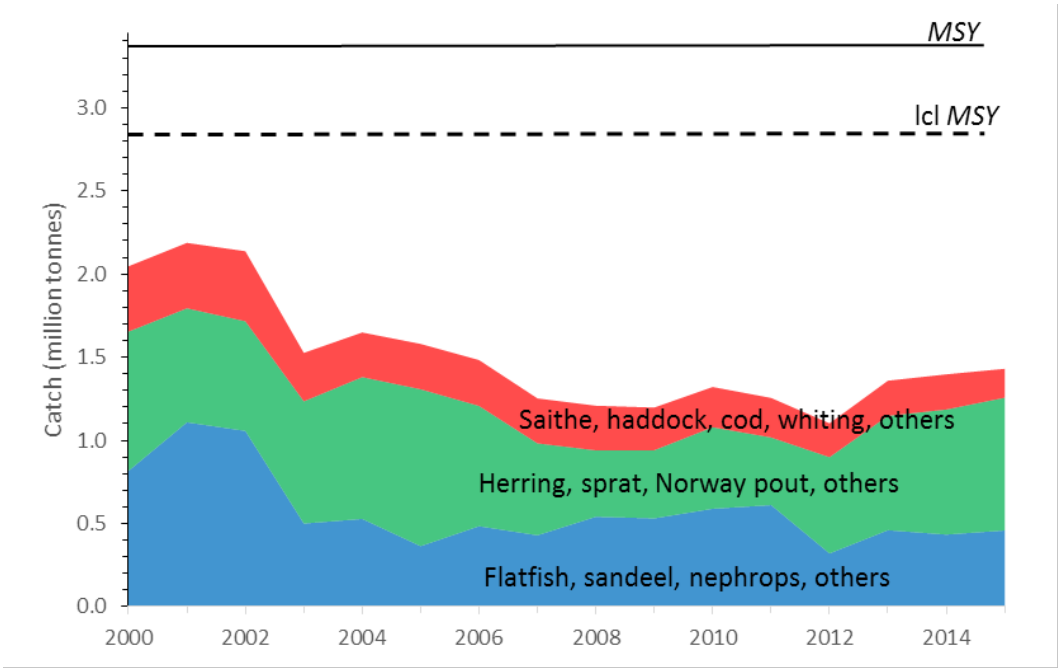



*Figure 27. Cumulative catches, including discards and recreational catch if available, for 45 stocks in the Greater North Sea, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [NorthSea_Sep23_2016.xlsx]*

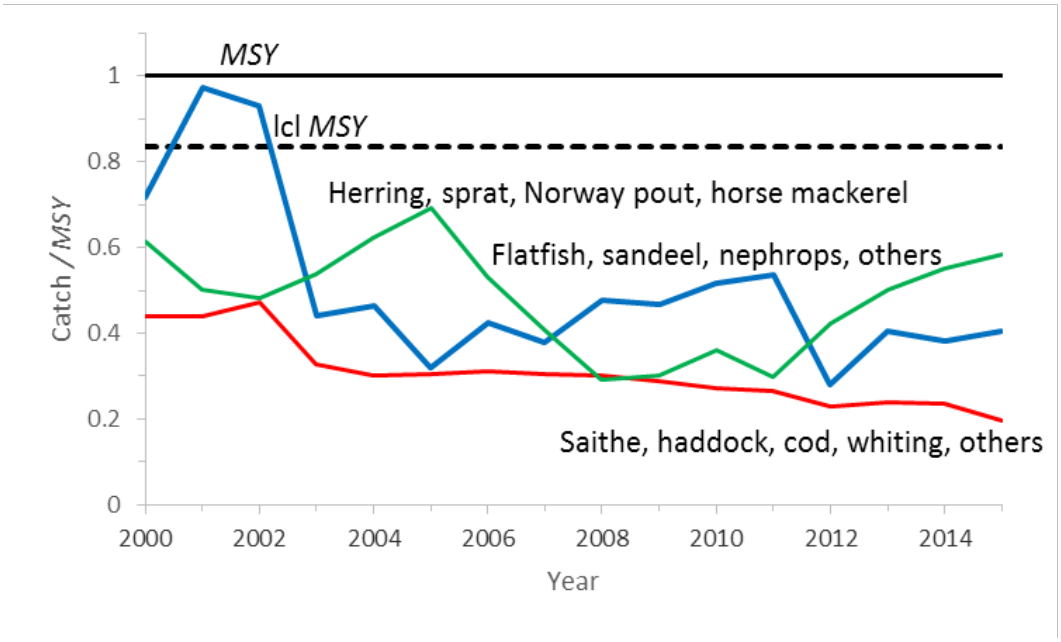



*Figure 28. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 45 stocks in the Greater North Sea. All groups could provide higher catches under sustainable management. [NorthSea_Sep23_2016.xlsx]*

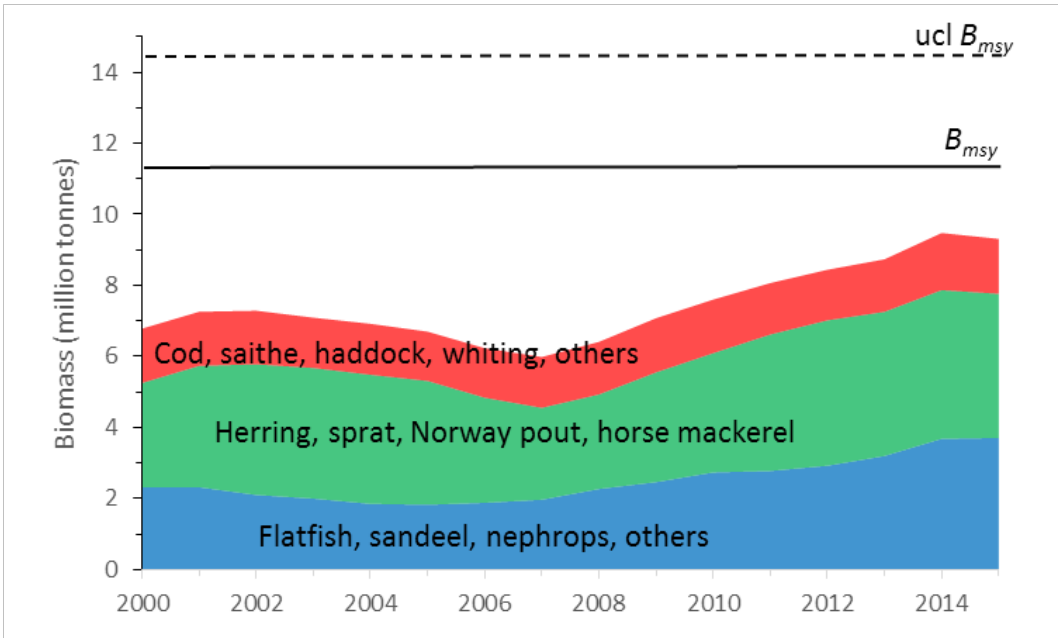



*Figure 29. Cumulative total biomass of 45 stocks in the Greater North Sea relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of $B_{msy}$ (dashed line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. The functional groups of large predators (red), pelagic plankton feeders (green), and benthic organisms (blue) are indicated, with listing of main species. [NorthSea_Sep23_2016.xlsx]*

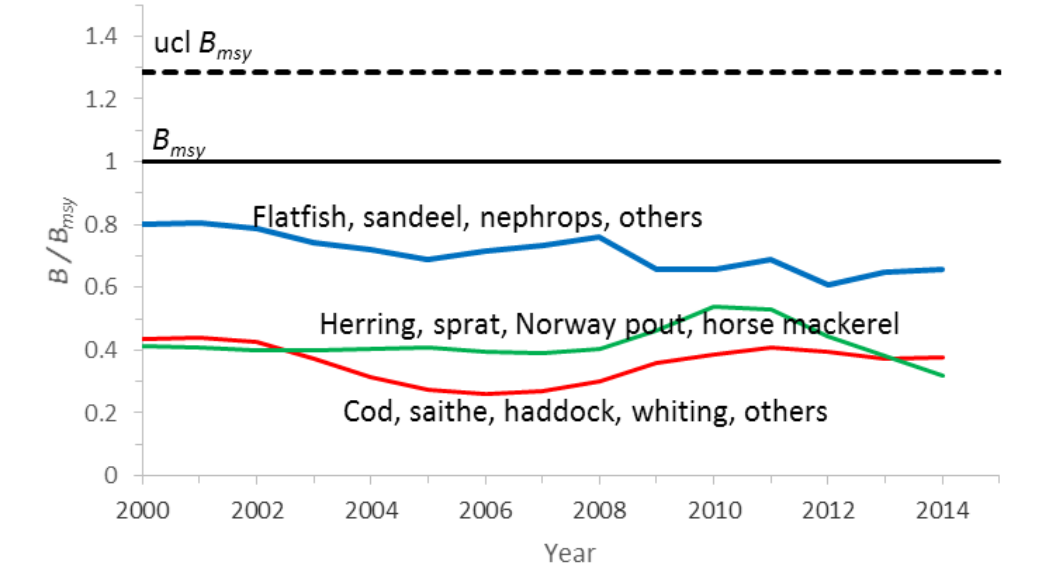



*Figure 30. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 45 stocks in the Greater North Sea assigned to main functional groups. All functional groups are well below the MSY-level, with no visible trend of increase. [NorthSea_Sep23_2016.xlsx]*

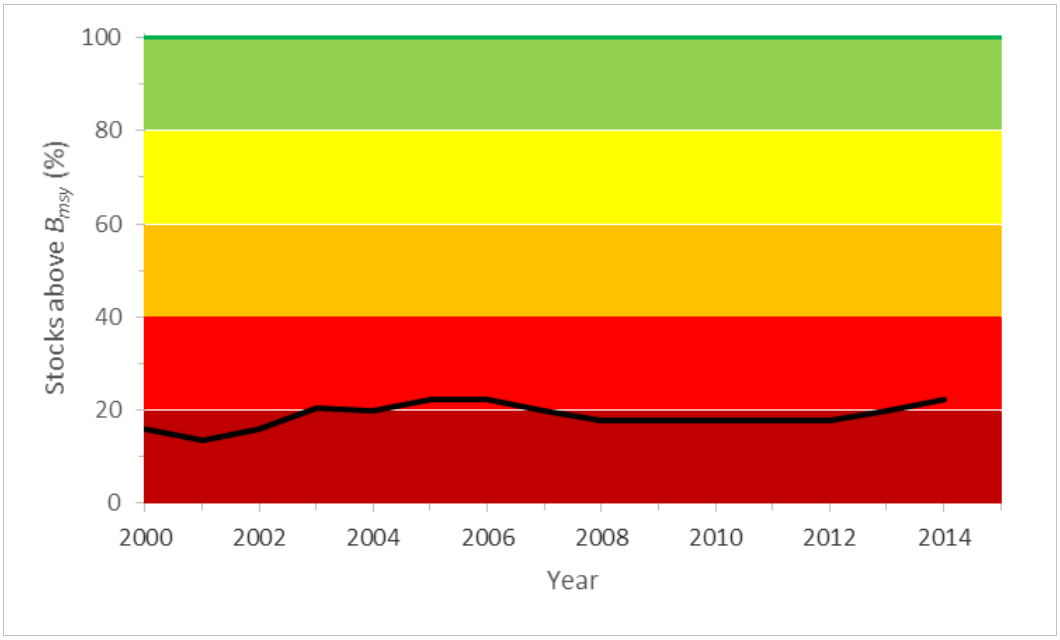



*Figure 31. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 45 stocks in the Greater North Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks shall be above 100% $B_{msy}$ eventually. In 2014, only 22% of the stocks fulfilled that requirement. [NorthSea_Sep23_2016.xlsx]*

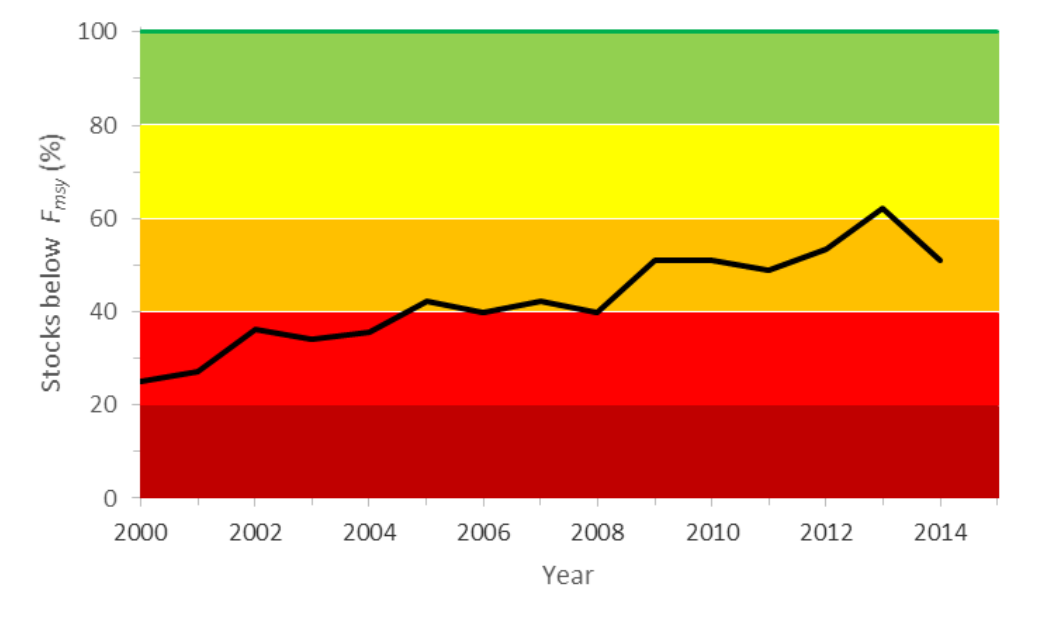



*Figure 32. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 45 stocks in the Greater North Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{ms}$ in 2015, latest in 2020. In 2014, 50% of the stocks fulfilled that requirement. [NorthSea_Sep23_2016.xlsx]*

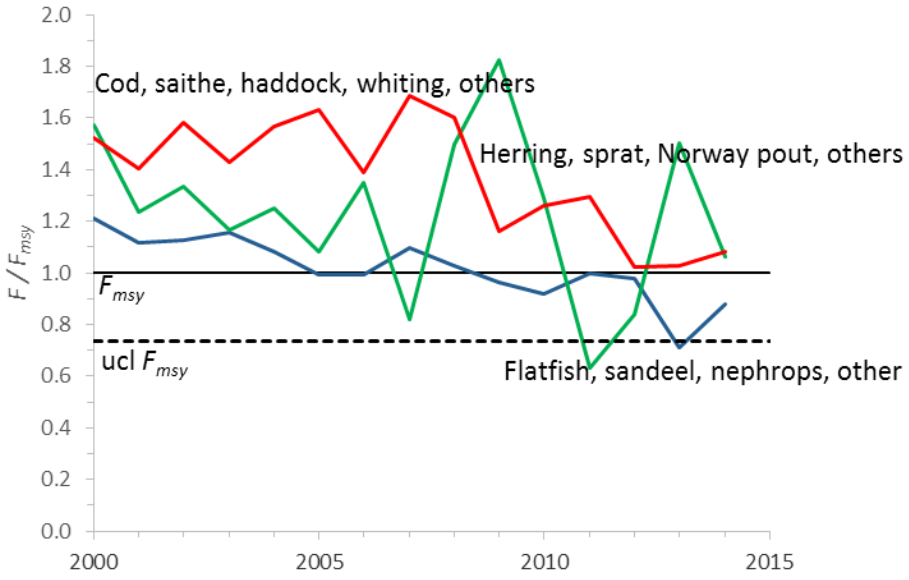



*Figure 33. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 45 stocks in the Greater North Sea assigned to main functional groups. The median fishing pressure for these groups is near the MSY-level in recent years, with about 50% of the stocks continuing to be overfished. [NorthSea_Sep23_2016.xlsx]*

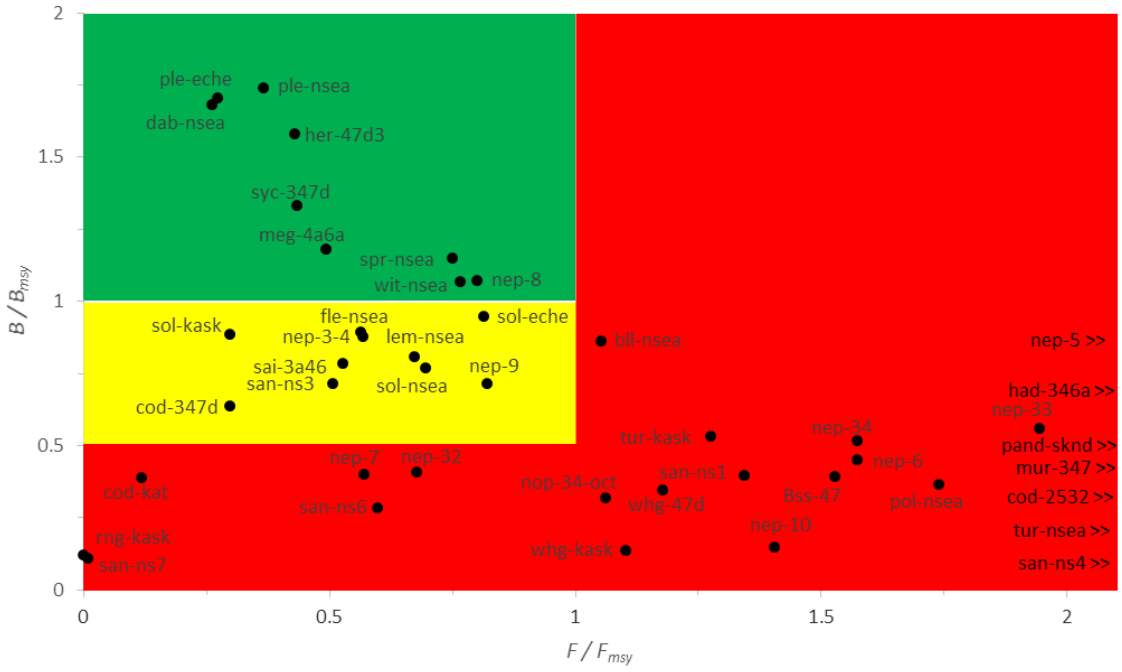



Figure 34. Presentation of 45 Greater North Sea stocks in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size. Several stocks (some indicated by ->>) are not displayed because they are fished beyond the upper limit of the X-axis. *[NorthSea_Sep23_2016.xlsx]*

**Baltic Sea**

The following two paragraphs were taken from the ICES Advice 2008, Book 8,

http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2008/2008/8%201-8%202%20Baltic%20ecosystem%20overview.pdf.

"The Baltic Sea is one of the largest brackish areas in the world. It receives fresh water from a number of larger and smaller rivers while salt water enters from the North Sea along the bottom of the narrow straits between Denmark and Sweden. This creates a salinity gradient from southwest to northeast and a water circulation characterized by the inflow of saline bottom water and a surface current of brackish water flowing out of the area.

The Baltic Sea is characterized by large areas (ca 30%) that are less than 25 m deep, interspersed by a number of deeper basins with a maximum depth of 459 m. The Gulf of Bothnia and the Gulf of Riga are internal fjords, while the Baltic Proper and the Gulf of Finland feature several deep basins separated by sills. The western and northern parts of the Baltic have rocky bottoms and extended archipelagos, while the bottom in the central, southern, and eastern parts consists mostly of sandy or muddy sediment."

ICES assessment reports published in 2016 and with data until 2015 were analyzed for 20 stocks in the Baltic Sea. The graphs below summarize their status and exploitation level within an MSY-framework. Wide ranging species such as European eel (*Anguilla anguilla*) or summer guests such as Atlantic mackerel (*Scomber scombrus*) are not included and are analyzed separately. The list of species and their current exploitation and status is summarized in Table 8. Detailed assessments for every stock are available in Appendix 1 and in the spreadsheet Baltic_Sep21_2016_4.xlsx.

Of the 20 stocks, 8 (40%) were subject to ongoing overfishing ($F > F_{msy}$) and 9 stocks (45%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). In three stocks (15%) catches exceeded the maximum sustainable yield ($C/MSY > 1$). Five stocks (25%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing (marked red in Table 8). Altogether, 8 stocks (40%) were subject to unsustainable exploitation (catch > *MSY* or $F > F_{msy}$ or $B < 0.2\ B_{msy}$), with the too high catches marked red in Table 8. Five stocks (25%) could be considered healthy, defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 20 stocks of 3 million tonnes in 2015 was well below the biomass level of 4 million tonnes that can produce maximum yields. Summed catches of 685 thousand tonnes were well below (72%) the summed maximum sustainable yield of 958 thousand tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above *Bmsy*. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 8. Analysis of 20 stocks in the Baltic Sea, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$), $F_{msy\ cur}$ applicable for current stock size, relative $F/F_{msy\ cur}$ for current stock size, biomass that can produce MSY ($B_{msy}$), and relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where $F/F_{msy\ cur} < 1$ and $B/B_{msy} > 1$ are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Unsustainable catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy\ cur} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red) and pelagic plankton feeders (green). [Baltic_Sep21_2016_4.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Scophthalmus rhombus* | bll-2232 | 2015 | 79 | 40 | 0.51 | 0.24 | 0.24 | 0.22 | 0.93 | 335 | 182 | 0.54 |
| *Limanda limanda* | dab-2232 | 2015 | 1,975 | 1,268 | 0.64 | 0.44 | 0.44 | 0.22 | 0.49 | 4,523 | 5,873 | 1.30 |
| *Platichthys flesus* | fle-2223 | 2015 | 2,571 | 1,130 | 0.44 | 0.22 | 0.22 | 0.06 | 0.26 | 11,676 | 19,547 | 1.67 |
| *Platichthys flesus* | fle-2425 | 2015 | 18,253 | 11,090 | 0.61 | 0.32 | 0.32 | 0.14 | 0.42 | 56,464 | 81,976 | 1.45 |
| *Platichthys flesus* | fle-2628 | 2015 | 4,080 | 4,443 | **1.09** | 0.25 | 0.21 | 0.65 | **3.03** | 16,091 | 6,821 | **0.42** |
| *Platichthys flesus* | fle-2732 | 2015 | 1,394 | 176 | 0.13 | 0.28 | 0.08 | 0.23 | **2.71** | 5,022 | 766 | **0.15** |
| *Pleuronectes platessa* | ple-2123 | 2015 | 4,752 | 2,687 | 0.57 | 0.38 | 0.38 | 0.17 | 0.44 | 12,585 | 16,183 | 1.29 |
| *Pleuronectes platessa* | ple-2432 | 2015 | 3,567 | 647 | 0.18 | 0.25 | 0.25 | 0.03 | 0.11 | 14,323 | 23,561 | 1.65 |
| *Scophthalmus maximus* | tur-2232 | 2015 | 891 | 234 | 0.26 | 0.34 | 0.27 | 0.23 | 0.84 | 2,608 | 1,034 | **0.40** |
| *Gadus morhua* | cod-2224 | 2015 | 51,624 | 11,982 | 0.23 | 0.29 | 0.15 | 0.25 | **1.67** | 179,401 | 47,258 | **0.26** |
| *Gadus morhua* | cod-2532 | 2015 | 117,100 | 43,670 | 0.37 | 0.30 | 0.17 | 0.40 | **2.43** | 392,575 | 108,788 | **0.28** |
| *Salmo salar* | sal-2231 | 2015 | 2,968 | 790 | 0.27 | 0.20 | 0.16 | 0.13 | 0.85 | 15,123 | 5,978 | **0.40** |
| *Salmo salar* | sal-32 | 2015 | 416 | 62 | 0.15 | 0.21 | 0.10 | 0.14 | **1.42** | 1,973 | 452 | **0.23** |
| *Salmo trutta* | trt-bal | 2015 | 1,902 | 189 | 0.10 | 0.23 | 0.10 | 0.10 | 0.99 | 8,342 | 1,865 | **0.22** |
| *Clupea harengus* | her-2532-gor | 2015 | 222,165 | 174,433 | 0.79 | 0.23 | 0.23 | 0.18 | 0.82 | 983,367 | 947,051 | 0.96 |
| *Clupea harengus* | her-30 | 2015 | 67,302 | 110,415 | **1.64** | 0.18 | 0.18 | 0.19 | **1.05** | 367,702 | 573,209 | 1.56 |
| *Clupea harengus* | her-31 | 2015 | 6,734 | 4,527 | 0.67 | 0.27 | 0.27 | 0.26 | 0.96 | 24,655 | 17,249 | 0.70 |
| *Clupea harengus* | her-3a22 | 2015 | 130,784 | 37,491 | 0.29 | 0.22 | 0.21 | 0.13 | 0.63 | 600,298 | 286,158 | **0.48** |
| *Clupea harengus* | her-riga | 2015 | 31,023 | 32,851 | **1.06** | 0.23 | 0.23 | 0.27 | **1.14** | 132,836 | 123,315 | 0.93 |
| *Sprattus sprattus* | spr-2232 | 2015 | 288,905 | 247,000 | 0.85 | 0.24 | 0.24 | 0.31 | **1.29** | 1,200,389 | 795,911 | 0.66 |

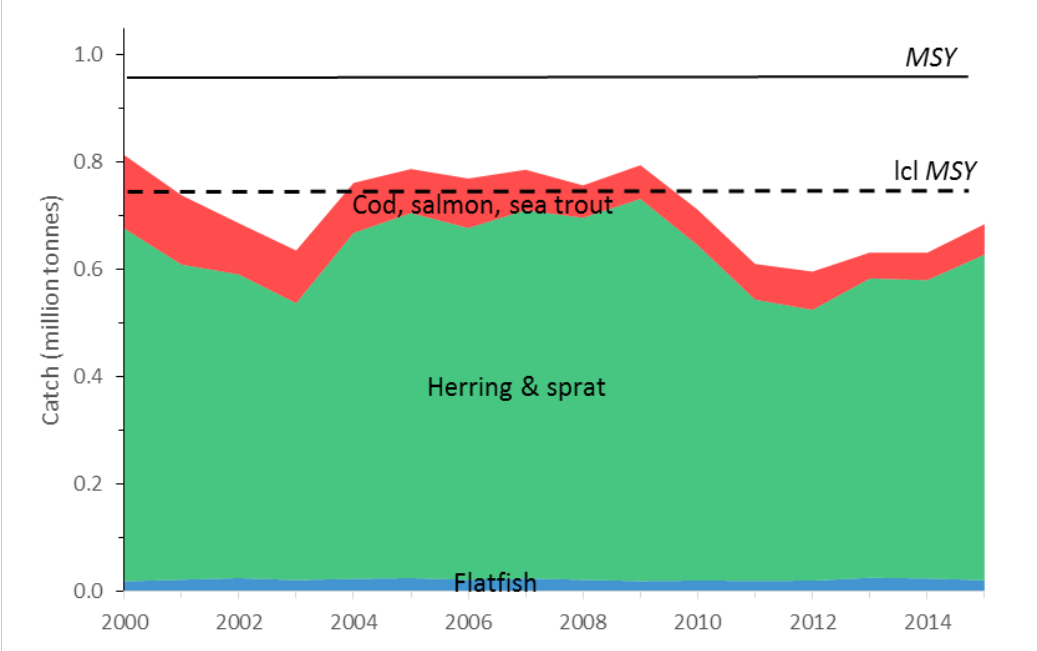



*Figure 35. Cumulative catches, including discards and recreational catch if available, for 20 stocks in the Baltic Sea, with indication of main functional groups of large predators (red), pelagic plankton feeders (green) and benthic fish and invertebrates (blue), with indication of main species in this area. The black line indicates the cumulative maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [Baltic_Sep21_2016_4.xlsx]*

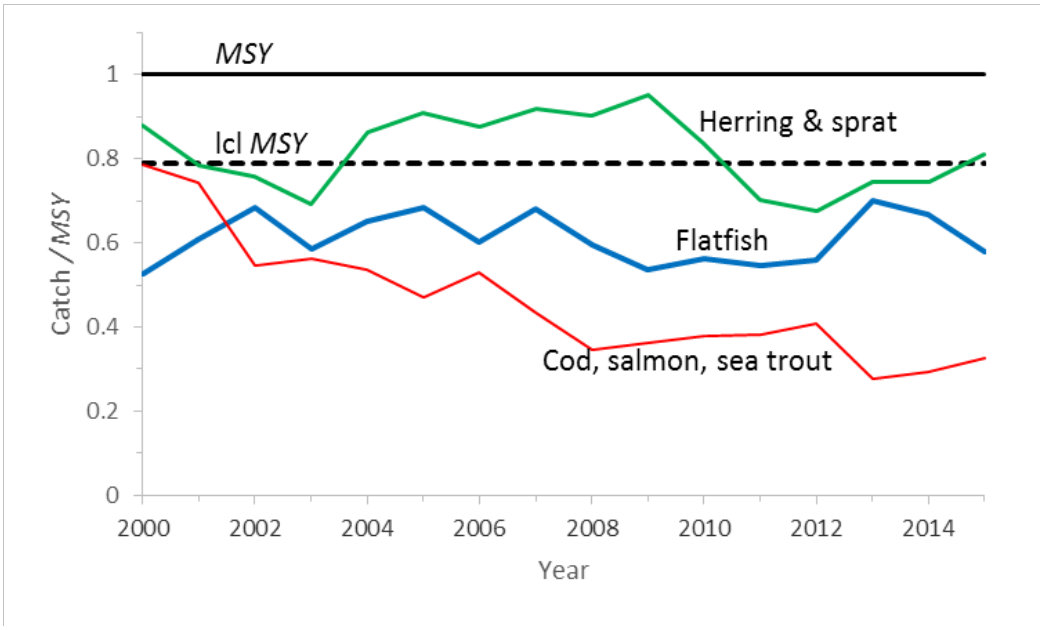



*Figure 36. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 20 stocks in the Baltic Sea. Pelagic plankton feeders (here only sprat and herring, green curve) supported catches around the precautionary over all lower 95% confidence limit of MSY (dashed line). Benthic organisms (here only flatfish, blue curve) supported catches below but near the precautionary level. Since 2002, the low biomass (see below) of large predators (here cod, salmon and sea trout, red curve) produced catches well below precautionary sustainable levels. [Baltic_Sep21_2016_4.xlsx]*

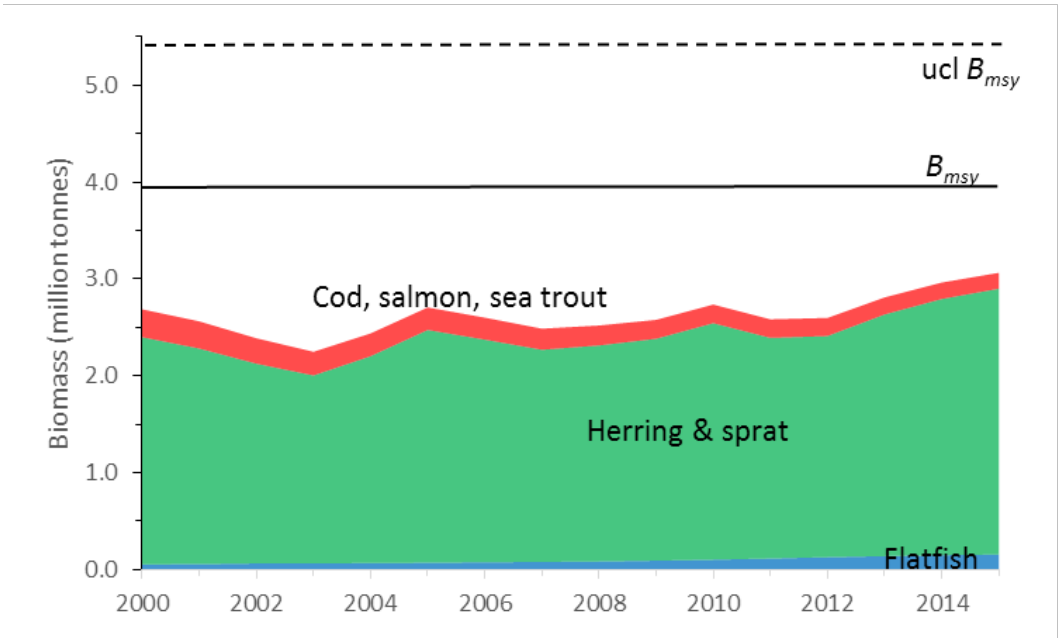



*Figure 37. Cumulative total biomass of 20 stocks in the Baltic Sea relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of $B_{msy}$ (dashed green line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. The functional groups of large predators (red), pelagic plankton feeders (green), and benthic organisms (blue) are indicated, with listing of main species. Note that flatfish have nearly tripled their biomass from 56,000 tonnes in 2000 to 152,000 tonnes in 2014. [Baltic_Sep21_2016_4.xlsx]*

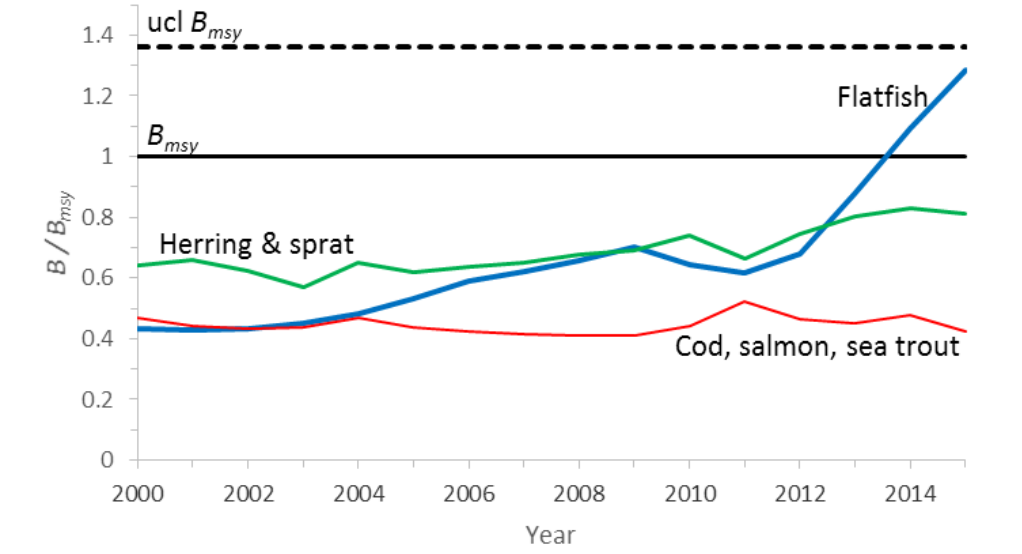



*Figure 38. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 20 stocks in the Baltic Sea assigned to main functional groups. Large predators (red curve) and pelagic plankton feeders (green curve) have biomass levels well below $B_{msy}$, without a clear upward trend. In contrast, benthic organisms (here only flatfish, blue curve) have recovered well in recent years and are approaching the precautionary biomass level (over all upper 95% confidence level of $B_{msy}$, green line). [Baltic_Sep21_2016_4.xlsx]*

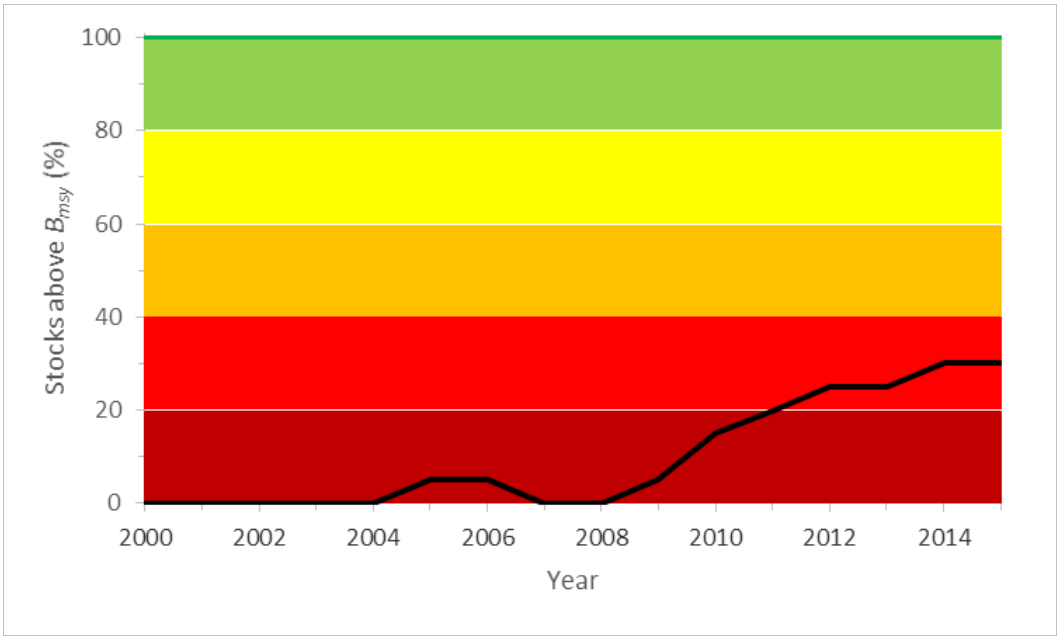



*Figure 39. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 20 stocks in the Baltic Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks shall be above 100% $B_{msy}$ eventually. In 2015, only 30% of the stocks fulfilled that requirement. [Baltic_Sep21_2016_4.xlsx]*

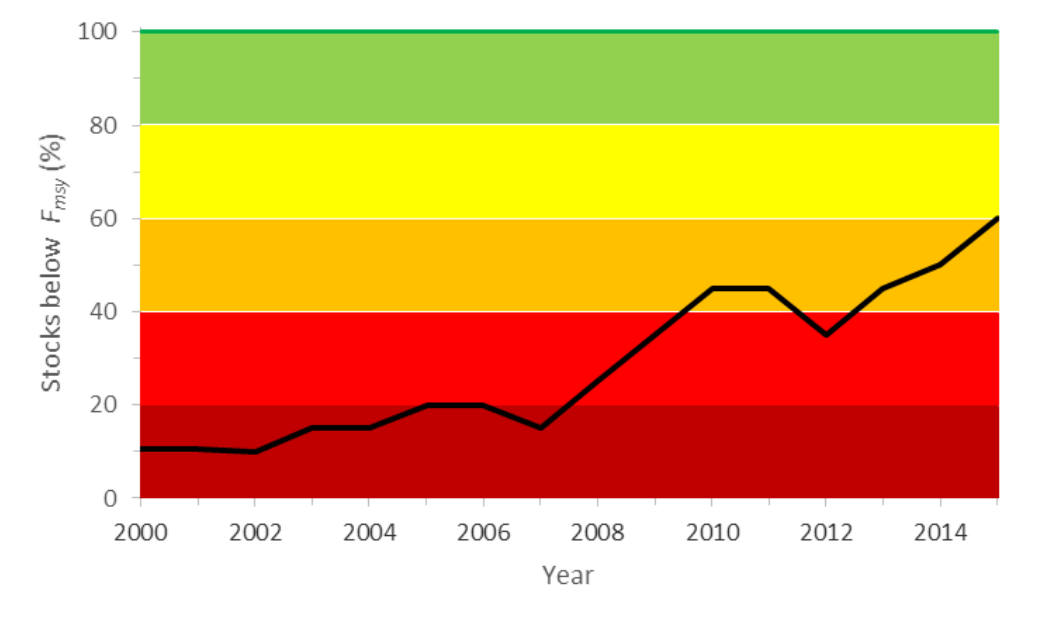



*Figure 40. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 20 stocks in the Baltic Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{msy}$ in 2015, latest in 2020. In 2015, 60% of the stocks fulfilled that requirement. [Baltic_Sep21_2016_4.xlsx]*

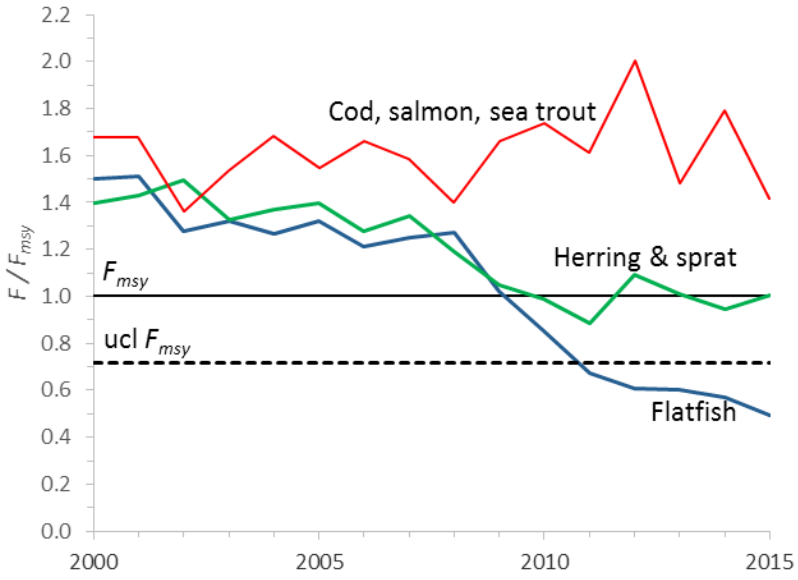



*Figure 41. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$, black line) for 20 stocks in the Baltic Sea assigned to main functional groups. Large predators (red curve) are subject to severe overfishing. Pelagic plankton feeders (green curve) were overfished before 2010 and were exploited at the maximum sustainable level afterwards. Flatfish were overfished until 2008 but were exploited below the precautionary sustainable level (median lower 95% confidence limit of $F_{msy}$ across all stocks) since 2011, allowing for the strong increase in biomass after 2012 (see above). [Baltic_Sep21_2016_4.xlsx]*

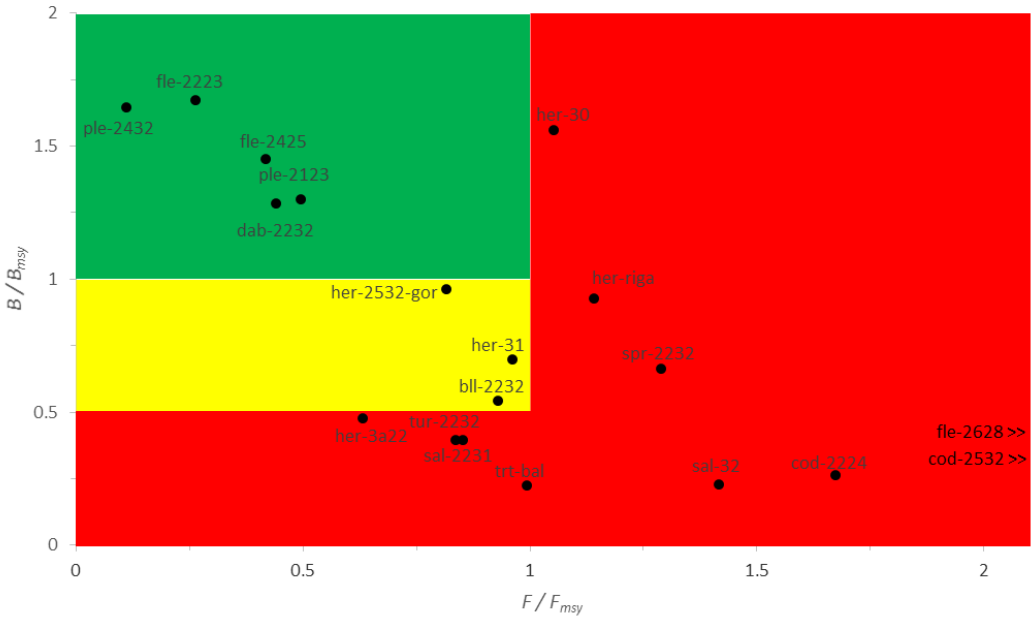



*Figure 42. Presentation of 20 Baltic Sea stocks in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Two stocks are off the $F/F_{msy}$ scale, indicated by >>. [Baltic_Sep21_2016_4.xlsx]*

**Celtic Seas and Rockall**

The following paragraph was taken from the ICES Advice 2016, Book 5,

http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/Celtic_Sea_Ecoregion-Ecosystem_overview.pdf.

"The Celtic Seas ecoregion covers the northwestern shelf seas of the EU. It includes areas of the deeper eastern Atlantic Ocean and coastal seas that are heavily influenced by oceanic inputs. The ecoregion ranges from north of Shetland to Brittany in the south. Three key areas constitute this ecoregion: the Malin shelf; the Celtic Sea and west of Ireland; the Irish Sea."

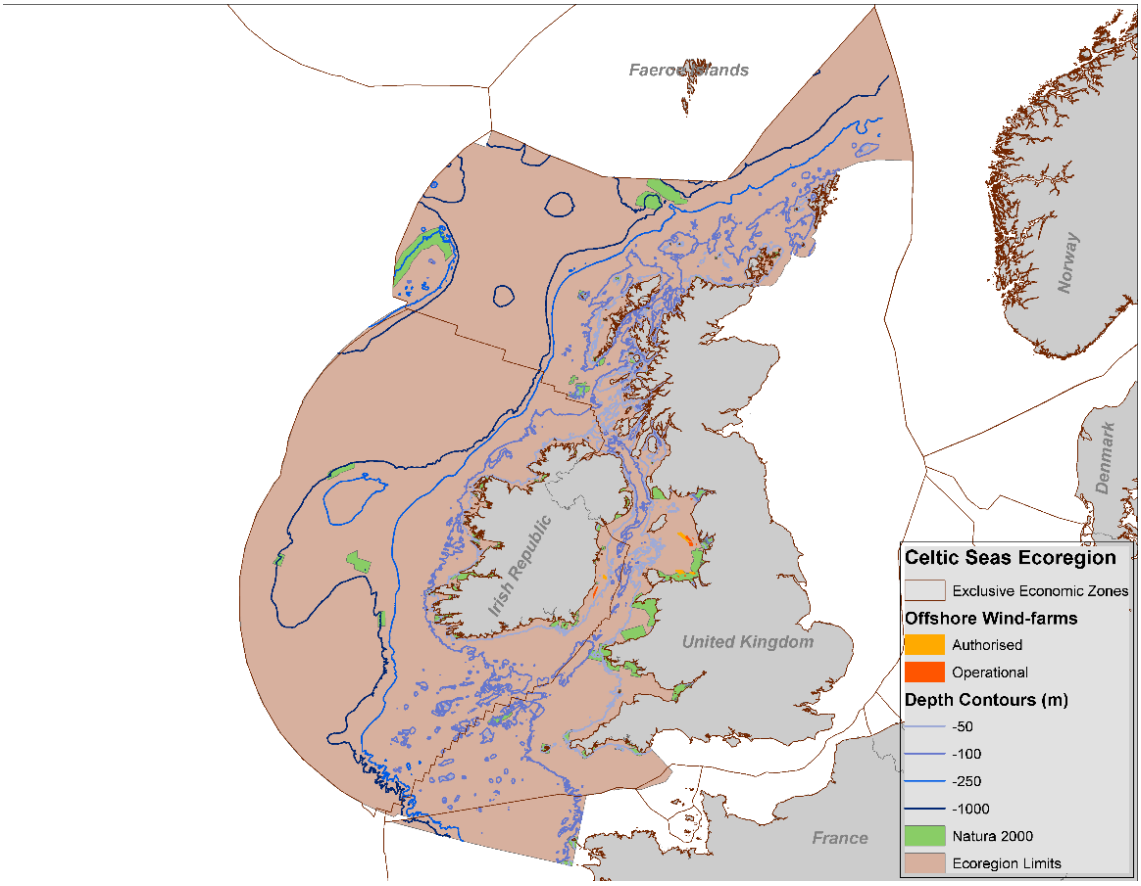



*Figure 43. The Celtic Seas ecoregion, showing EEZs, larger offshore Natura 2000 sites, and operational and authorized wind farms. Source: ICES Advice 2016, Book 5.*

ICES aassessment reports with data from 2014/2015 were analyzed for 47 stocks in the Celtic Seas and Rockall. The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 9. Detailed assessments for every stock are available in Appendix 1 and in the spreadsheet CelticSeas_Sep27_2016.xlsx.

Of the 47 stocks, 22 (47%) were subject to ongoing overfishing ($F > F_{msy}$) and 19 stocks (40%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). In three stocks (6%) catches exceeded the maximum sustainable yield ($C/MSY > 1$). Fourteen stocks (30%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing (marked red in Table9). Altogether, 25 stocks (53%) were subject to unsustainable exploitation (catch > *MSY* or $F > F_{msy}$ or $B < 0.2\ B_{msy}$), with the too high catches marked red in Table 9. Only 10 stocks (21%) could be considered as being well managed and in good condition sensu CFP (2013), defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 47 stocks of 1.3 million tonnes in the last year with available data was below the biomass level of 2.1 million tonnes that can produce maximum yields. Summed catches of 228 thousand tonnes were well below the summed maximum sustainable yield of 475 thousand tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above *Bmsy*. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 9. Analysis of 47 stocks in the Celtic Seas and Rockall waters, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$) , $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red) and pelagic plankton feeders (green). [CelticSeas_Sep27_2016.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lophius budegassa* | anb-78ab | 2015 | 8,174 | 10,319 | **1.26** | 0.23 | 0.23 | 0.39 | **1.65** | 34,826 | 26,630 | 0.76 |
| *Lophius* spp. | ang-ivvi | 2014 | 18,276 | 13,203 | 0.72 | 0.19 | 0.19 | 0.21 | **1.12** | 97,171 | 62,941 | 0.65 |
| *Molva dypterygia* | bli-5b67 | 2015 | 11,417 | 2,758 | 0.24 | 0.15 | 0.15 | 0.05 | 0.31 | 74,667 | 58,573 | 0.78 |
| *Capros aper* | boc-nea | 2014 | 89,359 | 45,231 | 0.51 | 0.22 | 0.11 | 0.45 | **4.03** | 403,051 | 100,983 | **0.25** |
| *Lepidorhombus* spp. | meg-rock | 2014 | 897 | 343 | 0.38 | 0.33 | 0.33 | 0.17 | 0.50 | 2,696 | 2,052 | 0.76 |
| *Lepidorhombus whiffiagonis* | mgw-78 | 2015 | 19,038 | 13,076 | 0.69 | 0.32 | 0.32 | 0.18 | 0.57 | 60,180 | 72,346 | 1.20 |
| *Nephrops norvegicus* | nep-11 | 2014 | 3,745 | 3,312 | 0.88 | 0.03 | 0.03 | 0.04 | **1.55** | 147,272 | 84,042 | 0.57 |
| *Nephrops norvegicus* | nep-12 | 2014 | 4,966 | 3,394 | 0.68 | 0.31 | 0.31 | 0.30 | 0.97 | 16,032 | 11,327 | 0.71 |
| *Nephrops norvegicus* | nep-13 | 2014 | 6,319 | 6,881 | **1.09** | 0.30 | 0.30 | 0.30 | 1.00 | 21,150 | 22,957 | 1.09 |
| *Nephrops norvegicus* | nep-14 | 2014 | 750 | 711 | 0.95 | 0.25 | 0.25 | 0.29 | **1.18** | 3,013 | 2,423 | 0.80 |
| *Nephrops norvegicus* | nep-15 | 2014 | 10,577 | 10,013 | 0.95 | 0.31 | 0.31 | 0.30 | 0.95 | 33,947 | 33,869 | 1.00 |
| *Nephrops norvegicus* | nep-16 | 2014 | 2,441 | 1,189 | 0.49 | 0.20 | 0.11 | 0.35 | **3.12** | 12,294 | 3,436 | **0.28** |
| *Nephrops norvegicus* | nep-17 | 2014 | 839 | 800 | 0.95 | 0.19 | 0.14 | 0.48 | **3.36** | 4,446 | 1,675 | **0.38** |
| *Nephrops norvegicus* | nep-19 | 2014 | 834 | 468 | 0.56 | 0.26 | 0.26 | 0.24 | 0.93 | 3,208 | 1,929 | 0.60 |
| *Nephrops norvegicus* | nep-2021 | 2014 | 2,403 | 1,837 | 0.76 | 0.26 | 0.26 | 0.42 | **1.63** | 9,093 | 4,398 | **0.48** |
| *Nephrops norvegicus* | nep-22 | 2014 | 2,660 | 2,615 | 0.98 | 0.24 | 0.24 | 0.19 | 0.81 | 11,120 | 13,504 | 1.21 |
| *Nephrops norvegicus* | nep-oth-6a | 2014 | 362 | 245 | 0.68 | 0.28 | 0.28 | 0.32 | **1.15** | 1,310 | 770 | 0.59 |
| *Nephrops norvegicus* | nep-oth-7 | 2014 | 424 | 174 | 0.41 | 0.23 | 0.18 | 0.23 | **1.26** | 1,851 | 746 | **0.40** |
| *Pleuronectes platessa* | ple-7b-c | 2014 | 196 | 23 | 0.12 | 0.17 | 0.07 | 0.09 | **1.28** | 1,136 | 243 | **0.21** |
| *Pleuronectes platessa* | ple-7h-k | 2015 | 288 | 33 | 0.11 | 0.23 | 0.05 | 0.25 | **4.95** | 1,232 | 133 | **0.11** |
| *Pleuronectes platessa* | ple-celt | 2015 | 1,590 | 381 | 0.24 | 0.36 | 0.36 | 0.05 | 0.13 | 4,413 | 8,039 | 1.82 |
| *Pleuronectes platessa* | ple-echw | 2015 | 2,030 | 1,424 | 0.70 | 0.17 | 0.17 | 0.08 | 0.44 | 11,718 | 18,665 | 1.59 |
| *Pleuronectes platessa* | ple-iris | 2015 | 2,646 | 1,004 | 0.38 | 0.26 | 0.26 | 0.06 | 0.21 | 10,005 | 17,817 | 1.78 |

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Coryphaenoides rupestris* | rng-5b67 | 2015 | 6,866 | 701 | 0.10 | 0.12 | 0.12 | 0.02 | 0.19 | 56,716 | 31,189 | 0.55 |
| *Pagellus bogaraveo* | sbr-678 | 2015 | 548 | 177 | 0.32 | 0.22 | 0.08 | 0.42 | **5.43** | 2,441 | 421 | **0.17** |
| *Solea solea* | sol-7b-c | 2014 | 57 | 26 | 0.46 | 0.16 | 0.16 | 0.15 | 0.95 | 349 | 171 | **0.49** |
| *Solea solea* | sol-7h-k | 2015 | 548 | 244 | 0.44 | 0.25 | 0.25 | 0.14 | 0.55 | 2,209 | 1,788 | 0.81 |
| *Solea solea* | sol-celt | 2015 | 1,147 | 2,714 | **2.37** | 0.22 | 0.22 | 0.83 | **3.70** | 5,117 | 3,273 | 0.64 |
| *Solea solea* | sol-echw | 2015 | 1,012 | 772 | 0.76 | 0.21 | 0.21 | 0.14 | 0.70 | 4,934 | 5,371 | 1.09 |
| *Solea solea* | sol-iris | 2015 | 3,145 | 76 | 0.02 | 0.26 | 0.07 | 0.05 | 0.63 | 12,091 | 1,670 | **0.14** |
| *Brosme brosme* | usk-rock | 2015 | 1,100 | 226 | 0.21 | 0.23 | 0.11 | 0.19 | **1.72** | 4,847 | 1,185 | **0.24** |
| *Gadus morhua* | cod-7e-k | 2015 | 8,546 | 4,719 | 0.55 | 0.29 | 0.26 | 0.36 | **1.35** | 29,407 | 13,276 | **0.45** |
| *Gadus morhua* | cod-iris | 2015 | 9,706 | 385 | 0.04 | 0.32 | 0.24 | 0.03 | 0.14 | 30,448 | 11,467 | **0.38** |
| *Gadus morhua* | cod-rock | 2014 | 1,223 | 15 | 0.01 | 0.29 | 0.01 | 0.15 | **>10** | 4,281 | 101 | **0.02** |
| *Gadus morhua* | cod-scow | 2014 | 17,055 | 1,668 | 0.10 | 0.23 | 0.04 | 0.30 | **8.16** | 72,666 | 5,625 | **0.08** |
| *Melanogrammus aeglefinus* | had-7b-k | 2015 | 16,690 | 15,239 | 0.91 | 0.22 | 0.22 | 0.19 | 0.88 | 75,764 | 78,572 | 1.04 |
| *Melanogrammus aeglefinus* | had-iris | 2015 | 3,856 | 833 | 0.22 | 0.39 | 0.31 | 0.21 | 0.69 | 9,931 | 3,938 | **0.40** |
| *Melanogrammus aeglefinus* | had-rock | 2015 | 16,961 | 2,972 | 0.18 | 0.43 | 0.21 | 0.31 | **1.47** | 39,882 | 9,731 | **0.24** |
| *Pollachius pollachius* | pol-celt | 2014 | 7,294 | 5,255 | 0.72 | 0.32 | 0.32 | 0.37 | **1.16** | 23,050 | 14,364 | 0.62 |
| *Merlangius merlangus* | whg-7e-k | 2015 | 24,675 | 19,275 | 0.78 | 0.22 | 0.22 | 0.13 | 0.62 | 113,101 | 143,529 | 1.27 |
| *Merlangius merlangus* | whg-iris | 2015 | 10,212 | 1,922 | 0.19 | 0.29 | 0.04 | 0.70 | **>10** | 35,418 | 2,749 | **0.08** |
| *Merlangius merlangus* | whg-scow | 2015 | 15,492 | 1,062 | 0.07 | 0.44 | 0.17 | 0.15 | 0.91 | 35,568 | 6,911 | **0.19** |
| *Clupea harengus* | her-67bc | 2015 | 92,343 | 19,885 | 0.22 | 0.23 | 0.23 | 0.08 | 0.36 | 404,031 | 239,415 | 0.59 |
| *Clupea harengus* | her-irls | 2015 | 23,754 | 18,355 | 0.77 | 0.31 | 0.31 | 0.21 | 0.65 | 75,637 | 89,398 | 1.18 |
| *Clupea harengus* | her-nirs | 2015 | 12,512 | 4,869 | 0.39 | 0.26 | 0.26 | 0.16 | 0.63 | 48,676 | 29,971 | 0.62 |
| *Sprattus sprattus* | spr-celt | 2014 | 5,785 | 4,392 | 0.76 | 0.35 | 0.35 | 0.42 | **1.21** | 16,749 | 10,514 | 0.63 |
| *Sprattus sprattus* | spr-ech | 2015 | 4,577 | 3,003 | 0.66 | 0.29 | 0.29 | 0.14 | 0.47 | 15,583 | 21,810 | 1.40 |

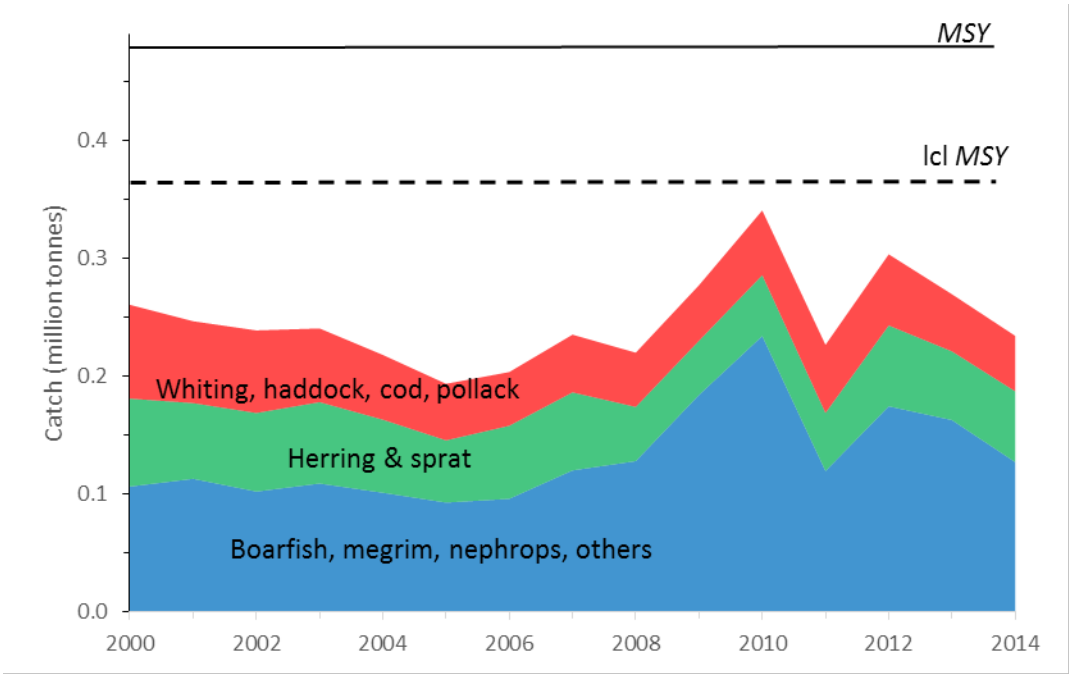



*Figure 44. Cumulative catches, including discards and recreational catch if available, for 47 stocks in the Celtic Seas and Rockall, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [CelticSeas_Sep27_2016.xlsx]*

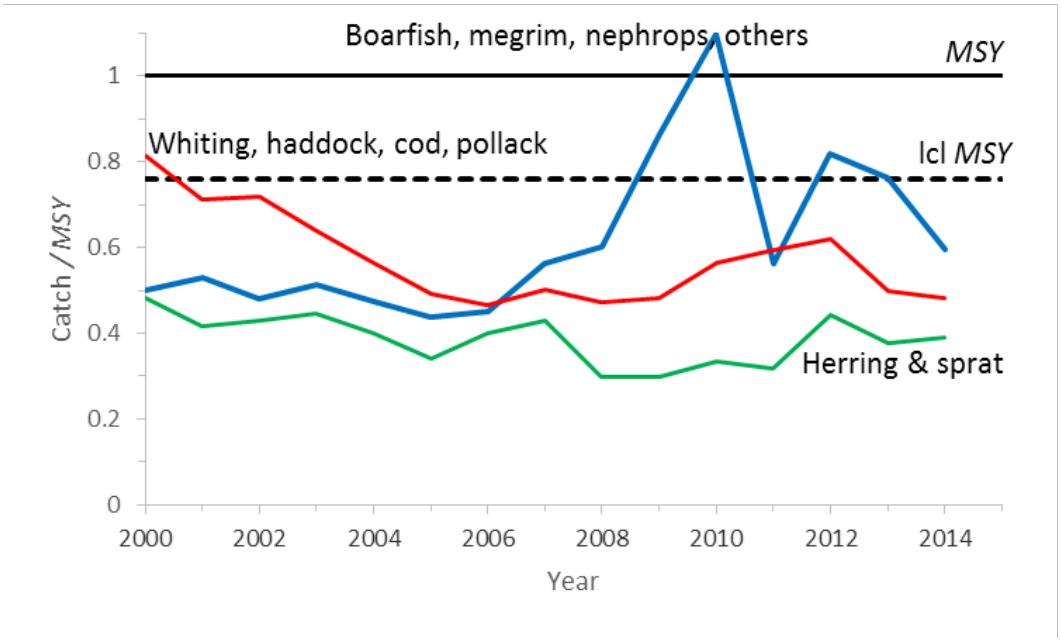



*Figure 45. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 47 stocks in the Celtic Seas and Rockall. Large predators (red line) could support higher catches after rebuilding of the stocks. [CelticSeas_Sep27_2016.xlsx]*

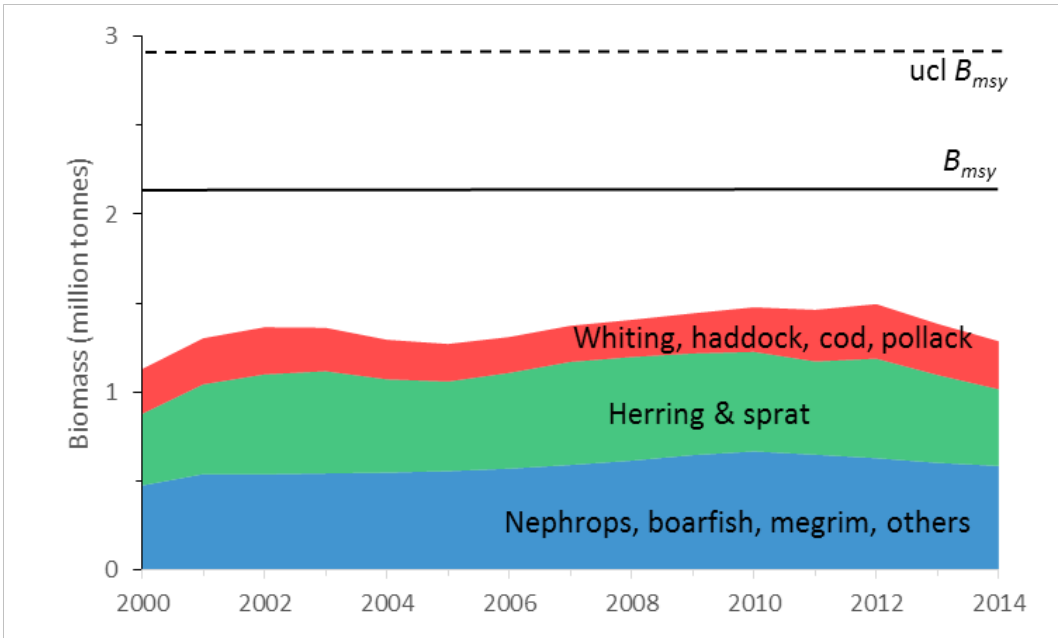



*Figure 46. Cumulative total biomass of 47 stocks in the Celtic Seas and Rockall relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of $B_{msy}$ (dashed line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. The functional groups of benthic organisms (blue), pelagic plankton feeders (green) and large predators (red), are indicated, with listing of main species. Exploited biomass in the ecoregion is well below the MSY level. [CelticSeas_Sep27_2016.xlsx]*

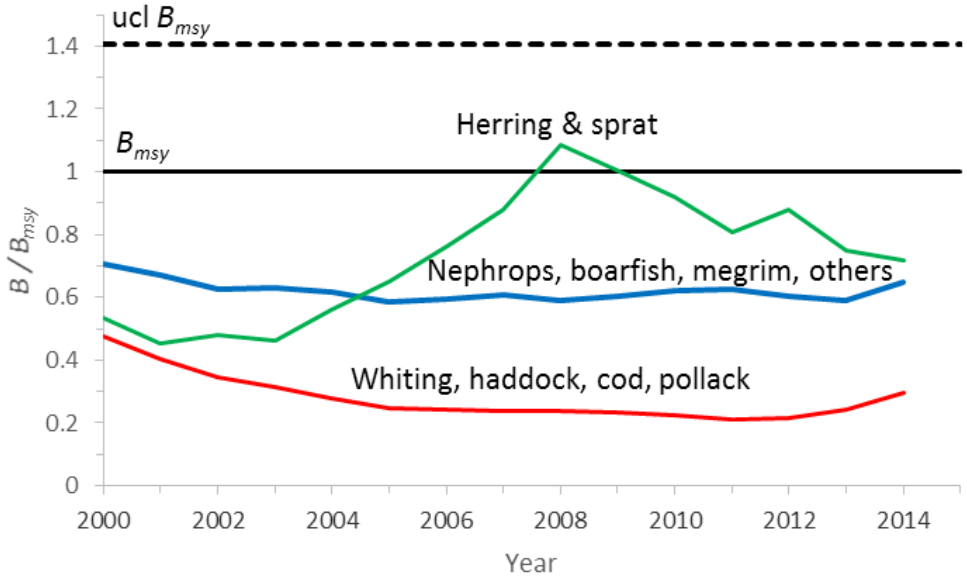



*Figure 47. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 47 stocks in the Celtic Seas and Rockall assigned to main functional groups. Biomass of all functional groups is well below the MSY-level in recent years. [CelticSeas_Sep27_2016.xlsx]*

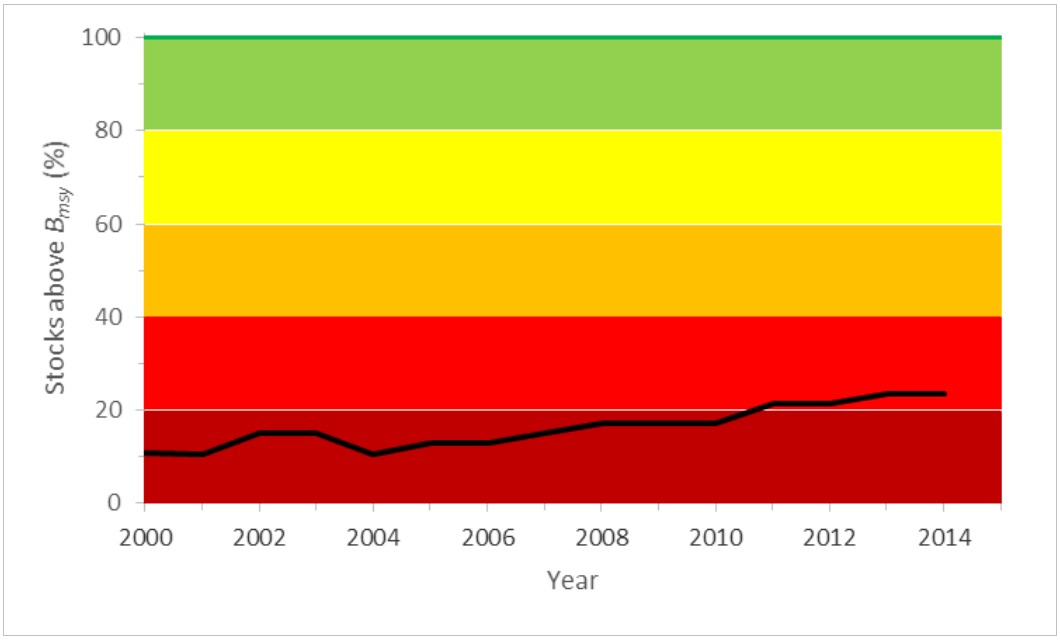



*Figure 48. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 47 stocks in the Celtic Seas and Rockall (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2014, only 23% of the stocks fulfilled that requirement. [CelticSeas_Sep27_2016.xlsx]*

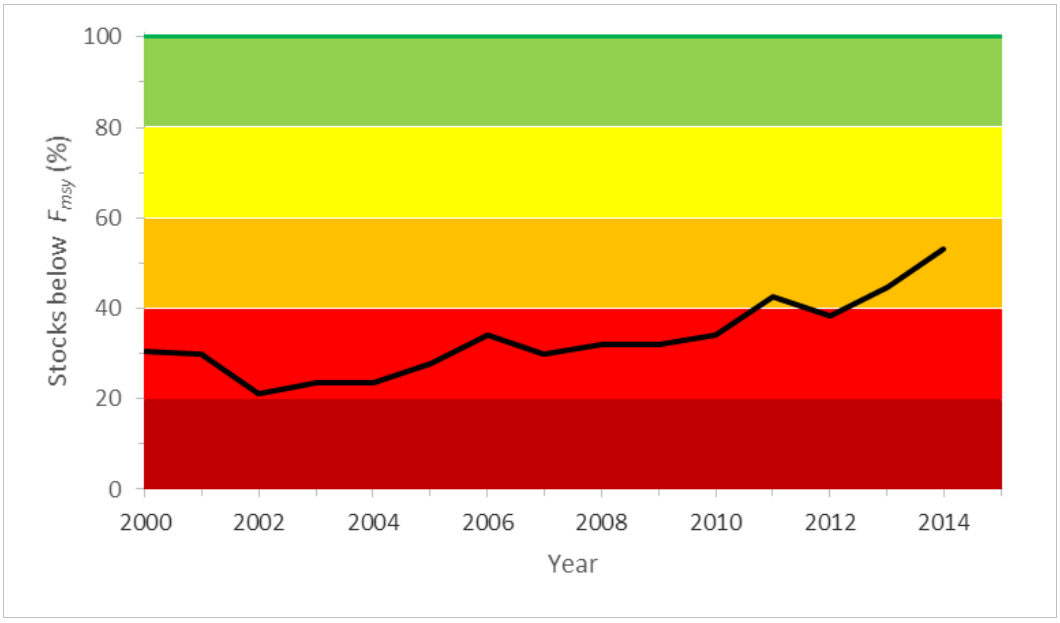



*Figure 49. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 47 stocks in the Celtic Seas and Rockall (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{msy}$ in 2015, latest in 2020. In 2014, 53% of the stocks fulfilled that requirement. [CelticSeas_Sep27_2016.xlsx]*

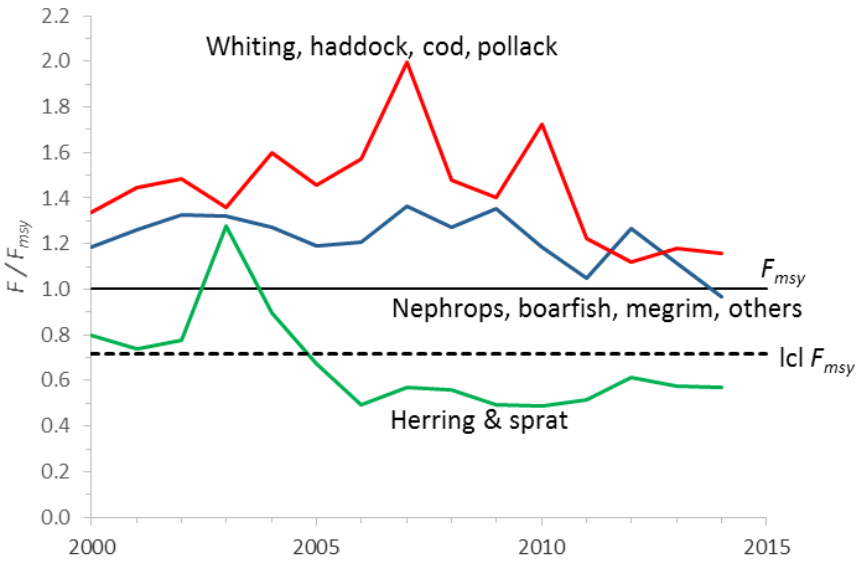



*Figure 50. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 47 stocks in the Celtic Seas and Rockall assigned to main functional groups. While the fishing pressure on pelagic plankton feeders (green curve) seems adequate for these key-stone species, the fishing pressure for large predators and benthic organisms is still above the MSY-level in recent years. [CelticSeas_Sep27_2016.xlsx]*

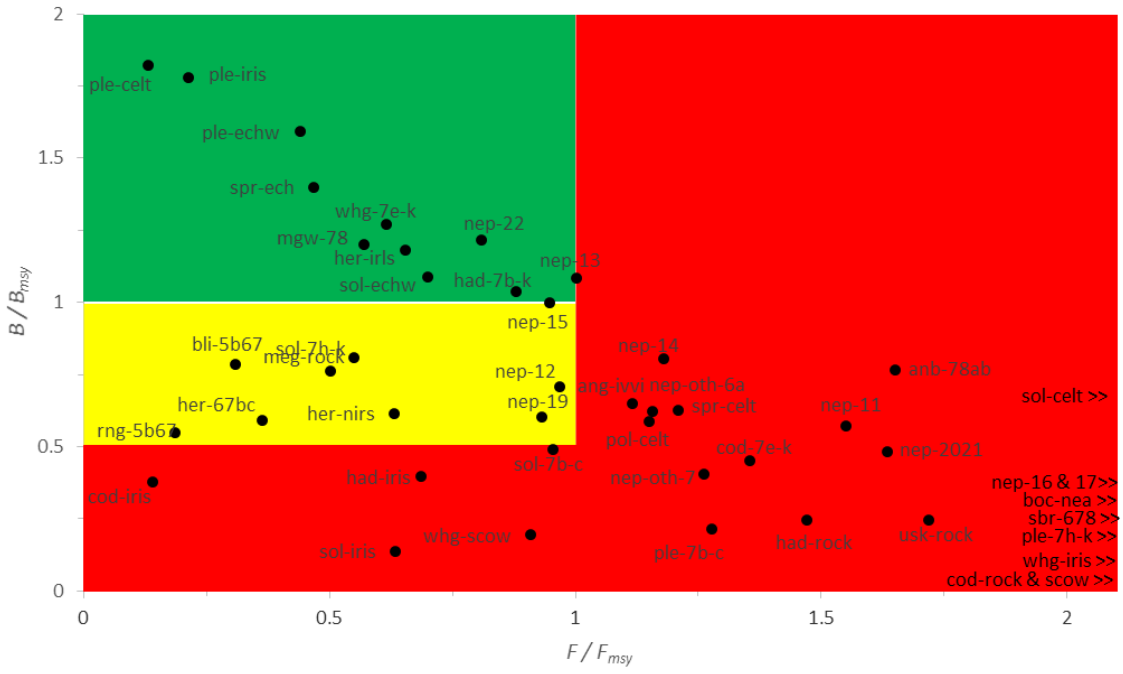



*Figure 51. Presentation of 47 stocks from the Celtic Seas and Rockall in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size. Several stocks (indicated by ->>) are exploited above the upper limit of the X-axis. [CelticSeas_Sep27_2016.xlsx]*

**Bay of Biscay and Iberian Sea, including Azores**

The following paragraph describing the Bay of Biscay and the Iberian Coast Sea was taken from the ICES Advice 2016, Book 7,

http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/Bay_of_Biscay_and_the%20Iberian%20Coast%20Ecoregion%20-Ecosystem%20overview.pdf.

"The ICES Bay of Biscay and the Iberian Coast ecoregion covers the southwestern shelf seas and adjacent deeper eastern Atlantic Ocean waters of the EU. The ecoregion includes waters from Brittany to the Gulf of Cadiz; four key areas constitute the ecoregion:

- the Bay of Biscay, characterized by a wide shelf extending west of France. Upwelling events occur in summer off southern Brittany and low-salinity water lenses are associated with the river outflows of the Landes coastline;
- the northern Iberian Shelf, characterized by a narrow shelf with summer upwelling events off Galicia;
- the western Iberian Shelf, characterized by a narrow shelf west of Portugal with summer upwelling events;
- the Gulf of Cadiz, characterized by a wider shelf strongly influenced by input of warm Mediterranean waters."

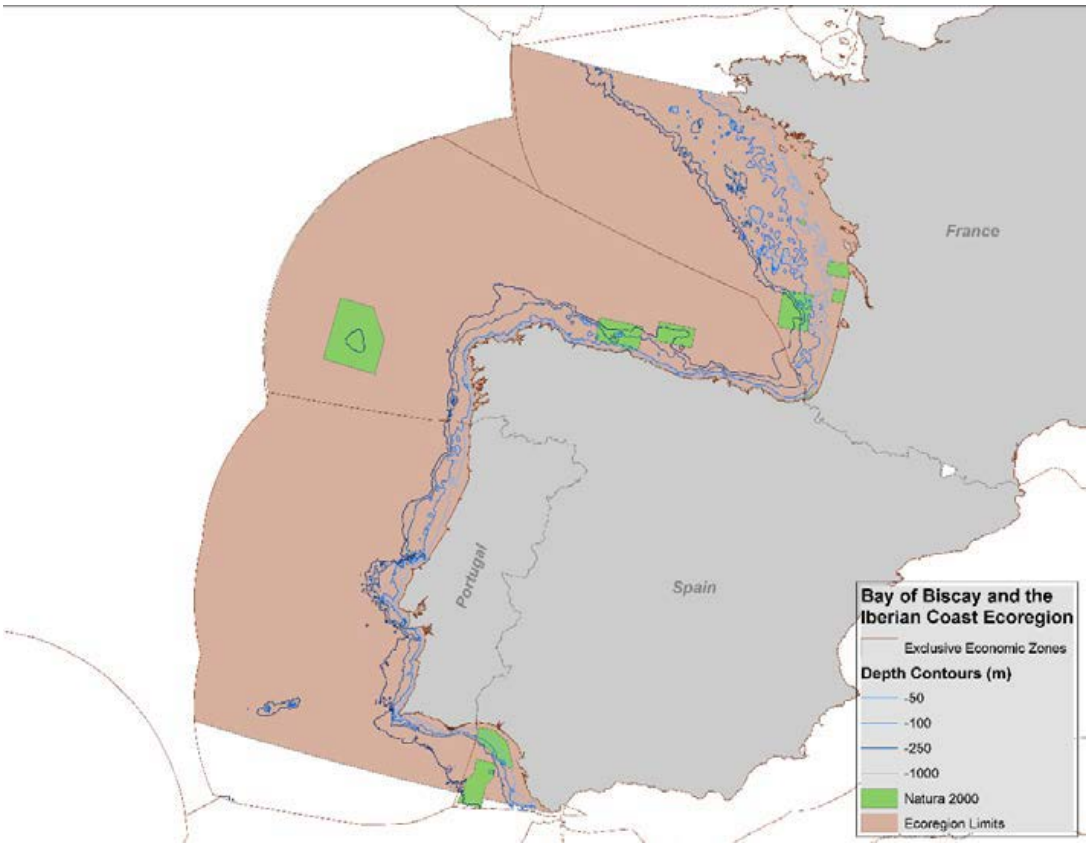



*Figure 52. The Bay of Biscay and the Iberian Coast ecoregion, showing EEZs and larger offshore Natura 2000 sites.*

ICES assessment reports with data until 2015 were analyzed for 31 stocks in the Bay of Biscay, Iberian Coast and Azores. The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 10. Detailed assessments for every stock are available in Appendix 1 and in the spreadsheet Iberian_Sep28_2016.xlsx.

Of the 31 stocks, 18 (58%) were subject to ongoing overfishing ($F > F_{msy}$) and 7 stocks (23%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). In 7 stocks (23%) catches exceeded the maximum sustainable yield ($C/MSY > 1$). Seven stocks (23%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing, or being severely depleted ($B < 0.2\ B_{msy}$). The scientific names of these stocks are marked red in Table 10. Altogether, 19 stocks (61%) were subject to unsustainable exploitation (catch > MSY or F > Fmsy or B < 0.2 Bmsy), with the too high catches marked red in Table 10. Only 4 stocks (13%) could be considered as being well managed and in good condition sensu CFP (2013), defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 31 stocks of 0.86 million tonnes in the last year with available data was well below the biomass level of 1.3 million tonnes that can produce maximum yields. Summed catches of 202 thousand tonnes were well below the summed maximum sustainable yield of 344 thousand tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above $B_{msy}$. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 10. Analysis of 31 stocks in the Bay of Biscay, Iberian Coast and Azores, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$) , $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red), and pelagic plankton feeders (green). [Iberian_Sep28_2016.xlsx]*

| Scientific name | Stock | Year | MSY | Catch | C/MSY | $F_{msy}$ | $F_{msy\ cur}$ | F | $F/F_{msy\ cur}$ | $B_{msy}$ | B | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Beryx* spp. | alf-comb | 2015 | 661 | 365 | 0.55 | 0.13 | 0.13 | 0.13 | 0.96 | 4,977 | 2,856 | 0.57 |
| *Lophius budegassa* | anb-8c9a | 2015 | 1,966 | 1,040 | 0.53 | 0.19 | 0.19 | 0.09 | 0.48 | 10,182 | 11,207 | 1.10 |
| *Lophius piscatorius* | anp-78ab | 2015 | 23,956 | 25,266 | **1.05** | 0.25 | 0.25 | 0.32 | **1.29** | 97,563 | 79,958 | 0.82 |
| *Lophius piscatorius* | anp-8c9a | 2015 | 4,844 | 1,748 | 0.36 | 0.23 | 0.23 | 0.05 | 0.24 | 21,430 | 31,815 | 1.48 |
| *Lepidorhombus boscii* | mgb-8c9a | 2015 | 1,897 | 1,745 | 0.92 | 0.15 | 0.15 | 0.15 | 0.98 | 12,592 | 11,783 | 0.94 |
| *Lepidorhombus whiffiagonis* | mgw-8c9a | 2015 | 755 | 297 | 0.39 | 0.41 | 0.32 | 0.41 | **1.28** | 1,851 | 727 | **0.39** |
| *Nephrops norvegicus* | nep-2829 | 2015 | 424 | 247 | 0.58 | 0.31 | 0.31 | 0.29 | 0.91 | 1,352 | 862 | 0.64 |
| *Nephrops norvegicus* | Neph-IXa | 2013 | 1,591 | 238 | 0.15 | 0.11 | 0.01 | 0.70 | **>10** | 14,328 | 340 | **0.02** |
| *Nephrops norvegicus* | Neph-VIIIab | 2013 | 11,932 | 7,344 | 0.62 | 0.28 | 0.28 | 0.30 | **1.08** | 43,160 | 24,545 | 0.57 |
| *Nephrops norvegicus* | Neph-VIIIc | 2013 | 428 | 20 | 0.05 | 0.21 | 0.03 | 0.15 | **5.82** | 2,046 | 130 | **0.06** |
| *Pleuronectes platessa* | ple-89a | 2014 | 286 | 220 | 0.77 | 0.27 | 0.27 | 0.21 | 0.75 | 1,041 | 1,065 | 1.02 |
| *Raja clavata* | rjc-bisc | 2013 | 305 | 299 | 0.98 | 0.09 | 0.03 | 0.62 | **>10** | 3,287 | 483 | **0.15** |
| *Raja clavata* | rjc-pore | 2013 | 1,031 | 703 | 0.68 | 0.18 | 0.18 | 0.17 | 0.92 | 5,626 | 4,154 | 0.74 |
| *Raja brachyura* | rjh-pore | 2013 | 352 | 275 | 0.78 | 0.10 | 0.10 | 0.15 | **1.51** | 3,555 | 1,835 | 0.52 |
| *Raja montagui* | rjm-pore | 2013 | 231 | 165 | 0.71 | 0.20 | 0.18 | 0.32 | **1.81** | 1,144 | 508 | **0.44** |
| *Leucoraja naevus* | rjn-pore | 2013 | 67 | 37 | 0.56 | 0.20 | 0.20 | 0.18 | 0.89 | 327 | 206 | 0.63 |
| *Pagellus bogaraveo* | sbr-ix | 2015 | 683 | 295 | 0.43 | 0.25 | 0.24 | 0.23 | 0.95 | 2,688 | 1,280 | **0.48** |
| *Pagellus bogaraveo* | sbr-x | 2015 | 1,028 | 701 | 0.68 | 0.29 | 0.29 | 0.33 | **1.14** | 3,537 | 2,116 | 0.60 |
| *Solea* spp. | sol-8c9a | 2014 | 1,131 | 829 | 0.73 | 0.28 | 0.28 | 0.37 | **1.30** | 4,028 | 2,269 | 0.56 |
| *Solea solea* | sol-bisc | 2015 | 5,220 | 3,641 | 0.70 | 0.29 | 0.29 | 0.30 | **1.05** | 18,084 | 12,022 | 0.66 |
| *Dicentrarchus labrax* | Bss-8ab | 2014 | 2,740 | 2,991 | **1.09** | 0.29 | 0.29 | 0.36 | **1.23** | 9,444 | 8,382 | 0.89 |

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Dicentrarchus labrax* | Bss-8c9a | 2014 | 740 | 917 | **1.24** | 0.29 | 0.29 | 0.50 | **1.75** | 2,579 | 1,828 | 0.71 |
| *Merluccius merluccius* | hke-soth | 2015 | 20,974 | 13,839 | 0.66 | 0.27 | 0.27 | 0.21 | 0.77 | 78,080 | 67,164 | 0.86 |
| *Pollachius pollachius* | pol-89a | 2014 | 1,880 | 1,983 | **1.05** | 0.36 | 0.36 | 0.60 | **1.67** | 5,269 | 3,321 | 0.63 |
| *Merlangius merlangus* | whg-89a | 2014 | 2,167 | 1,690 | 0.78 | 0.33 | 0.33 | 0.45 | **1.37** | 6,629 | 3,786 | 0.57 |
| *Engraulis encrasicolus* | ane-bisc | 2015 | 50,731 | 25,134 | 0.50 | 0.43 | 0.43 | 0.24 | 0.55 | 118,983 | 106,462 | 0.89 |
| *Engraulis encrasicolus* | ane-pore | 2015 | 6,315 | 9,597 | **1.52** | 0.37 | 0.37 | 0.80 | **2.19** | 17,294 | 12,014 | 0.69 |
| *Trachurus trachurus* | hom-soth | 2015 | 30,710 | 32,723 | **1.07** | 0.23 | 0.23 | 0.18 | 0.78 | 132,501 | 181,103 | 1.37 |
| *Trachurus picturatus* | jaa-10 | 2015 | 2,746 | 1,136 | 0.41 | 0.29 | 0.29 | 0.23 | 0.80 | 9,449 | 4,897 | 0.52 |
| *Sardina pilchardus* | sar-78 | 2014 | 35,966 | 45,312 | **1.26** | 0.31 | 0.31 | 0.34 | **1.08** | 114,522 | 133,106 | 1.16 |
| *Sardina pilchardus* | sar-soth | 2015 | 130,667 | 21,000 | 0.16 | 0.25 | 0.14 | 0.14 | **1.03** | 526,426 | 146,960 | **0.28** |

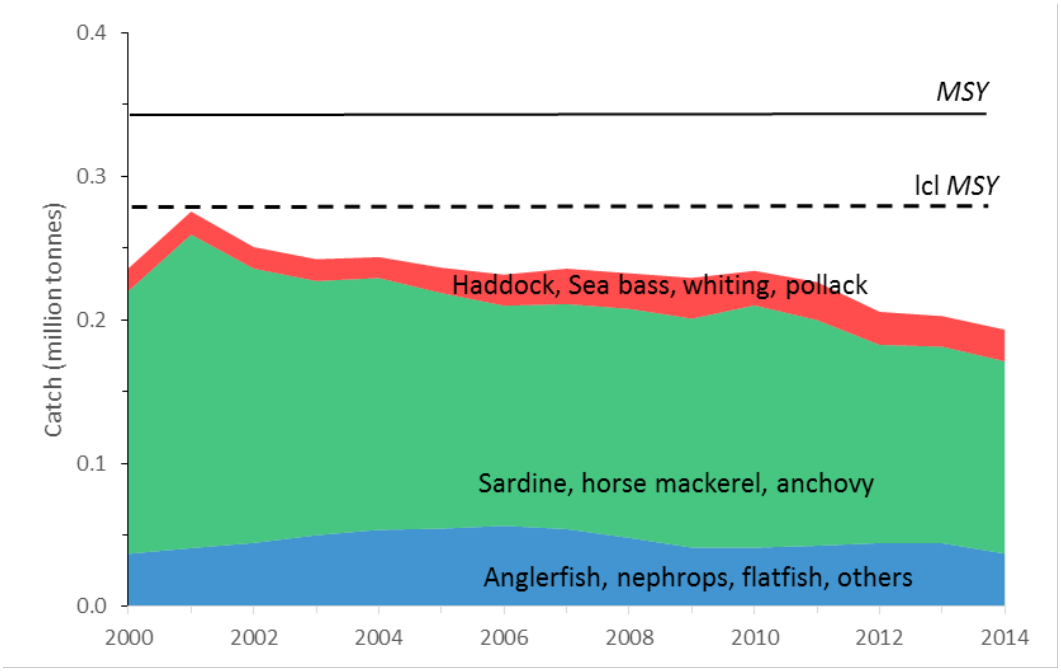



*Figure 53. Cumulative catches for 31 stocks in the Bay of Biscay, Iberian Coast and Azores, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [Iberian_Sep28_2016.xlsx]*

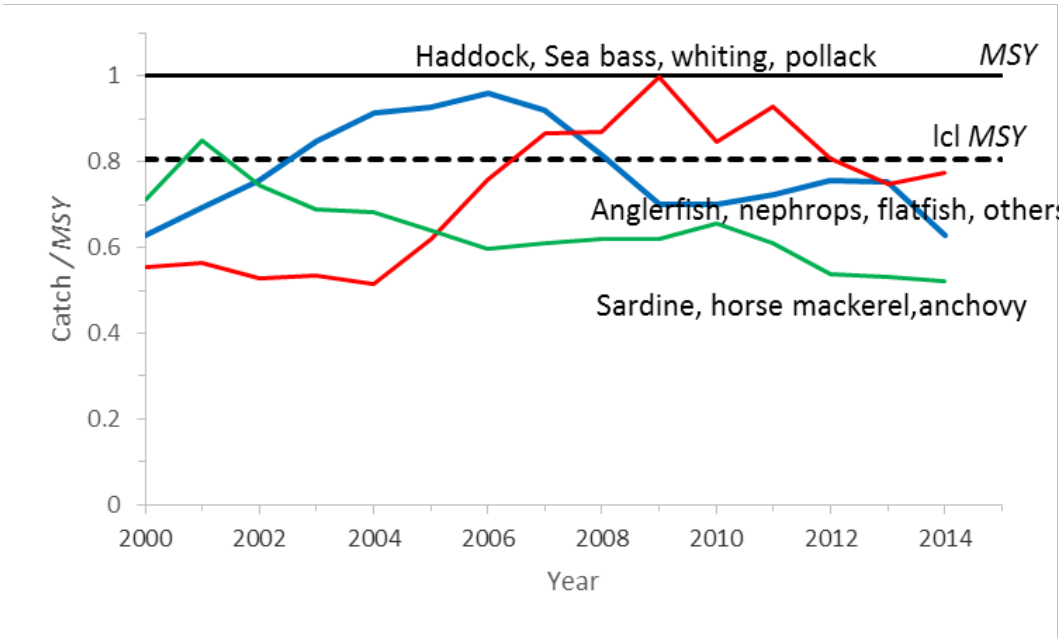



*Figure 54. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 31 stocks in the Bay of Biscay, Iberian Coast and Azores. Median catches for large predators (red curve) are near their long-term target, albeit taken at high cost from too small stocks. [Iberian_Sep28_2016.xlsx]*

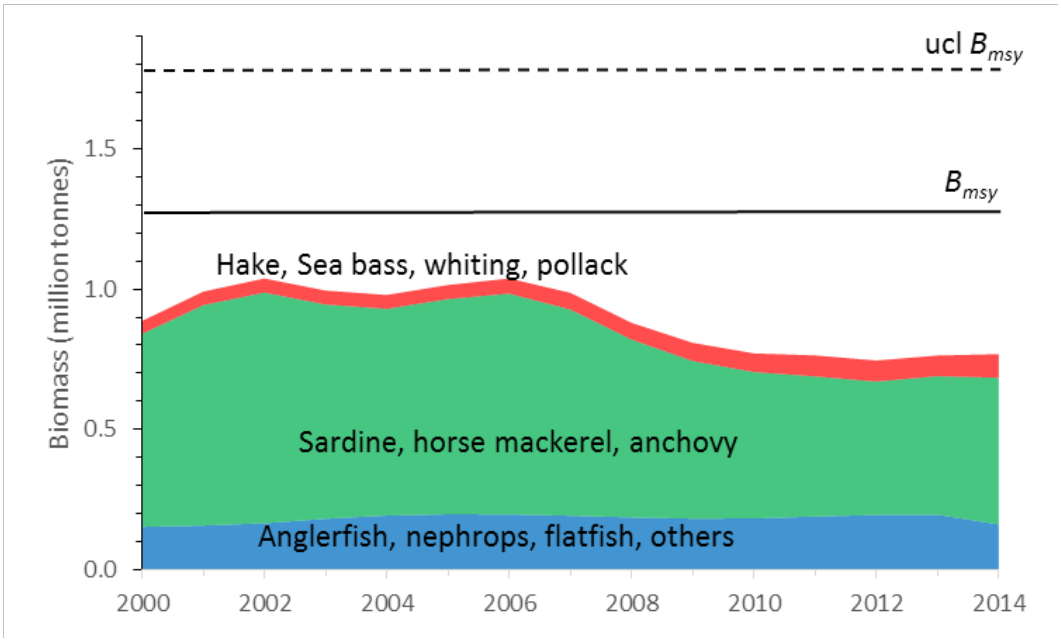



*Figure 55. Cumulative total biomass of 31 stocks in the Bay of Biscay, Iberian Coast and Azores relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of Bmsy (dashed green line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. The functional groups of large predators (red), pelagic plankton feeders (green), and benthic organisms (blue) are indicated, with listing of main species. The overall biomass of exploited species in this ecoregion is much too low. [Iberian_Sep28_2016.xlsx]*

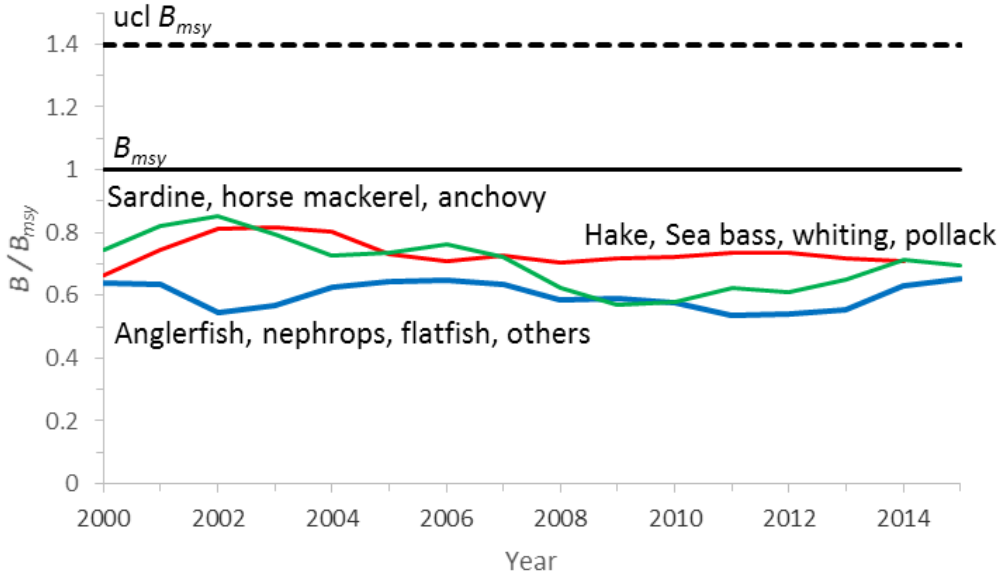



*Figure 56. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 31 stocks in the Bay of Biscay, Iberian Coast and Azores assigned to main functional groups. Median biomass of functional groups is much too low in this ecoregion. [Iberian_Sep28_2016.xlsx]*

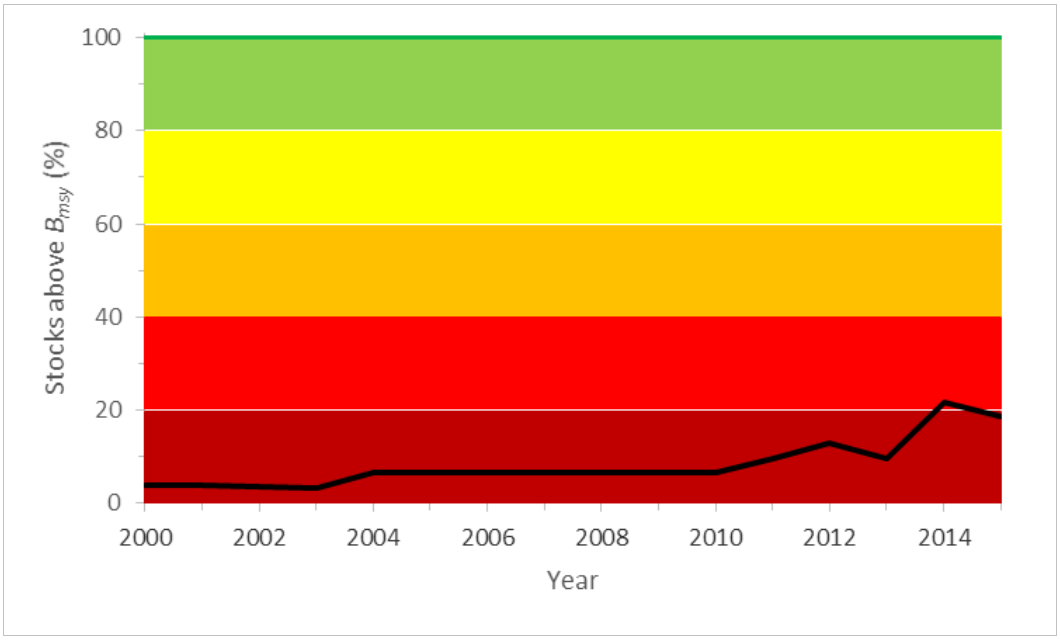



*Figure 57. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 31 stocks in the Bay of Biscay, Iberian Coast and Azores (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2015, only 19% of the stocks fulfilled that requirement. [Iberian_Sep28_2016.xlsx]*

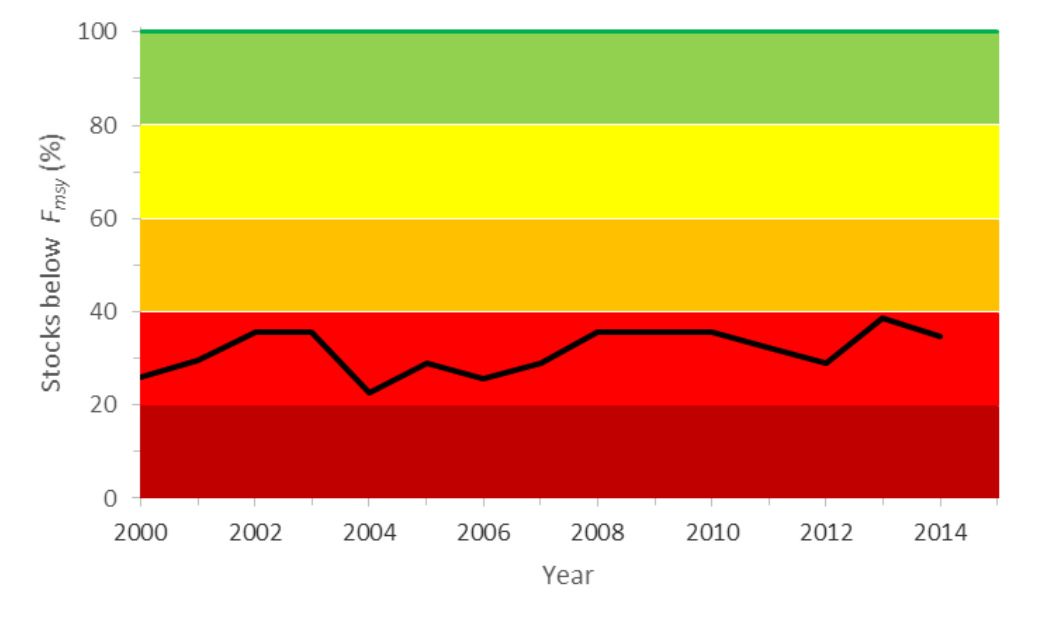



*Figure 58. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 31 stocks in the Bay of Biscay, Iberian Coast and Azores (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{msy}$ in 2015, latest in 2020. In 2014, 35% of the stocks fulfilled that requirement. [Iberian_Sep28_2016.xlsx]*

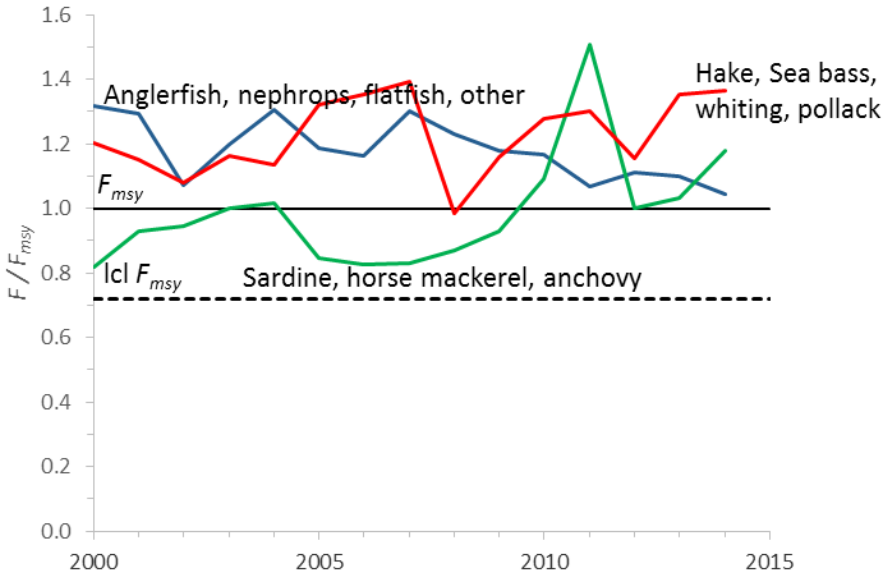



*Figure 59. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 31 stocks in the Bay of Biscay, Iberian Coast and Azores assigned to main functional groups. Median fishing pressure is above the maximum sustainable level in all functional groups in this ecoregion. [Iberian_Sep28_2016.xlsx]*

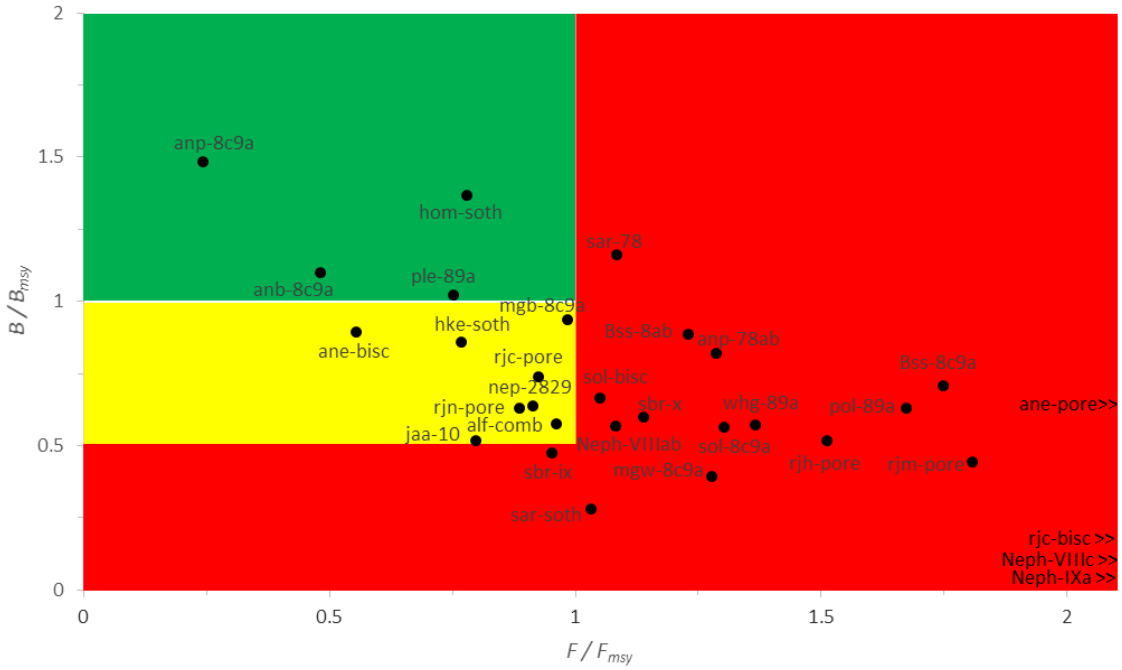
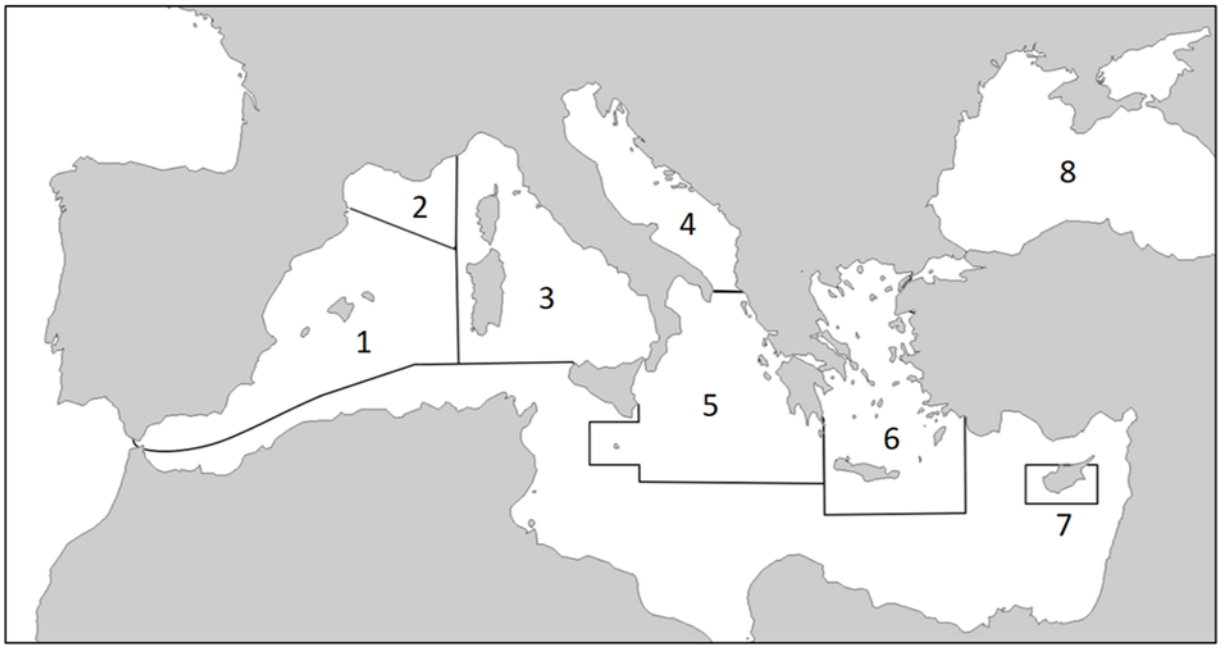



*Figure 60. Presentation of 31 stocks in the Bay of Biscay, Iberian Coast and Azores in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Fishing pressure for several stocks (->>) is beyond the upper limit of the X-axis. [Iberian_Sep28_2016.xlsx]*

## MEDITERRANEAN AND BLACK SEA

The following map shows the geographical limits of the studied subareas in the Mediterranean and Black Sea.




| | | | |
|---|---|---|---|
| 1 – Balearic Sea | 3 – Sardinia | 5 – Ionian Sea | 7 – Cyprus |
| 2 – Gulf of Lions | 4 – Adriatic Sea | 6 – Aegean Sea | 8 – Black Sea |

*Figure 61. Map of the Mediterranean and Black Sea. 1: Balearic, GFCM subdivision 1.1 excluding African coasts; 2: Gulf of Lions, GFCM subdivision 1.2; 3: Sardinia, GFCM subdivision 1.3 excluding African coasts; 4: Adriatic Sea, GFCM subdivision 2.1, includes GSAs 17&18; 5. Ionian Sea, GFCM subdivision 2.2, only GSAs 19&20; 6. Aegean Sea, GFCM subdivision 3.1, GSAs 22&23; 7: Cyprus, GFCM subdivision 3.2, only GSA 25; 8: Black Sea, GFCM subdivision 4.2, GSA 29.*

### Gulf of Lions

The following two paragraphs describing the Gulf of Lions (GSA 7) were taken from

http://www.indiseas.org/ecosystems/gulf-of-lions/environment.

"The Gulf of Lions is located in the north-western Mediterranean Sea (42°26.3'N, 3°9.9'E; 43°12.6'N, 5°27.5'E) covering a total area of 20,000 km$^2$ from the coastal area up to 2500 m depth.

The Gulf of Lions is a continental margin in the north-west Mediterranean Sea, with a large crescent-shaped continental shelf. Along the continental slope, the main mesoscale circulation feature is the Northern Current, a strong geostrophic current, which generally flows along the continental slope. More than ten rivers with a total watershed area of about 125,000 km$^2$ discharge significant volumes of water into the gulf. The dominant drivers in the area are the strong north-western (tramontane) and northern (mistral) winds which induce strong coastal upwelling activity, the western Mediterranean mesoscale

circulation, and the fresh water input from the Rhone River. These drivers generate important primary and secondary production in the Gulf. The substrate is characterized by muddy and sandy bottoms. The Gulf of Lions is host to a high diversity of pelagic, demersal and benthic organisms, including top predators such as sea birds, dolphins, hake and Atlantic bluefin tuna. The most important species in term of fishery landings are European pilchard and European anchovy; they are also key trophic groups in the food web, linking pelagic primary producers to consumers through their consumption of phytoplankton and their role as prey to consumers. Other important fish species are Atlantic mackerel and blue whiting: Atlantic mackerel is a demersal top predator important in coupling between pelagic and benthic compartments; blue whiting is a forage species, highly abundant on the continental slope and important in the diet of top predators such as hake and dolphins. Sea birds, dolphins and cuttlefish represent keystone species."

JRC-STEFC assessment reports and FAO-GFCM landings with data until 2014 were analyzed for 15 stocks in the Gulf of Lions. The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 11. Detailed assessments for every stock are available in Appendix 2 and in the spreadsheet Lions_Gulf_Oct12_16.xlsx.

Of the 15 stocks, 13 (87%) were subject to ongoing overfishing (F > Fmsy) and 13 stocks (87%) were outside of safe biological limits (B < 0.5 Bmsy). Twelve stocks in the Gulf of Lions (80%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing or being severely depleted ($B < 0.2\ B_{msy}$). The scientific names of these stocks are marked red in Table 11. Altogether, 13 stocks (87%) were subject to unsustainable exploitation (catch > MSY or F > Fmsy or B < 0.2 Bmsy), with the too high catches marked red in Table 11. In contrast, no stock could be considered healthy, defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 15 stocks of 43.7 thousand tonnes in 2014 was well below the biomass level of 113 thousand tonnes that can produce maximum yields. Summed catches of 8,551 tonnes were below (26%) the summed maximum sustainable yield of 32,637 tonnes. This is mainly caused by a sharp decline in pelagic plankton feeders since 2000. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above $B_{msy}$. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 11. Analysis of 15 stocks in the Gulf of Lions, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$), $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red) and pelagic plankton feeders (green). [Lions_Gulf_Oct12_16.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Conger conger* | CONGCON_LI | 2014 | 543 | 115 | 0.21 | 0.18 | 0.10 | 0.13 | **1.34** | 3,072 | 863 | **0.28** |
| *Loligo vulgaris* | LOLIVUL_LI | 2014 | 389 | 225 | 0.58 | 0.18 | 0.11 | 0.35 | **3.08** | 2,103 | 645 | **0.31** |
| *Nephrops norvegicus* | NEPRNOR_LI | 2014 | 100 | 27 | 0.27 | 0.26 | 0.16 | 0.22 | **1.35** | 388 | 123 | **0.32** |
| *Octopus vulgaris* | OCTOVUL_LI | 2014 | 1,355 | 1,472 | **1.09** | 0.40 | 0.40 | 0.52 | **1.31** | 3,420 | 2,829 | 0.83 |
| *Pagellus erythrinus* | PAGEERY_LI | 2014 | 402 | 175 | 0.43 | 0.20 | 0.16 | 0.21 | **1.34** | 2,030 | 818 | **0.40** |
| *Sepia officinalis* | SEPIOFF_LI | 2014 | 262 | 120 | 0.46 | 0.18 | 0.13 | 0.23 | **1.83** | 1,459 | 516 | **0.35** |
| *Solea solea* | SOLEVUL_LI | 2014 | 517 | 130 | 0.25 | 0.16 | 0.10 | 0.14 | **1.44** | 3,185 | 941 | **0.30** |
| *Trisopterus minutus* | TRISMIN_LI | 2014 | 890 | 656 | 0.74 | 0.30 | 0.27 | 0.48 | **1.81** | 3,010 | 1,359 | **0.45** |
| *Dicentrarchus labrax* | DICELAB_LI | 2014 | 547 | 164 | 0.30 | 0.21 | 0.11 | 0.25 | **2.33** | 2,624 | 665 | **0.25** |
| *Merluccius merluccius* | MERLMER_LI | 2014 | 2,383 | 1,654 | 0.69 | 0.25 | 0.18 | 0.47 | **2.54** | 9,601 | 3,547 | **0.37** |
| *Micromesistius poutassou* | MICMPOU_LI | 2014 | 261 | 104 | 0.40 | 0.35 | 0.19 | 0.52 | **2.78** | 740 | 198 | **0.27** |
| *Boops boops* | BOOPBOO_LI | 2014 | 568 | 253 | 0.45 | 0.25 | 0.19 | 0.30 | **1.58** | 2,265 | 850 | **0.38** |
| *Engraulis encrasicolus* | ENGRENC_LI | 2014 | 6,835 | 1,891 | 0.28 | 0.29 | 0.29 | 0.16 | 0.53 | 23,465 | 12,178 | 0.52 |
| *Sardina pilchardus* | SARDPIL_LI | 2014 | 16,288 | 826 | 0.05 | 0.31 | 0.20 | 0.05 | 0.25 | 51,866 | 16,356 | **0.32** |
| *Scomber scombrus* | SCOMSCO_LI | 2014 | 1,297 | 739 | 0.57 | 0.31 | 0.26 | 0.42 | **1.60** | 4,193 | 1,771 | **0.42** |

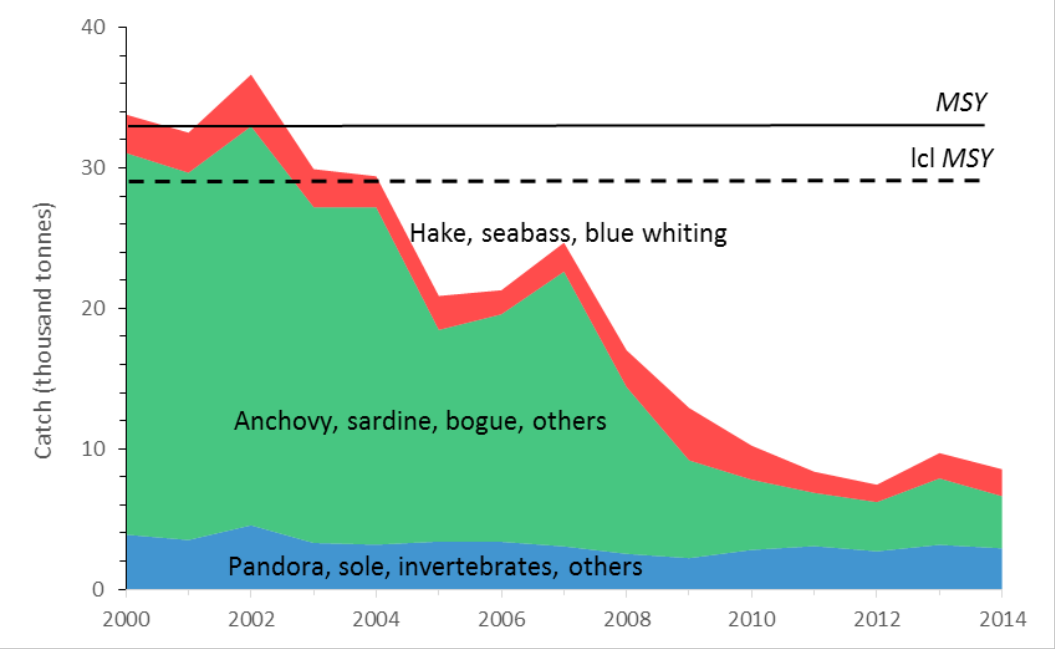



*Figure 62. Cumulative catches, including discards and recreational catch if available, for 15 stocks in the Gulf of Lions, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [Lions_Gulf_Oct12_16.xlsx]*

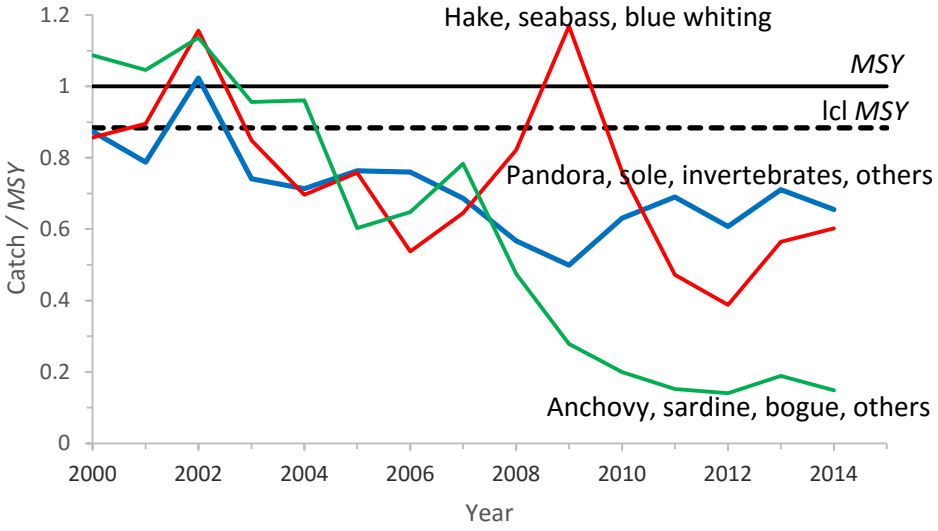



*Figure 63. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 15 stocks in the Gulf of Lions. Catches of large predators (red curve) and pelagic plankton feeders (green curve) were in sharp declining since 2000 because of too low biomass (see below). [Lions_Gulf_Oct12_16.xlsx]*

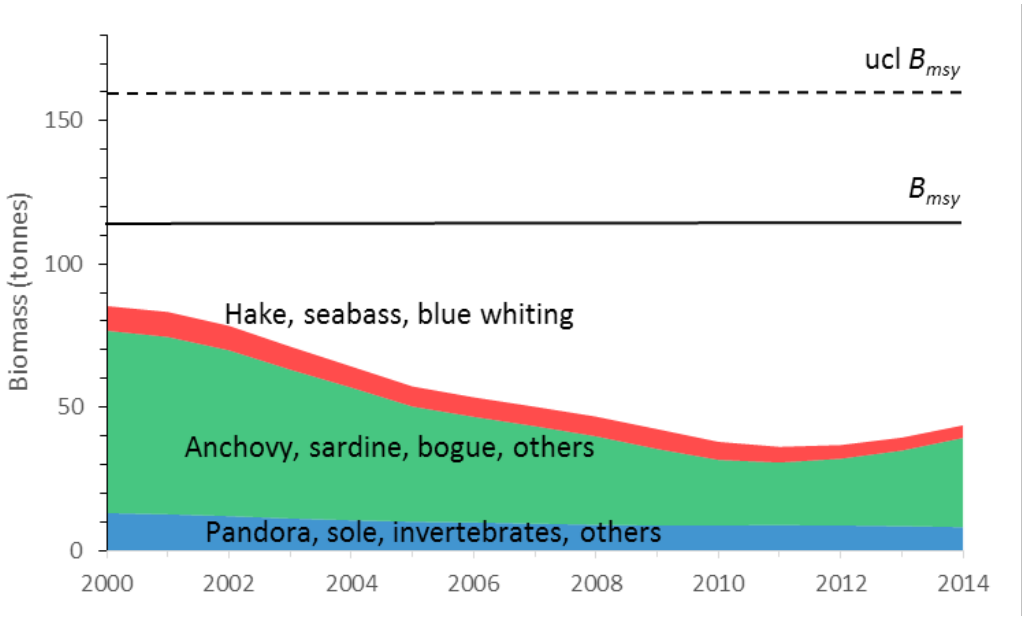



*Figure 64. Cumulative total biomass of 15 stocks in the Gulf of Lions relative to the biomass that can produce the maximum sustainable yield (Bmsy = black line). The upper 95% confidence limit of Bmsy (dashed line) would present a precautionary target biomass above Bmsy. This is also the area where the maximum economic yield could be obtained. All functional groups were far below the Bmsy level. [Lions_Gulf_Oct12_16.xlsx]*

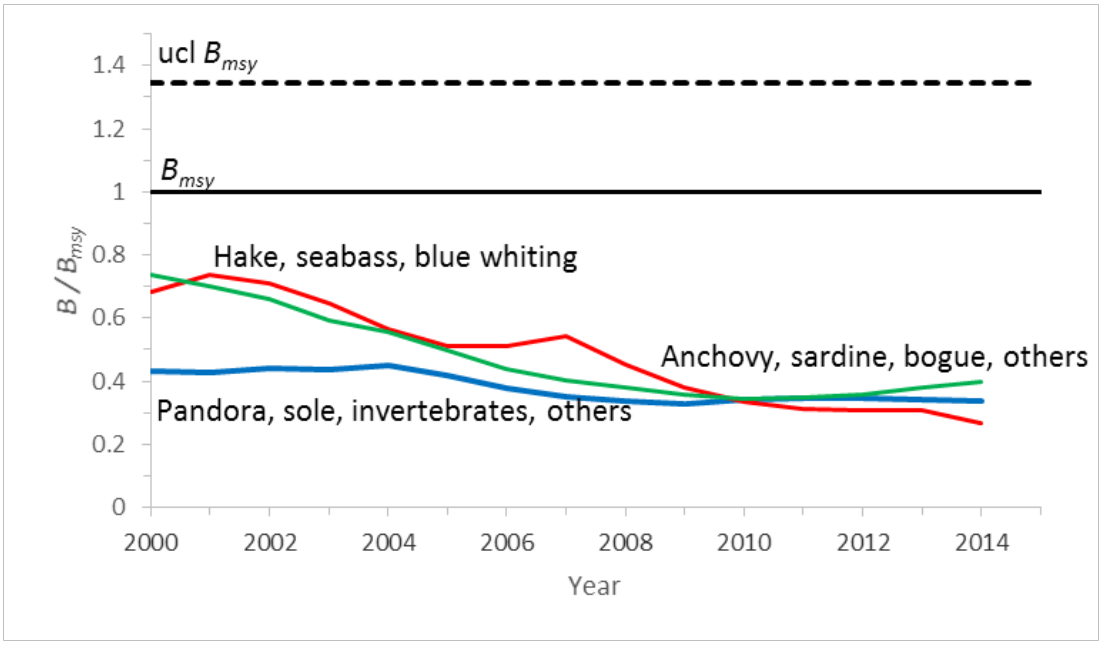



*Figure 15. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 15 stocks in the Gulf of Lions assigned to main functional groups. All functional groups have biomass levels well below $B_{msy}$, without a clear upward trend. [Lions_Gulf_Oct12_16.xlsx]*

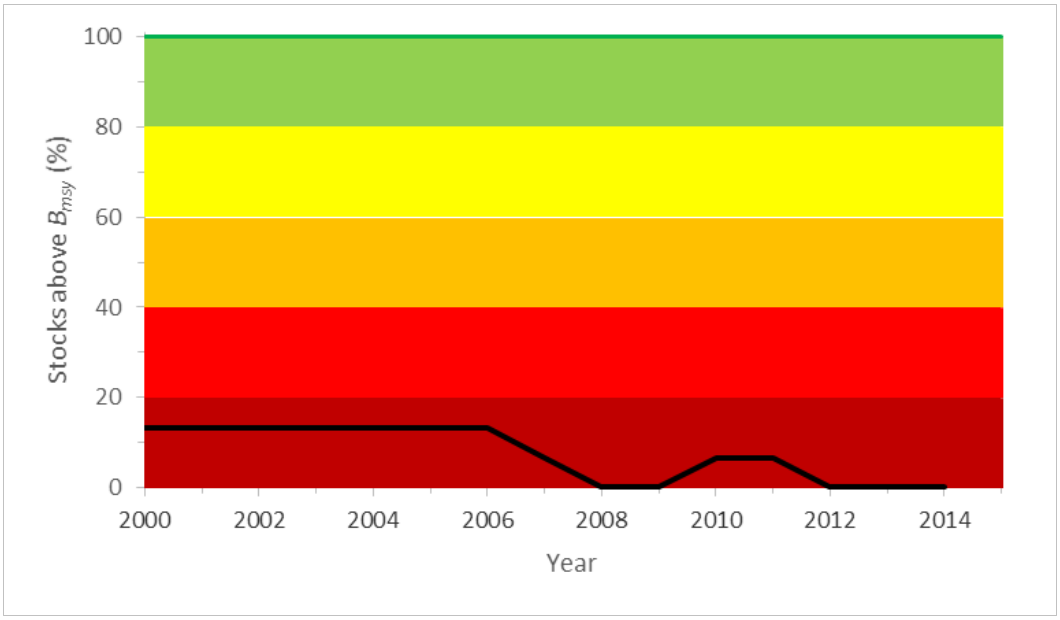



*Figure 66. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 15 stocks in the Gulf of Lions (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2014, no stocks fulfilled that requirement. [Lions_Gulf_Oct12_16.xlsx]*

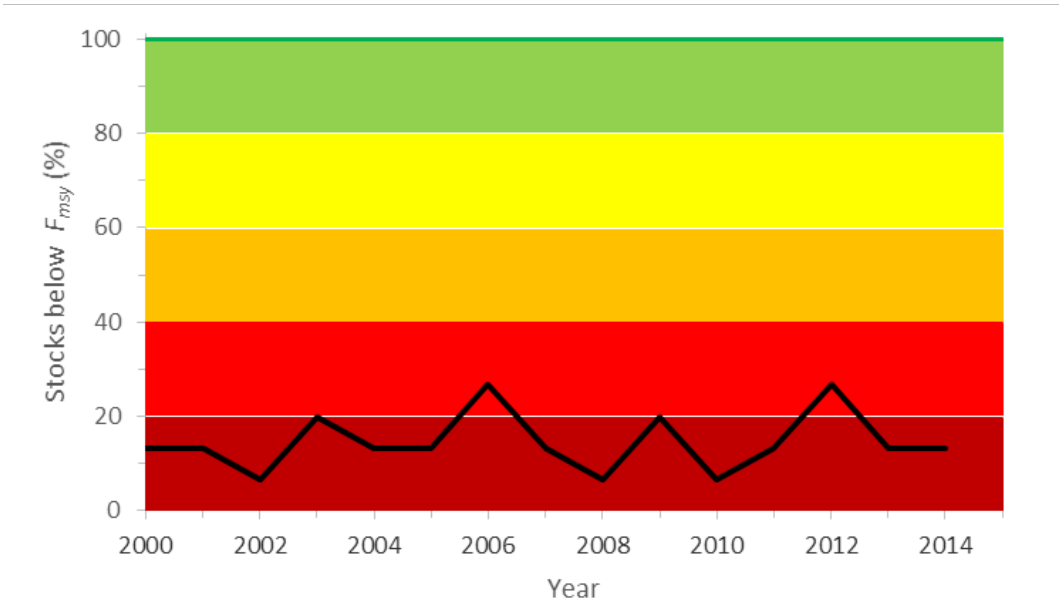



*Figure 67. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 15 stocks in the Gulf of Lions (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{msy}$ in 2015, latest in 2020. In 2014, only two stocks (13%) fulfilled that requirement. [Lions_Gulf_Oct12_16.xlsx]*

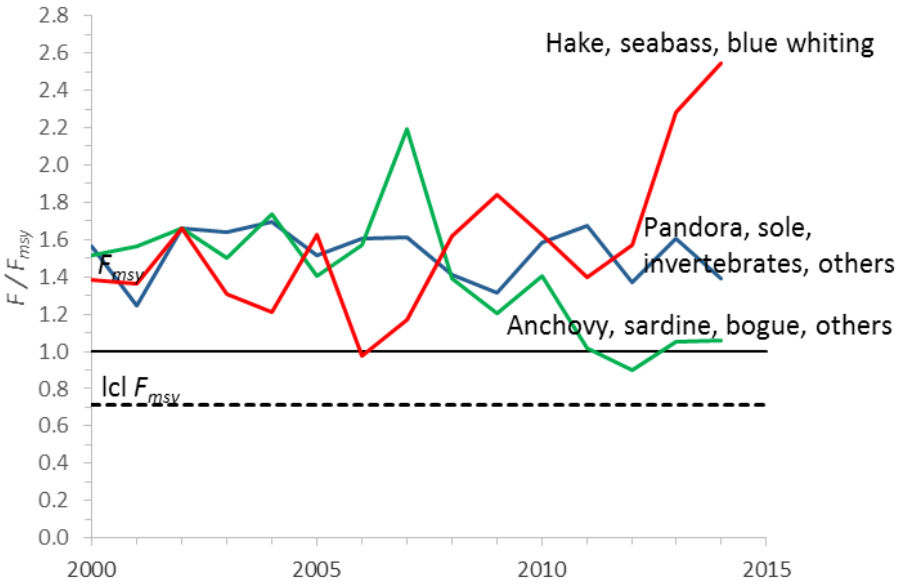



*Figure 68. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 15 stocks in the Gulf of Lions assigned to main functional groups. Except for two pelagic plankton feeders, all stocks are subject to strong overfishing in 2014. [Lions_Gulf_Oct12_16.xlsx]*

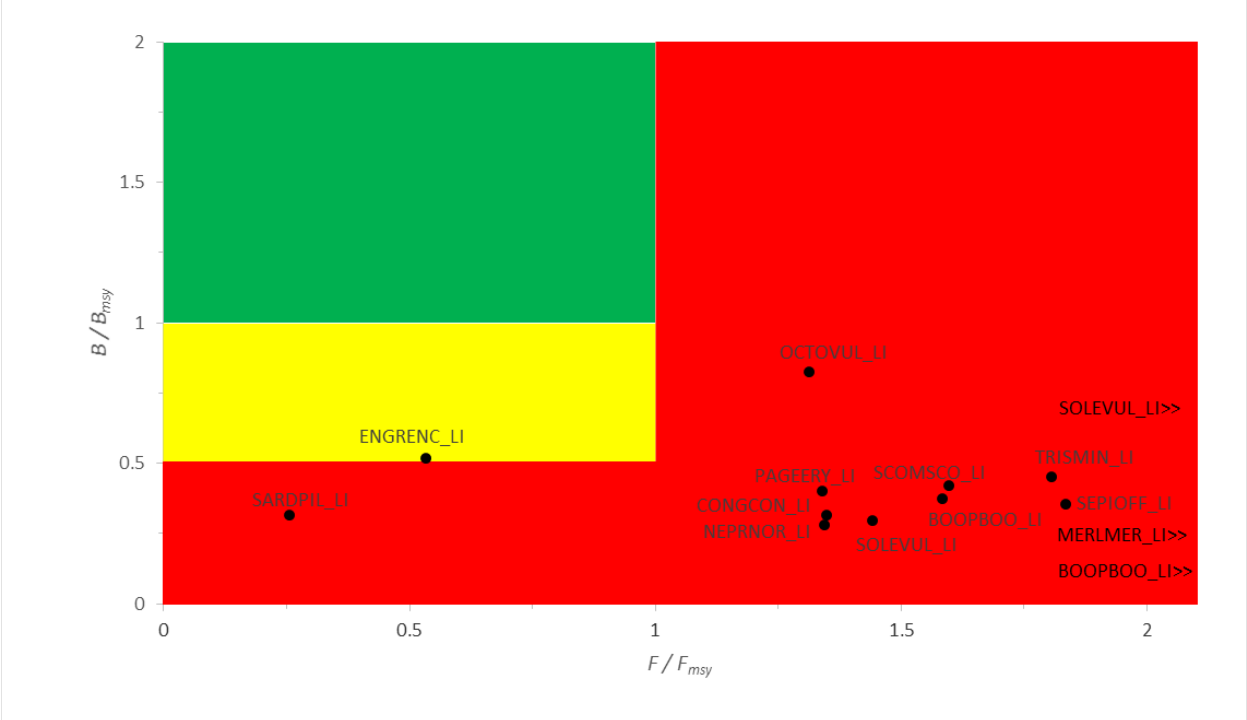



*Figure 69. Presentation of 15 stocks in the Gulf of Lions in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Only one stock is in safe biological limits and presented in the green area. [Lions_Gulf_Oct12_16.xlsx]*

**Balearic Sea**

The following two paragraphs describing the Balearic Sea (GSA 5) were taken from the website www.fao.org and modified from http://www.indiseas.org.

"The waters of the Balearic Sea (western Mediterranean) bounded by a line commencing on the coast of Africa at the Algerian/Tunisian frontier at 8°37'E longitude; thence running due north to 38°00' north latitude; thence due west to 8°00' east longitude; thence due north to 41°20' north latitude; thence westward along a rhumb line to the mainland coast at the eastern end of the frontier between France and Spain; thence following the Spanish coast to Punta Marroqui; thence due south along 5°36' west longitude to the coast of Africa; thence following in an eastwards direction along the coast of Africa to the starting point. For the purposes of this work only the landings and biomasses of the northern coastline were used.

The Balearic Sea is generally described as oligotrophic, but temporal enrichment occurs due to regional environmental events, mainly related to wind conditions, the existence of a temporal thermocline and a shelf-slope current and river discharges. These factors greatly influence the productivity and fishing activity of the area, which yields are mainly composed of small pelagic fishes."

JRC-STEFC assessment reports and FAO-GFCM landings with data until 2014 were analyzed for 22 stocks in the Balearic Sea (GFCM subarea 1.1). The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 12. Detailed assessments for every stock are available in Appendix 2 and in the spreadsheet Balearic_Oct12_16.xlsx.

Of the 22 stocks, 21 (95%) were subject to ongoing overfishing ($F > F_{msy}$) and 14 stocks (64%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). Catches did not exceed the maximum sustainable yield ($C/MSY > 1$) in any of the stocks. Fifteen stocks (68%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing or being severely depleted ($B < 0.2\ B_{msy}$). The scientific names of these stocks are marked red in Table 12. Altogether, 21 stocks (95%) were subject to unsustainable exploitation (catch > MSY or F > Fmsy or B < 0.2 Bmsy), with the too high catches marked red in Table 12, and no stock could be considered healthy, defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 22 stocks of 358 thousand tonnes in 2014 was well below the biomass level of 716 thousand tonnes that can produce maximum sustainable yields. Summed catches of 126,500 tonnes were below (59%) the summed maximum sustainable yield of 213,000 tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above $B_{msy}$. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 12. Analysis of 22 stocks in the Balearic Sea, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$), $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red), and pelagic plankton feeders (green). [Balearic_Oct12_16.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Aristeomorpha foliacea* | ARISFOL_BA | 2014 | 38 | 10 | 0.26 | 0.25 | 0.14 | 0.23 | **1.56** | 153 | 44 | **0.29** |
| *Aristeus antennatus* | ARITANT_BA | 2014 | 1,855 | 1,629 | 0.88 | 0.28 | 0.28 | 0.48 | **1.71** | 6,593 | 3,389 | 0.51 |
| *Conger conger* | CONGCON_BA | 2014 | 566 | 131 | 0.23 | 0.18 | 0.07 | 0.20 | **2.86** | 3,216 | 647 | **0.201** |
| *Lepidorhombus whiffiagonis* | LEPIWHI_BA | 2014 | 113 | 19 | 0.17 | 0.34 | 0.15 | 0.25 | **1.64** | 335 | 76 | **0.23** |
| *Loligo vulgaris* | LOLIVUL_BA | 2014 | 1,260 | 361 | 0.29 | 0.16 | 0.11 | 0.12 | **1.10** | 8,118 | 2,925 | **0.36** |
| *Mullus barbatus* | MULLBAR_BA | 2014 | 652 | 634 | 0.97 | 0.40 | 0.40 | 0.59 | **1.48** | 1,626 | 1,066 | 0.66 |
| *Mullus surmuletus* | MULLSUR_BA | 2014 | 557 | 230 | 0.41 | 0.58 | 0.36 | 0.77 | **2.16** | 961 | 297 | **0.31** |
| *Nephrops norvegicus* | NEPRNOR_BA | 2014 | 605 | 397 | 0.66 | 0.28 | 0.28 | 0.34 | **1.23** | 2,199 | 1,174 | 0.53 |
| *Pagellus erythrinus* | PAGEERY_BA | 2014 | 2,084 | 1,811 | 0.87 | 0.34 | 0.34 | 0.31 | 0.92 | 6,219 | 5,885 | 0.95 |
| *Parapenaeus longirostris* | PAPELON_BA | 2014 | 2,482 | 1,043 | 0.42 | 0.47 | 0.24 | 0.80 | **3.38** | 5,244 | 1,308 | **0.25** |
| *Phycis blennoides* | PHYCBLE_BA | 2014 | 540 | 254 | 0.47 | 0.21 | 0.19 | 0.22 | **1.19** | 2,576 | 1,145 | **0.44** |
| *Sepia officinalis* | SEPIOFF_BA | 2014 | 432 | 270 | 0.63 | 0.26 | 0.18 | 0.47 | **2.66** | 1,687 | 579 | **0.34** |
| *Solea solea* | SOLEVUL_BA | 2014 | 969 | 308 | 0.32 | 0.23 | 0.12 | 0.27 | **2.19** | 4,207 | 1,132 | **0.27** |
| *Trisopterus minutus* | TRISLUS_BA | 2014 | 249 | 145 | 0.58 | 0.37 | 0.37 | 0.40 | **1.07** | 673 | 364 | 0.54 |
| *Merluccius merluccius* | MERLMER_BA | 2014 | 5,676 | 3,028 | 0.53 | 0.22 | 0.10 | 0.50 | **4.79** | 25,518 | 6,021 | **0.24** |
| *Micromesistius poutassou* | MICMPOU_BA | 2014 | 5,371 | 1,222 | 0.23 | 0.18 | 0.08 | 0.18 | **2.12** | 29,565 | 6,854 | **0.23** |
| *Boops boops* | BOOPBOO_BA | 2014 | 8,299 | 6,615 | 0.80 | 0.31 | 0.31 | 0.46 | **1.48** | 26,424 | 14,246 | 0.54 |
| *Engraulis encrasicolus* | ENGRENC_BA | 2014 | 33,132 | 22,203 | 0.67 | 0.19 | 0.19 | 0.23 | **1.20** | 171,342 | 95,368 | 0.56 |
| *Sardina pilchardus* | SARDPIL_BA | 2014 | 114,100 | 66,120 | 0.58 | 0.36 | 0.36 | 0.38 | **1.06** | 319,009 | 175,221 | 0.55 |
| *Sardinella aurita* | SARIAUR_BA | 2014 | 25,495 | 16,151 | 0.63 | 0.40 | 0.35 | 0.57 | **1.61** | 64,177 | 28,476 | **0.44** |
| *Scomber colias* | SCOMPNE_BA | 2014 | 3,193 | 2,383 | 0.75 | 0.39 | 0.29 | 0.81 | **2.85** | 8,097 | 2,931 | **0.36** |

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Scomber scombrus* | SCOMSCO_BA | 2014 | 5,379 | 1,554 | 0.29 | 0.19 | 0.12 | 0.17 | **1.38** | 28,524 | 9,242 | **0.32** |

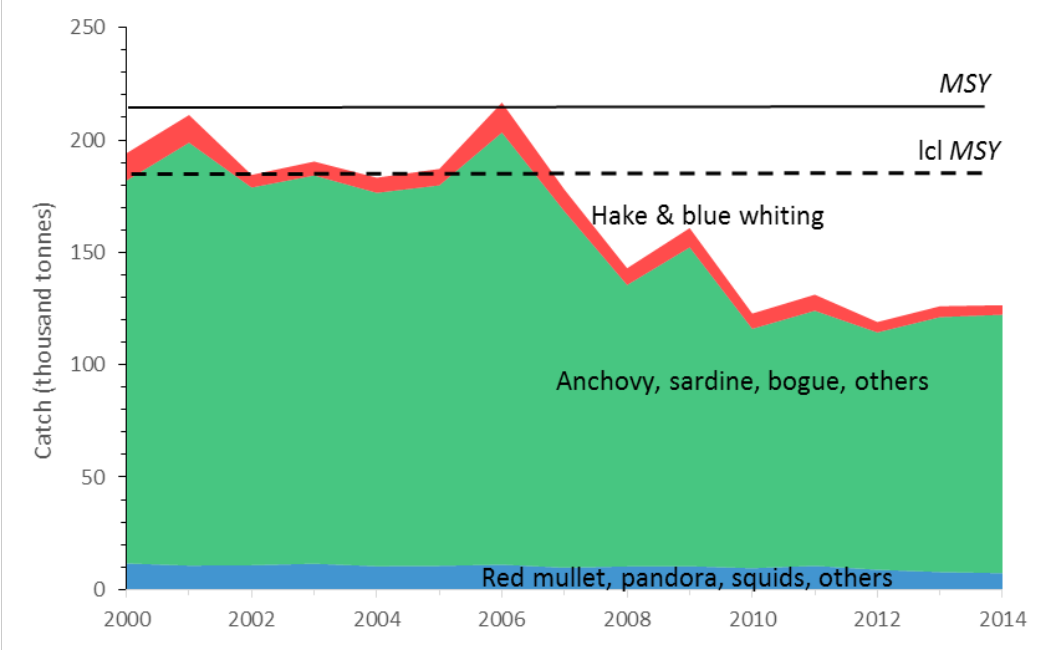



*Figure 70. Cumulative catches for 22 stocks in the Balearic Sea, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. Catches of pelagic plankton feeders have declined drastically in recent years, due to overfishing (see graphs below). [Balearic_Oct12_16.xlsx]*

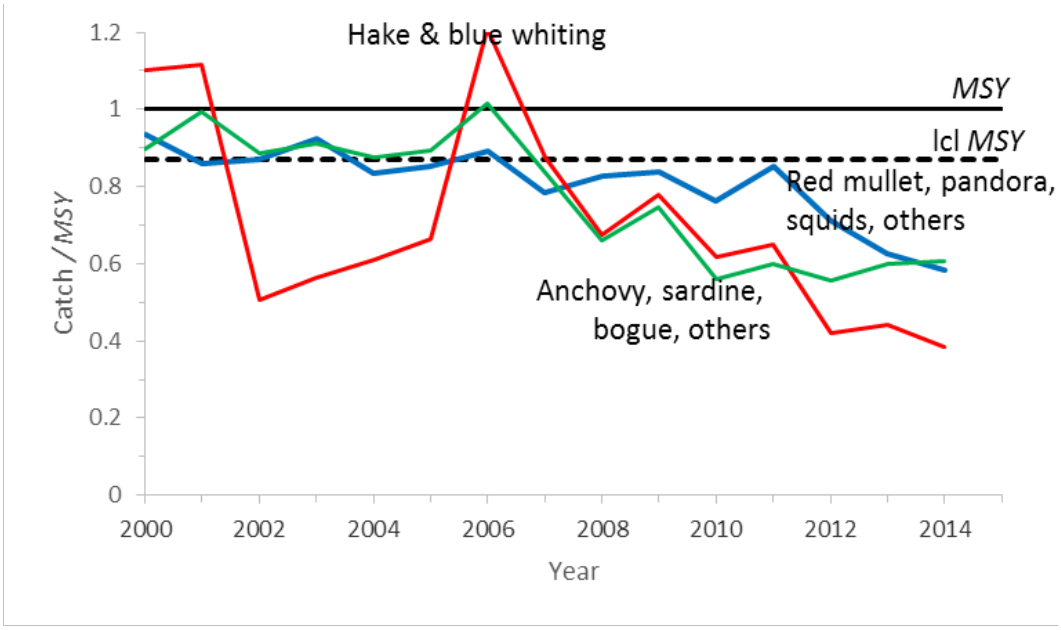



*Figure 71. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 22 stocks in the Balearic Sea. Pelagic plankton feeders (green curve) and large predators (red) supported catches below the precautionary lower 95% confidence limit of MSY (dashed line) and present declining levels since 2006. Benthic organisms (blue) supported catches near the precautionary level until 2011 and declined thereafter. Catches of large predators declined strongly since 2006. [Balearic_Oct12_16.xlsx]*

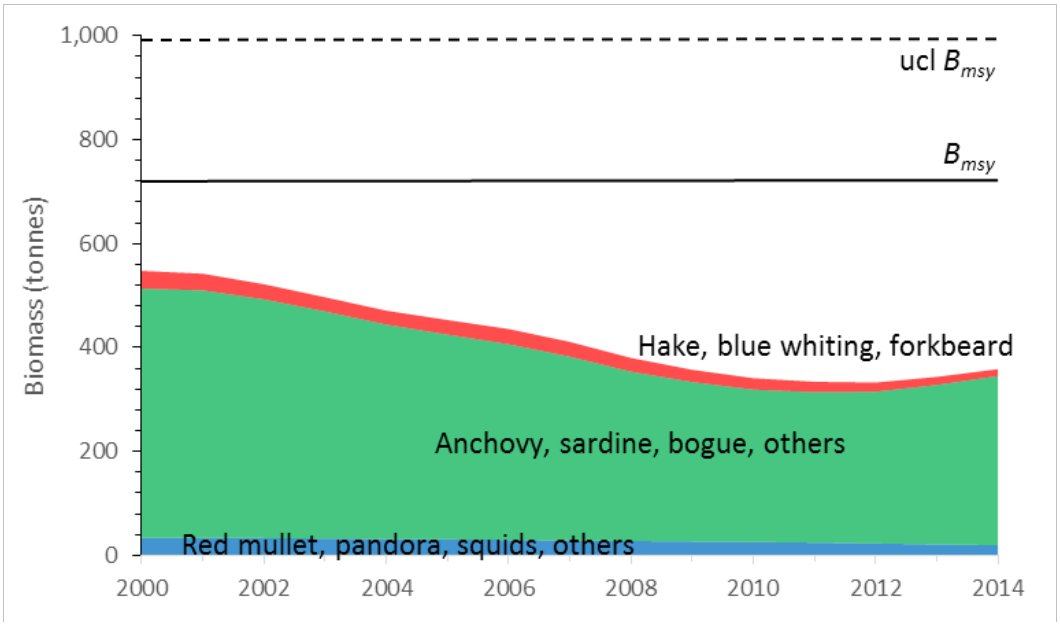



*Figure 72. Cumulative total biomass of 22 stocks in the Balearic Sea relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of Bmsy (dashed line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. The functional groups of large predators (red), pelagic plankton feeders (green), and benthic organisms (blue) are indicated. All functional groups were below the $B_{msy}$ level in recent years. [Balearic_Oct12_16.xlsx]*

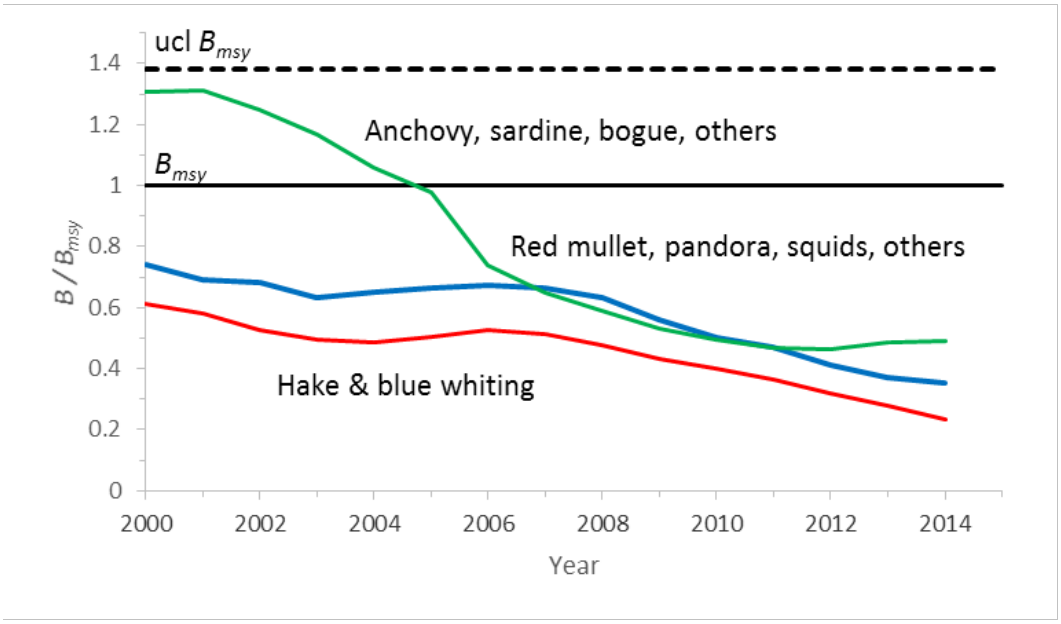



*Figure 73. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 22 stocks in the Balearic Sea assigned to main functional groups. Large predators (red), pelagic plankton feeders (green) and benthic organisms (blue) have biomass levels well below $B_{msy}$, even outside of safe biological limits in recent years [Balearic_Oct12_16.xlsx].*

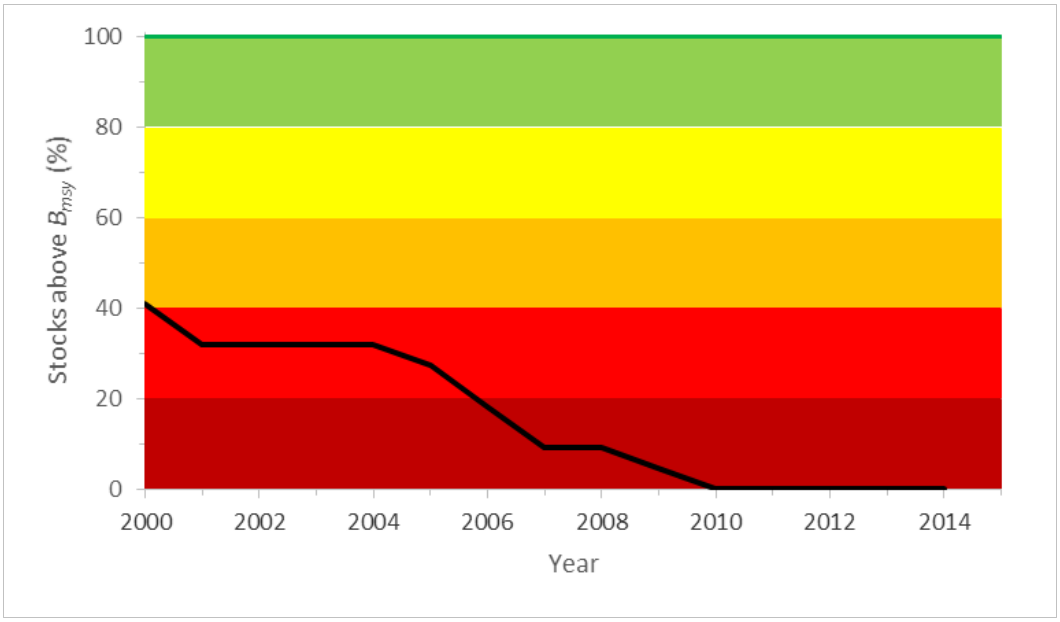



*Figure 74. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 22 stocks in the Balearic Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2014, no stocks fulfilled that requirement. [Balearic_Oct12_16.xlsx]*




*Figure 75. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 22 stocks in the Balearic Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{msy}$ in 2015, latest in 2020. In 2014, only one stock (5%) fulfilled that requirement. [Balearic_Oct12_16.xlsx]*

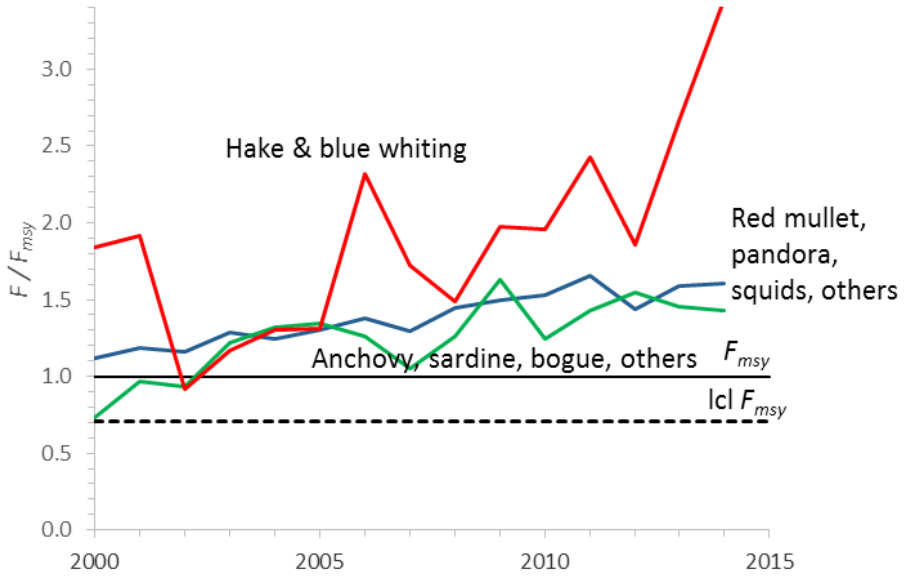



*Figure 76. Median fishing pressure relative to the maximum sustainable level (F/Fmsy) for 22 stocks in the Balearic Sea assigned to main functional groups. All groups were subject to severe ongoing overfishing in 2014. [Balearic_Oct12_16.xlsx]*

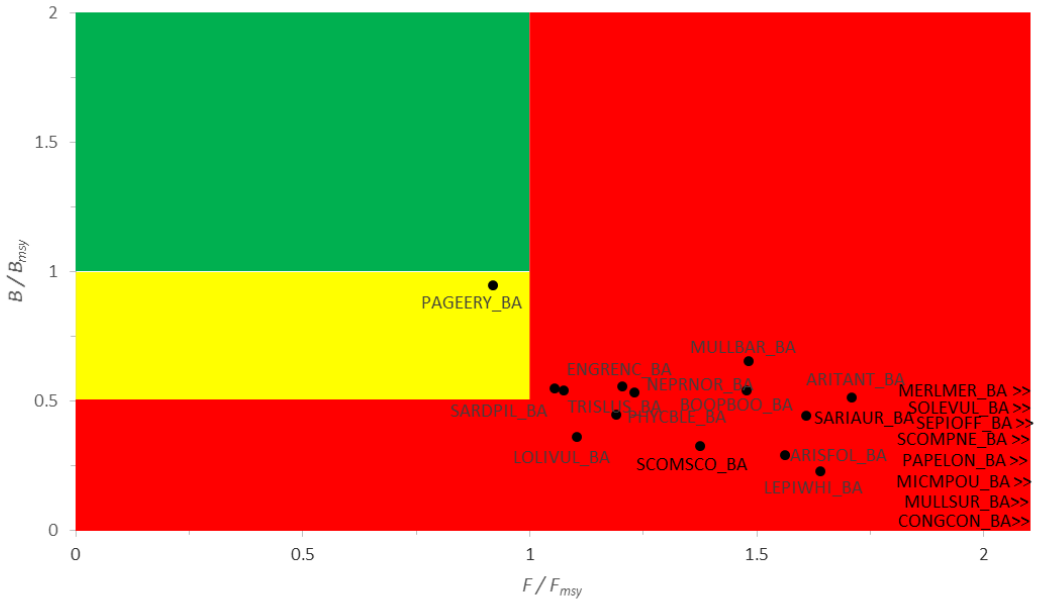



*Figure 77. Presentation of 22 Balearic Sea stocks in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Several stocks were strongly depleted (B < 0.5 Bmsy) and outside of the range for F/Fmsy in this chart. They are indicated with >> at the lower right corner. [Balearic_Oct12_16.xlsx]*

**Sardinia**

The following paragraph on the waters around Sardinia (GSA 11) was taken from the website www.fao.org and modified from http://www.indiseas.org.

"The waters of the Tyrrhenian Sea and adjacent waters bounded by a line commencing on the coast of Africa at the Algerian/Tunisian frontier at 8°37'E longitude; thence running due north to 38°00' north latitude; thence due west to 8°00' east longitude; thence due north to 41°20' north latitude; thence northward along a rhumb line to the mainland coast at the frontier between France and Italy; thence following the coast of Italy to 38°00' north latitude; thence due west along 38°00' north latitude to the coast of Sicily; thence following the northern coast of Sicily to Trapani (38°02' N latitude; and 12°32' E longitude); thence along a rhumb line to Cape Bon (Ras el Tib) at 37°08' N latitude; and 11°00' E longitude; thence westwards following the coast of Tunisia to the starting point. For the purposes of this work only the landings and biomasses of the northern coastline were used."

JRC-STEFC assessment reports and FAO-GFCM landings with data until 2014 were analyzed for 19 stocks in the Sardinia (GFCM subarea 1.3). The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 13. Detailed assessments for every stock are available in Appendix 2 and in the spreadsheet Sardinia_Oct14_16.xlsx.

Of the 19 stocks, 18 (95%) were subject to ongoing overfishing ($F > F_{msy}$) and 13 stocks (68%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). Catches exceed the maximum sustainable yield ($C/MSY > 1$) in two stocks. Thirteen stocks (68%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing or being severely depleted ($B < 0.2\ B_{msy}$). The scientific names of these stocks are marked red in Table 13. All stocks (100%) were subject to unsustainable exploitation (catch > *MSY* or $F > F_{msy}$ or $B < 0.2\ B_{msy}$), with the too high catches marked red in Table 13. None of the stocks could be considered healthy, defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 19 stocks of 74.6 thousand tonnes in 2014 was well below the biomass level of 174 thousand tonnes that can produce maximum sustainable yields. Summed catches of 30,113 tonnes were below the summed maximum sustainable yield of 43,500 tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above $B_{msy}$. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 13. Analysis of 19 stocks in Sardinia, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$), $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red), and pelagic plankton feeders (green). [Sardinia_Oct14_16.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Chamelea gallina* | CHAMGAL_SA | 2014 | 2,023 | 11 | 0.01 | 0.28 | 0.05 | 0.02 | 0.32 | 7,300 | 674 | **0.09** |
| *Dentex dentex* | DENTDEN_SA | 2014 | 1,626 | 149 | 0.09 | 0.22 | 0.08 | 0.10 | **1.23** | 7,533 | 1,451 | **0.19** |
| *Illex coindettii* | ILLECOI_SA | 2014 | 990 | 624 | 0.63 | 0.20 | 0.20 | 0.21 | **1.07** | 5,046 | 2,970 | 0.59 |
| *Loligo vulgaris* | LOLIVUL_SA | 2014 | 1,452 | 806 | 0.56 | 0.15 | 0.09 | 0.26 | **2.79** | 9,986 | 3,152 | **0.32** |
| *Mullus barbatus* | MULLBAR_SA | 2014 | 1,589 | 2,631 | **1.66** | 0.36 | 0.36 | 0.85 | **2.33** | 4,372 | 3,109 | 0.71 |
| *Nephrops norvegicus* | NEPRNOR_SA | 2014 | 634 | 208 | 0.33 | 0.23 | 0.12 | 0.29 | **2.50** | 2,761 | 707 | **0.26** |
| *Pagellus erythrinus* | PAGEERY_SA | 2014 | 444 | 424 | 0.96 | 0.32 | 0.28 | 0.71 | **2.59** | 1,385 | 595 | **0.43** |
| *Palinurus elephas* | PALIELE_SA | 2014 | 528 | 93 | 0.18 | 0.09 | 0.04 | 0.07 | **1.85** | 5,999 | 1,310 | **0.22** |
| *Parapenaeus longirostris* | PAPELON_SA | 2014 | 2,457 | 3,056 | **1.24** | 0.53 | 0.53 | 0.70 | **1.32** | 4,611 | 4,337 | 0.94 |
| *Sepia officinalis* | SEPIOFF_SA | 2014 | 345 | 320 | 0.93 | 0.28 | 0.28 | 0.34 | **1.21** | 1,218 | 930 | 0.76 |
| *Belone belone* | BELOBEL_SA | 2014 | 217 | 28 | 0.13 | 0.22 | 0.08 | 0.15 | **1.82** | 1,001 | 189 | **0.19** |
| *Coryphaena hippurus* | CORYHIP_SA | 2014 | 866 | 449 | 0.52 | 0.55 | 0.42 | 0.75 | **1.79** | 1,582 | 602 | **0.38** |
| *Epinephelus marginatus* | EPINGUA_SA | 2014 | 277 | 48 | 0.17 | 0.18 | 0.07 | 0.16 | **2.37** | 1,523 | 291 | **0.19** |
| *Merluccius merluccius* | MERLMER_SA | 2014 | 5,266 | 4,482 | 0.85 | 0.23 | 0.23 | 0.38 | **1.66** | 23,193 | 11,868 | 0.51 |
| *Micromesistius poutassou* | MICMPOU_SA | 2014 | 1,130 | 175 | 0.15 | 0.18 | 0.08 | 0.13 | **1.62** | 6,145 | 1,343 | **0.22** |
| *Boops boops* | BOOPBOO_SA | 2014 | 2,593 | 1,397 | 0.54 | 0.30 | 0.17 | 0.56 | **3.27** | 8,722 | 2,502 | **0.29** |
| *Engraulis encrasicolus* | ENGRENC_SA | 2014 | 9,564 | 7,575 | 0.79 | 0.27 | 0.26 | 0.44 | **1.69** | 35,352 | 17,124 | **0.48** |
| *Sardina pilchardus* | SARDPIL_SA | 2014 | 11,269 | 7,460 | 0.66 | 0.25 | 0.23 | 0.35 | **1.53** | 45,387 | 21,111 | **0.47** |
| *Spicara maena* | SPICMAE_SA | 2014 | 290 | 177 | 0.61 | 0.50 | 0.50 | 0.52 | **1.04** | 575 | 339 | 0.59 |

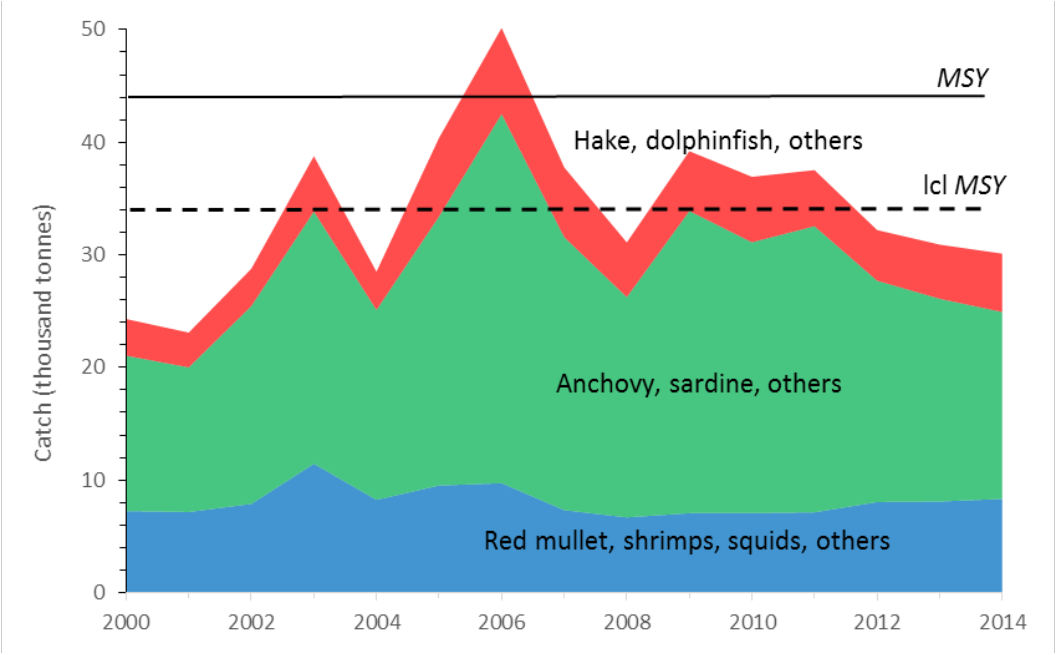



*Figure 28. Cumulative catches, including discards and recreational catch if available, for 19 stocks in Sardinia, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [Sardinia_Oct14_16.xlsx]*

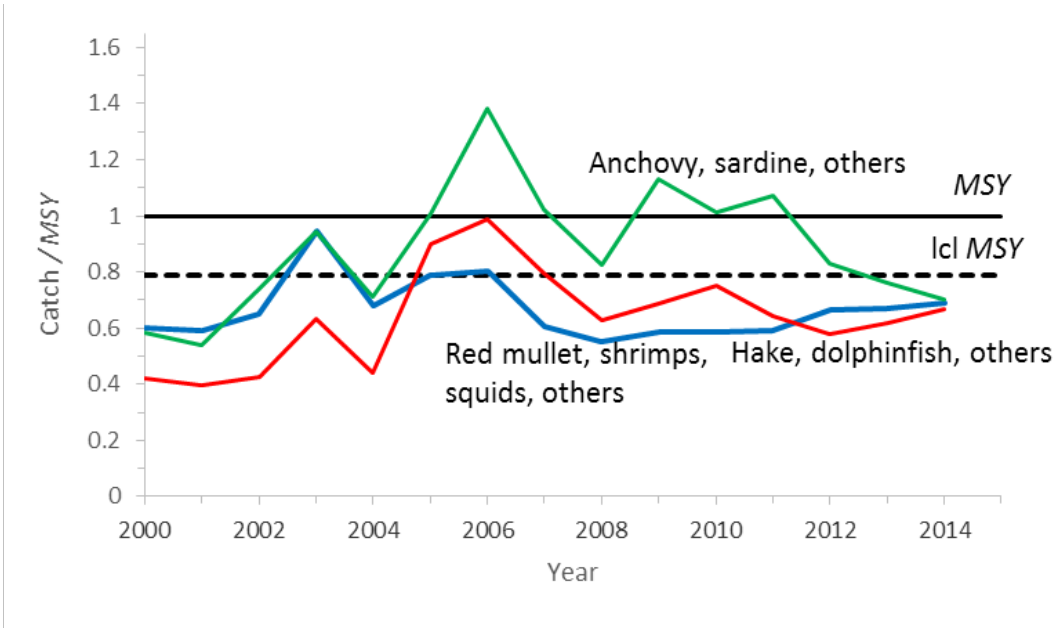



*Figure 79. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 19 stocks in Sardinia. Red mullet & shrimps (blue curve) were exploited unsustainably above MSY. Pelagic plankton feeders (green) and large predators (red) supported catches below the precautionary over all lower 95% confidence limit of MSY (dashed line). [Sardinia_Oct14_16.xlsx]*

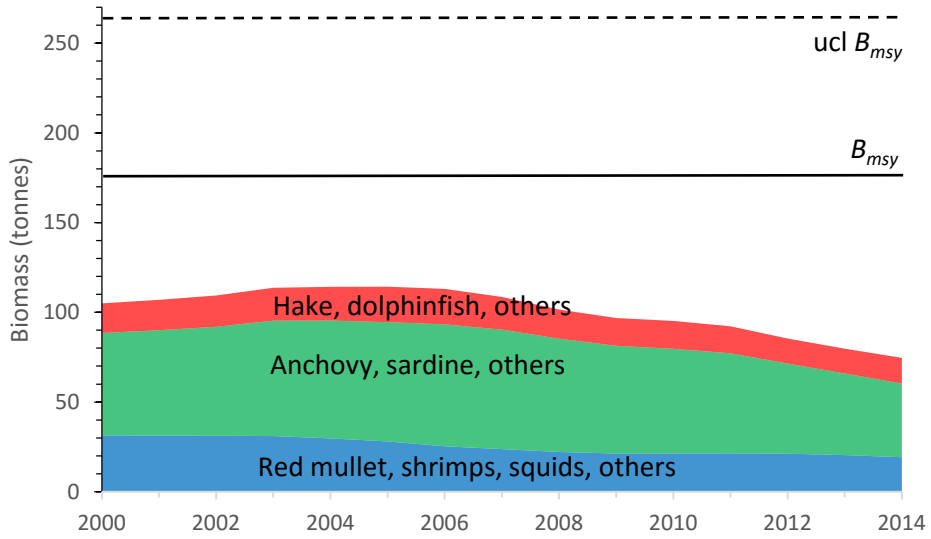



*Figure 80. Cumulative total biomass of 19 stocks in the Sardinia area relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of $B_{msy}$ (dashed line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. The functional groups of large predators (red), pelagic plankton feeders (green), and benthic organisms (blue) are indicated. All functional groups were far below the Bmsy level. [Sardinia_Oct14_16.xlsx]*

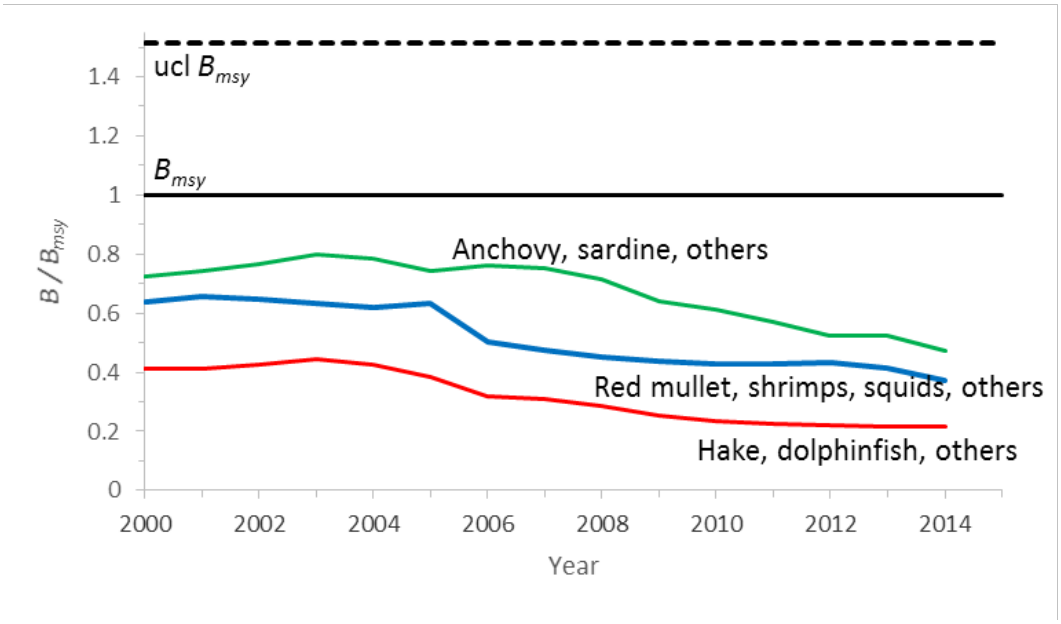



*Figure 81. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 19 stocks in Sardinia assigned to main functional groups. Pelagic plankton feeders (green), and benthic organisms (blue) have biomass levels well below $B_{msy}$. Large predators (red) are outside of safe biological limits. [Sardinia_Oct14_16.xlsx]*

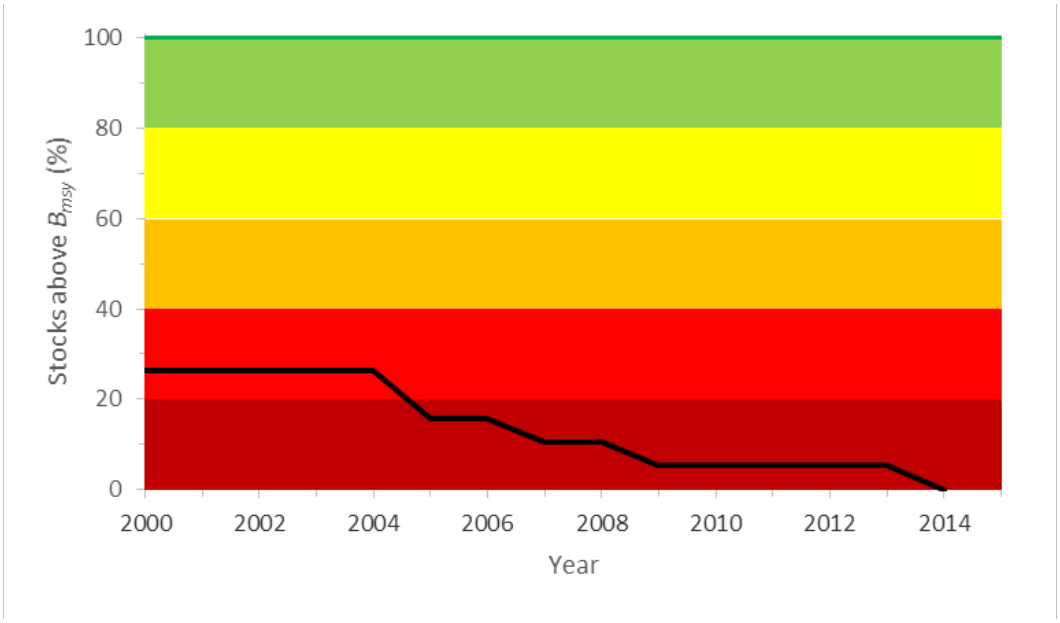



*Figure 82. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 19 stocks in the Sardinia ecoregion (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2014, no stocks fulfilled that requirement. [Sardinia_Oct14_16.xlsx]*

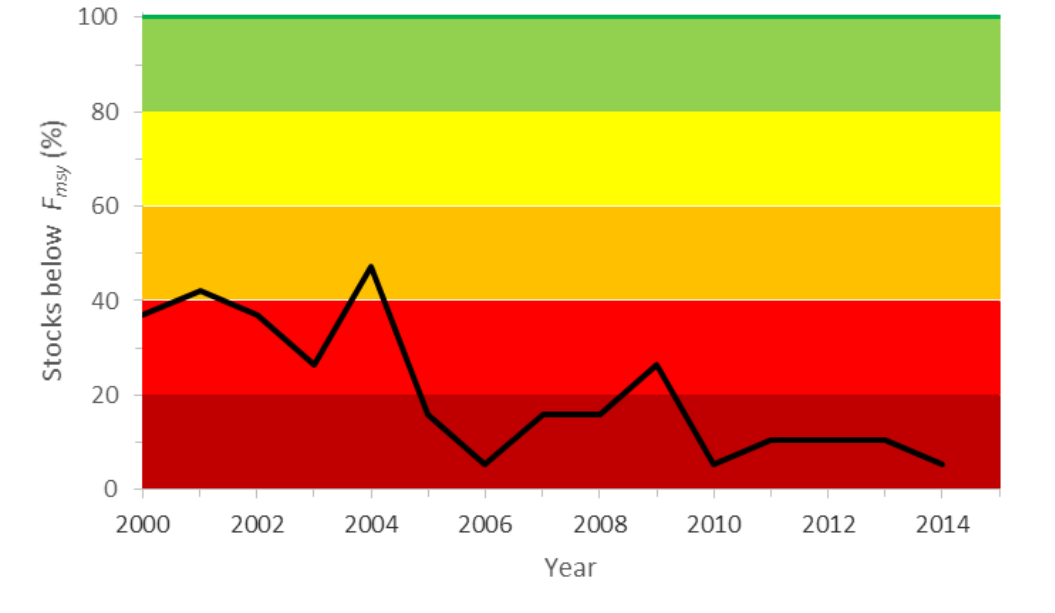



*Figure 33. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 19 stocks in the Sardinia ecoregion (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{msy}$ in 2015, latest in 2020. In 2014, only one stock (5%) fulfilled that requirement. [Sardinia_Oct14_16.xlsx]*

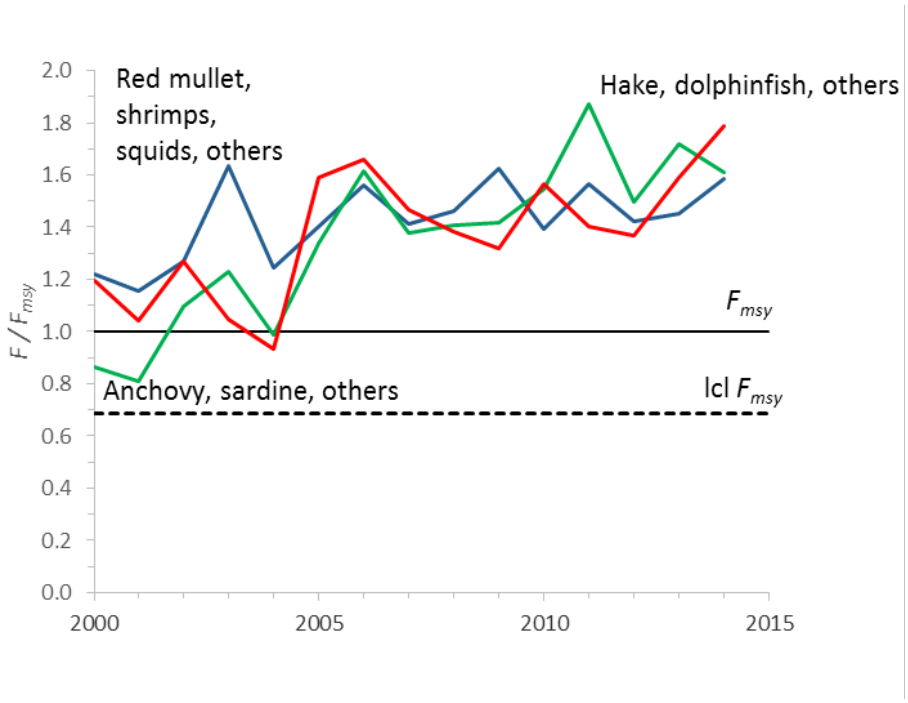



*Figure 84. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 19 stocks in Sardinia assigned to main functional groups. Nearly all stocks and all functional groups were exploited well above the maximum sustainable fishing pressure. [Sardinia_Oct14_16.xlsx]*

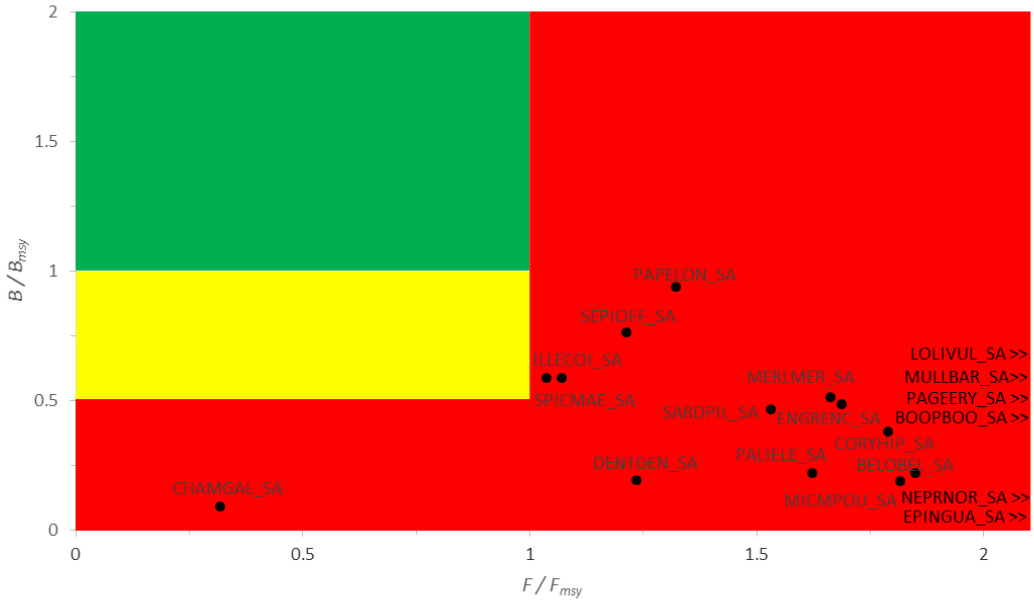



*Figure 85. Presentation of 19 Sardinia stocks in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Several stocks were strongly depleted (B < 0.5 Bmsy) and outside of the range for F/Fmsy in this chart. They are indicated with >> at the lower right corner. [Sardinia_Oct14_16.xlsx]*

**Adriatic Sea**

The following four paragraphs describing the Adriatic Sea (GSAs 17 & 18) were taken from the website www.fao.org and modified from http://www.indiseas.org.

"The waters of the Adriatic Sea north of a line running from the Albanian northern frontier on the east coast of the Adriatic Sea due west to Cape Gargano at 41°49'N latitude and 16°12'E longitude on the coast of Italy.

Three main water types have been identified in the Adriatic Sea: the Surface Water (SW), the Deep Water (DW) and the Modified Levantine Intermediate Waters (MLIW), and the general circulation is baroclinic. Owing to river runoff (mainly by the Po River located in the northwest) and the oceanographic conditions, the region exhibits a decreasing trend in nutrient concentration and production from north to south and from west to east. The substrate is characterized by muddy to sandy bottoms. The area has a mean depth of 75 m, with 30 m depth in the north, and its maximum depth is registered in the Pomo Pit as 280 m deep.

On the continental shelf from 10-50 m depth, the dominant fish species in terms of biomass are red mullet (*Mullus barbatus*), poor cod (*Trisopterus minutus*), various species of triglids, sole (*Solea solea*), various species of flatfishes, gobies and pandoras (*Pagellus* spp.). From 50 to 100 m deep, anglerfish (*Lophius* spp.), European hake (*Merluccius merluccius*), greater forkbeard (*Phycis blennoides*) and red bandfish (*Cepola macrophthalma*) are also abundant, as well as blue whiting (*Micromesistius poutassou*) at 100 to 200 m deep. In the pelagic domain, main fish species are sardine (*Sardina pilchardus*), anchovy (*Engraulis encrasicolus*), horse mackerel (*Trachurus* spp.) and mackerel (*Scomber* spp.). In the northern area, sprat (*Sprattus sprattus*) is found, although it was more abundant during the 1960s and 1970s than nowadays.

Several studies have highlighted the important relationship between environmental factors and primary and secondary production dynamics in the Mediterranean Sea and, especially in the north-central Adriatic Sea, such as wind mixing, river runoff, eutrophication and increase in water temperature. The wind mixing index has been positively related with recruitment of various demersal species most likely due to enhancement of fertilization and local planktonic production."

JRC-STEFC assessment reports and FAO-GFCM landings with data until 2013 or 2014 were analyzed for 30 stocks in the Adriatic Sea (GFCM subarea 2.1). The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 14. Detailed assessments for every stock are available in Appendix 2 and in the spreadsheet Adriatic_Oct14_16.xlsx.

Of the 30 stocks, 19 (63%) were subject to ongoing overfishing ($F > F_{msy}$) and 20 stocks (67%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). Catches exceeded the maximum sustainable yield ($C/MSY > 1$) in four stocks (13%). Fifteen stocks (50%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing or being severely depleted ($B < 0.2\ B_{msy}$). The scientific names of these stocks are marked red in Table 14. Altogether, 24 stocks (80%) were subject to unsustainable exploitation (catch > MSY or F > Fmsy or B < 0.2 Bmsy), with the too high catches marked red in Table 14. Only one stock (Purple dye murex, *Bolinus brandaris*, 3%) could be considered healthy, defined by not being subject to overfishing ($F < F_{msy}$ and Catch < *MSY*) and having a biomass above the one that can produce the maximum sustainable yield (marked green in Table 14).

Summed biomass of the 30 stocks of 412 thousand tonnes in 2013 was well below the biomass level of 769 thousand tonnes that can produce maximum sustainable yields. Summed catches of 141 thousand tonnes were below the summed maximum sustainable yield of 187 thousand tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above $B_{msy}$. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 14. Analysis of 30 stocks in the Adriatic Sea, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$), $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) or severe depletion (B < 0.2 Bmsy) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red) and pelagic plankton feeders (green). [Adriatic_Oct14_16.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Bolinus brandaris* | Boli_bra_AD | 2015 | 1,036 | 900 | 0.87 | 0.49 | 0.49 | 0.41 | 0.84 | 2,132 | 2,210 | 1.04 |
| *Chamelea gallina* | Cham_gal_AD | 2014 | 25,995 | 13,984 | 0.54 | 0.25 | 0.21 | 0.32 | **1.50** | 104,434 | 44,228 | **0.42** |
| *Conger conger* | Cong_con_AD | 2014 | 128 | 93 | 0.73 | 0.17 | 0.12 | 0.36 | **3.07** | 745 | 256 | **0.34** |
| *Dentex dentex* | Dent_den_AD | 2014 | 102 | 33 | 0.32 | 0.20 | 0.12 | 0.21 | **1.74** | 519 | 158 | **0.30** |
| *Homarus gammarus* | Hom_gam_AD | 2013 | 31 | 6 | 0.19 | 0.19 | 0.09 | 0.15 | **1.75** | 165 | 39 | **0.24** |
| *Illex coindettii* | Ille_coi_AD | 2013 | 3,201 | 688 | 0.22 | 0.30 | 0.19 | 0.20 | **1.05** | 10,538 | 3,375 | **0.32** |
| *Loligo vulgaris* | Loli_vul_AD | 2013 | 1,391 | 100 | 0.07 | 0.18 | 0.07 | 0.06 | 0.89 | 7,756 | 1,560 | **0.201** |
| *Lophius* spp. | Lophius_AD | 2013 | 377 | 250 | 0.66 | 0.21 | 0.21 | 0.20 | 0.93 | 1,786 | 1,279 | 0.72 |
| *Mullus barbatus* | Mull_bar_AD | 2013 | 3,953 | 3,373 | 0.85 | 0.25 | 0.25 | 0.42 | **1.68** | 15,921 | 8,074 | 0.51 |
| *Oblada melanura* | Obla_mel_AD | 2014 | 183 | 34 | 0.19 | 0.39 | 0.13 | 0.45 | **3.60** | 469 | 75 | **0.16** |
| *Pagellus erythrinus* | Page_ery_AD | 2013 | 359 | 79 | 0.22 | 0.18 | 0.09 | 0.16 | **1.76** | 1,951 | 488 | **0.25** |
| *Palinurus elephas* | Pali_ele_AD | 2014 | 48 | 10 | 0.21 | 0.11 | 0.08 | 0.06 | 0.79 | 424 | 154 | **0.36** |
| *Pecten jacobeus* | Pect_jac_AD | 2015 | 911 | 50 | 0.05 | 0.23 | 0.09 | 0.07 | 0.77 | 4,023 | 759 | **0.19** |
| *Penaeus kerathurus* | Pena_ker_AD | 2015 | 477 | 528 | **1.11** | 0.60 | 0.60 | 0.54 | 0.91 | 800 | 976 | 1.22 |
| *Scophthalmus maximus* | Pset_max_AD | 2013 | 7,487 | 8,134 | **1.09** | 0.23 | 0.23 | 0.21 | 0.93 | 32,880 | 38,371 | 1.17 |
| *Scophthalmus rhombus* | Scop_rho_AD | 2015 | 317 | 65 | 0.20 | 0.20 | 0.10 | 0.16 | **1.55** | 1,561 | 401 | **0.26** |
| *Sepia officinalis* | Sepi_off_AD | 2015 | 3,815 | 3,411 | 0.89 | 0.26 | 0.24 | 0.51 | **2.14** | 14,761 | 6,749 | **0.46** |
| *Solea solea* | Sole_sol_AD | 2015 | 1,740 | 2,151 | **1.24** | 0.31 | 0.31 | 0.63 | **2.06** | 5,651 | 3,391 | 0.60 |
| *Spondyliosoma cantharus* | Spod_can_AD | 2014 | 46 | 9 | 0.19 | 0.24 | 0.10 | 0.21 | **2.03** | 196 | 43 | **0.22** |
| *Squilla mantis* | Squi_man_AD | 2014 | 4,117 | 3,150 | 0.77 | 0.18 | 0.18 | 0.20 | **1.09** | 22,273 | 15,596 | 0.70 |
| *Trisopterus minutus* | Tris_min_AD | 2013 | 185 | 115 | 0.62 | 0.28 | 0.16 | 0.60 | **3.67** | 654 | 190 | **0.29** |

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Belone belone* | Belo_bel_AD | 2014 | 182 | 4 | 0.02 | 0.21 | 0.08 | 0.02 | 0.29 | 862 | 166 | **0.19** |
| *Merluccius merluccius* | Merl_mer_AD | 2013 | 20,962 | 9,542 | 0.46 | 0.24 | 0.11 | 0.46 | **4.05** | 88,311 | 20,930 | **0.24** |
| *Micromesistius poutassou* | Micr_pou_AD | 2013 | 939 | 132 | 0.14 | 0.21 | 0.15 | 0.08 | 0.55 | 4,461 | 1,588 | **0.36** |
| *Seriola dumerili* | Seri_dum_AD | 2014 | 55 | 93 | **1.70** | 0.36 | 0.36 | 0.45 | **1.27** | 153 | 205 | 1.34 |
| *Atherina boyeri* | Athe_boy_AD | 2014 | 2,764 | 348 | 0.13 | 0.16 | 0.12 | 0.06 | 0.45 | 16,860 | 6,284 | **0.37** |
| *Boops boops* | Boop_Boo_AD | 2014 | 1,600 | 103 | 0.06 | 0.22 | 0.06 | 0.11 | **1.80** | 7,122 | 953 | **0.13** |
| *Engraulis encrasicolus* | Engr_enc_AD | 2013 | 35,722 | 32,761 | 0.92 | 0.27 | 0.27 | 0.35 | **1.31** | 131,913 | 92,384 | 0.70 |
| *Sardina pilchardus* | Sard_pil_AD | 2013 | 66,605 | 59,814 | 0.90 | 0.24 | 0.24 | 0.38 | **1.58** | 275,041 | 156,175 | 0.57 |
| *Trachurus* spp. | Trachurus_AD | 2014 | 2,362 | 680 | 0.29 | 0.17 | 0.13 | 0.12 | 0.92 | 14,192 | 5,599 | **0.39** |

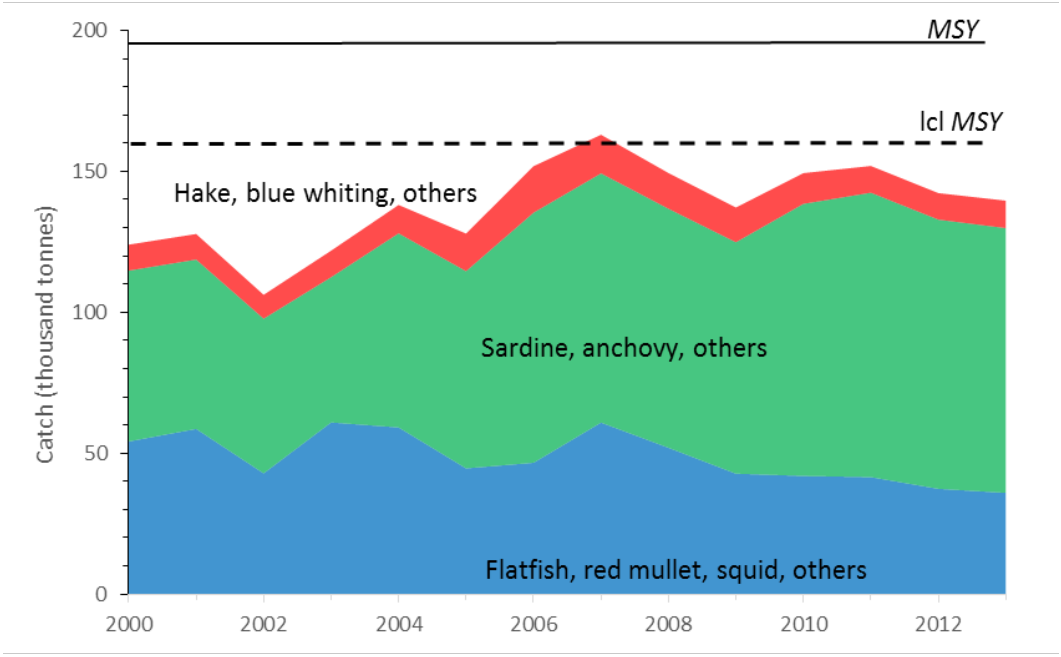



*Figure 86. Cumulative catches, including discards and recreational catch if available, for 30 stocks in the Adriatic Sea, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [Adriatic_Oct14_16.xlsx]*

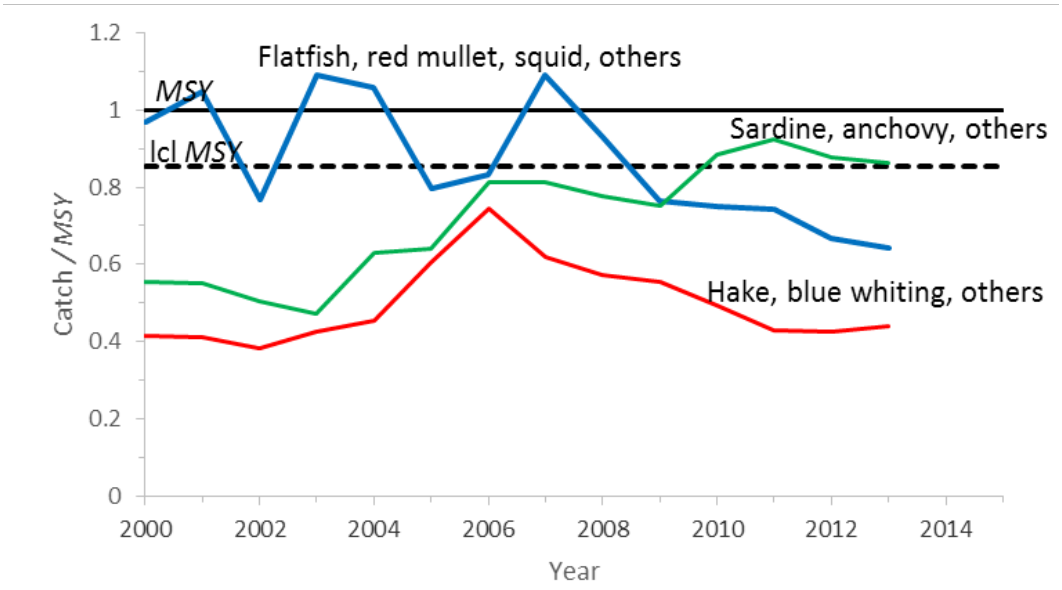



*Figure 87. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 30 stocks in the Adriatic Sea. Large predators (red) and benthic organisms (blue) supported catches below the precautionary over all lower 95% confidence limit of MSY (dashed line) and present declining trends. Pelagic plankton feeders (green line) supported catches near the precautionary level. [Adriatic_Oct14_16.xlsx]*

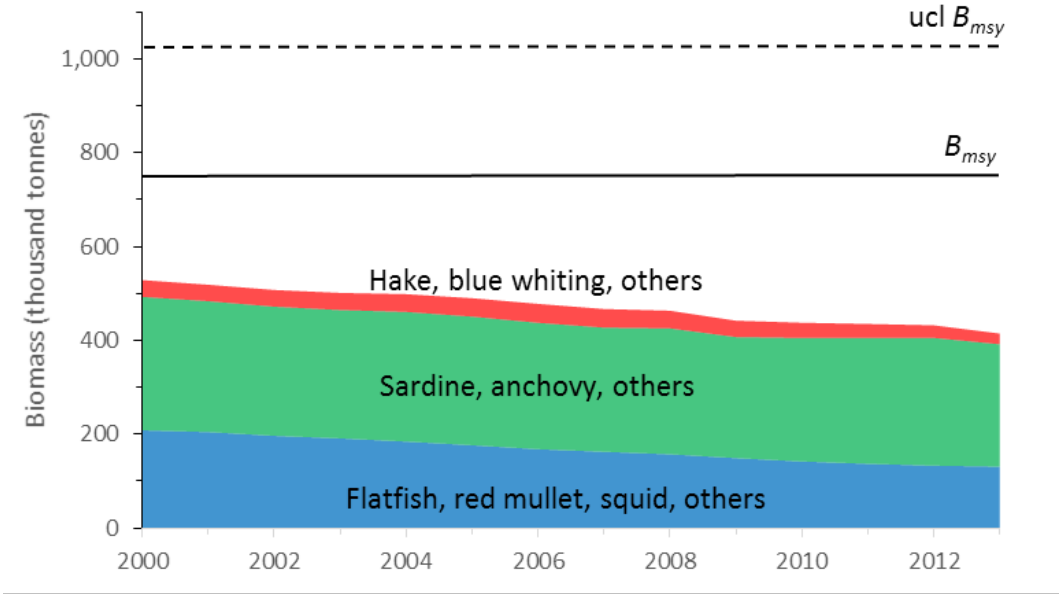



*Figure 88. Cumulative total biomass of 30 stocks in the Adriatic Sea relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of $B_{msy}$ (dashed green line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. The functional groups of large predators (red), pelagic plankton feeders (green), and benthic organisms (blue) are indicated. [Adriatic_Oct14_16.xlsx]*

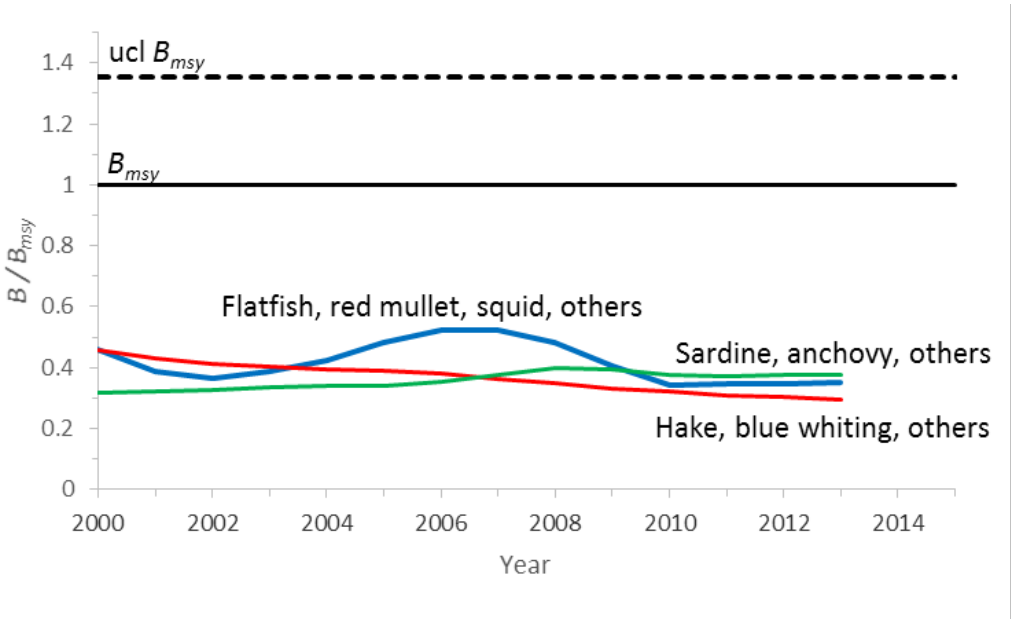



Figure 89. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 30 stocks in the Adriatic Sea assigned to main functional groups. Large predators (red), pelagic plankton feeders (green) and benthic organisms (blue) all have biomass levels well below Bmsy. *[Adriatic_Oct14_16.xlsx]*

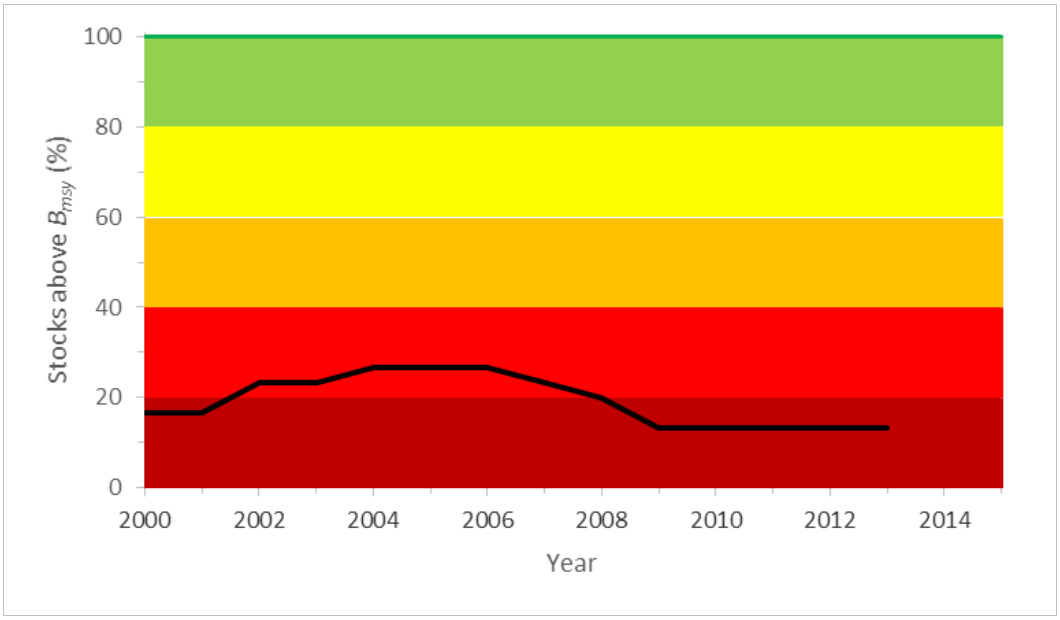



*Figure 90. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 30 stocks in the Adriatic Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2013, four stocks (13%) fulfilled that requirement. [Adriatic_Oct14_16.xlsx]*

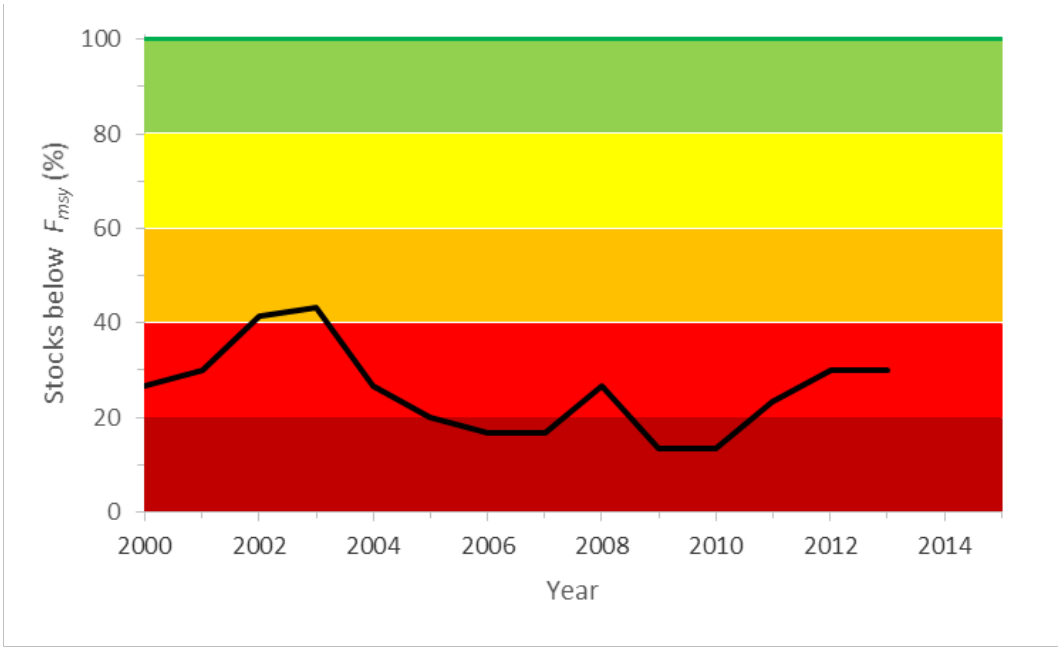



*Figure 91. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 30 stocks in the Adriatic Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{msy}$ in 2015, latest in 2020. In 2013, nine stocks (30%) fulfilled that requirement. [Adriatic_Oct14_16.xlsx]*

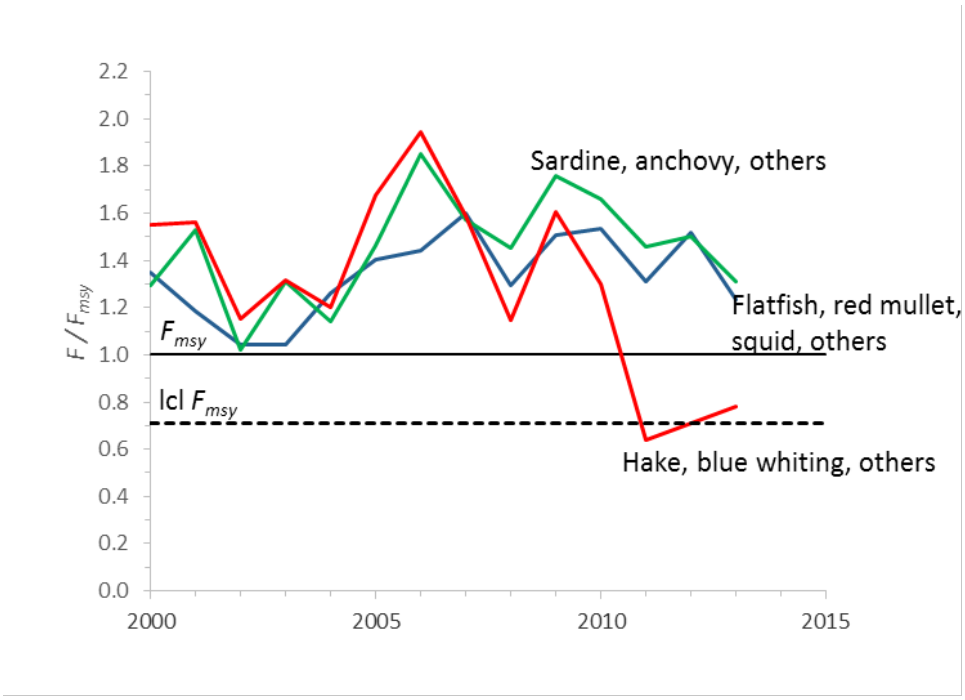



*Figure 42. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 30 stocks in the Adriatic Sea assigned to main functional groups. The decline in fishing pressure for large predators (red) after 2010 is cause by reduced pressure on blue whiting and masks the increased pressure on hake [Adriatic_Oct14_16.xlsx]*

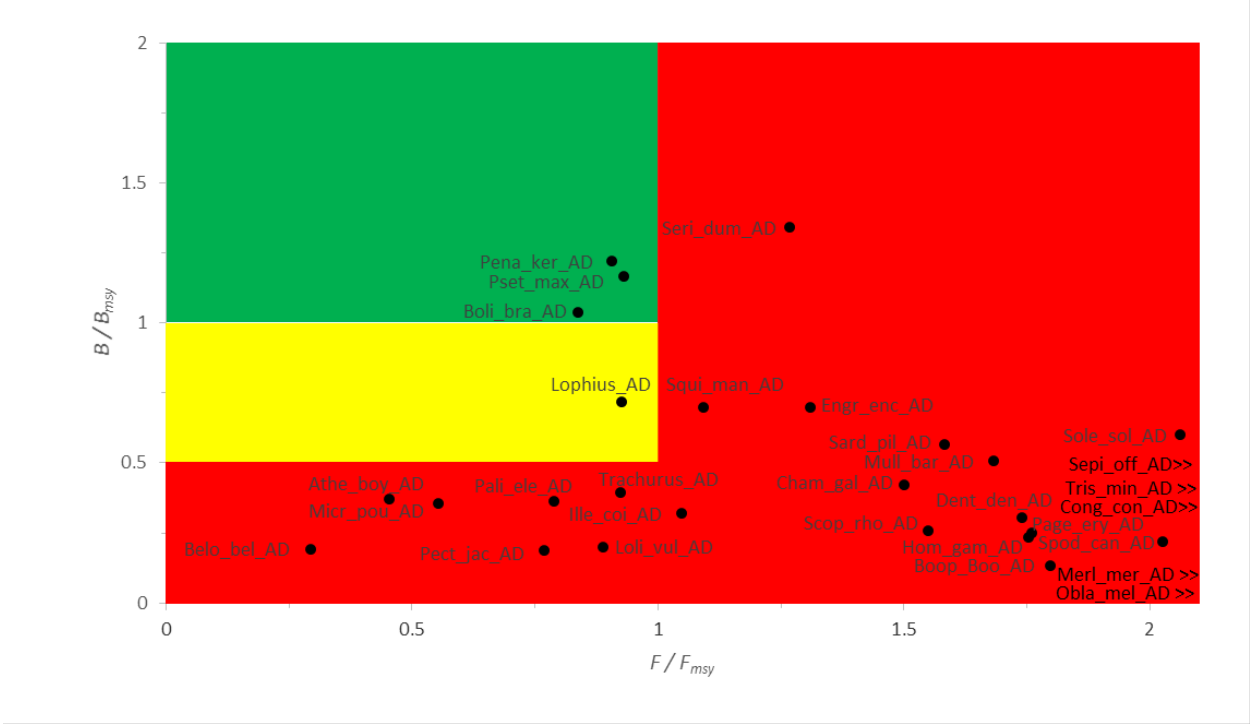



*Figure 93. Presentation of 30 Adriatic Sea stocks in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Several stocks were exploited above the range of this chart indicated by >> at the lower right corner. [Adriatic_Oct14_16.xlsx]*

**Ionian Sea**

The following four paragraphs describing the Ionian Sea (GSAs 19, 20) were taken from the website http://www.indiseas.org/ecosystems/ionian-sea-archipelago.

"The Inner Ionian Sea Archipelago is situated in the eastern Mediterranean Sea, on the Western part of Greece. The area covers approximately 1021 $km^2$ of sea surface and includes the islands of Meganisi, Kalamos and Kastos. The archipelago is delimited by the mainland of Greece, Lefkada Island and the northern tips of Kefalonia and Ithaca.

The Inner Ionian Sea Archipelago is extremely oligotrophic with values of Chlorophyll a, nutrients and particulate organic carbon among the lowest found in Mediterranean coastal waters. Most of the area is relatively shallow, ranging in depth between 100 and 200 m. The bottom is covered by seagrass meadows at depth between 1 and 30m. Such benthic macrophytes, despite being an important nursery ground for fish populations, in the last decades have suffered a tremendous decline in the area due to fishing operations (mainly by purse seiners, trawlers and beach seiners).

The European sardine (*Sardina pilcardus*) and anchovy (*Engraulis encrasicolus*) are the most important pelagic fish, in terms of biomass in the area, representing approximately 26% of the total Inner Ionian Sea Archipelago catch. Bogue (*Boops boops*), hake (*Merluccius merluccius*) and striped red mullet (*Mullus surmuletus*) dominate the demersal fish compartment. The area is an important spawning ground for European pilchard and hake.

An ecosystem model was built for the Inner Ionian Sea Archipelago to assess temporal changes (1964-2008) in abundance of the major marine organisms. Results of this study highlighted a clear decline of top predators and commercially important species (mainly European anchovy and European pilchard) due to overfishing and changes in ocean productivity."

JRC-STEFC assessment reports and FAO-GFCM landings with data until 2014 were analyzed for 31 stocks in the Ionian Sea (part of the GFCM subarea 2.2). The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 15. Detailed assessments for every stock are available in Appendix 2 and in the spreadsheet Ionian_Oct13_16.xlsx.

Of the 31 stocks, 26 (84%) were subject to ongoing overfishing ($F > F_{msy}$) and 19 stocks (61%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). In 7 stocks (23%) catches exceeded the maximum sustainable yield ($C/MSY > 1$). Seventeen stocks (55%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing or being severely depleted ($B < 0.2\ B_{msy}$). The scientific names of these stocks are marked red in Table 15. Altogether, 26 stocks (84%) were subject to unsustainable exploitation (catch > MSY or F > Fmsy or B < 0.2 Bmsy), with the too high catches marked red in Table 15. In contrast, no stock could be considered healthy, defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 31 stocks of 136 thousand tonnes in 2014 was well below the biomass level of 361 thousand tonnes that can produce maximum yields. Summed catches of 46 thousand tonnes were far below (46%) the summed maximum sustainable yield of 99 thousand tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near

the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above $B_{msy}$. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 15. Analysis of 31 stocks in the Ionian Sea, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$), $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) or severe depletion (B < 0.2 Bmsy) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red), and pelagic plankton feeders (green). [Ionian_Oct13_16.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Aristeomorpha foliacea* | ARISFOL_IS | 2014 | 1,927 | 2,057 | **1.07** | 0.31 | 0.31 | 0.52 | **1.67** | 6,179 | 3,943 | 0.64 |
| *Conger conger* | CONGCON_IS | 2014 | 378 | 330 | 0.87 | 0.18 | 0.18 | 0.25 | **1.43** | 2,137 | 1,304 | 0.61 |
| *Dentex dentex* | DENTDEN_IS | 2014 | 1,742 | 813 | 0.47 | 0.22 | 0.19 | 0.23 | **1.22** | 7,952 | 3,477 | **0.44** |
| *Eledone cirrosa* | ELEDCIR_IS | 2014 | 1,148 | 1,934 | **1.68** | 0.12 | 0.10 | 0.46 | **4.47** | 9,742 | 4,229 | **0.43** |
| *Illex coindetii* | ILLECOI_IS | 2014 | 2,274 | 791 | 0.35 | 0.22 | 0.22 | 0.13 | 0.60 | 10,512 | 6,056 | 0.58 |
| *Mullus barbatus* | MULLBAR_IS | 2014 | 4,641 | 1,200 | 0.26 | 0.26 | 0.10 | 0.35 | **3.48** | 17,543 | 3,382 | **0.19** |
| *Mullus surmuletus* | MULLSUR_IS | 2014 | 276 | 71 | 0.26 | 0.44 | 0.24 | 0.41 | **1.72** | 632 | 173 | **0.27** |
| *Nephrops norvegicus* | NEPRNOR_IS | 2014 | 2,079 | 780 | 0.38 | 0.22 | 0.13 | 0.27 | **2.11** | 9,649 | 2,876 | **0.30** |
| *Octopus vulgaris* | OCTOVUL_IS | 2014 | 5,230 | 980 | 0.19 | 0.36 | 0.20 | 0.24 | **1.21** | 14,673 | 4,087 | **0.28** |
| *Pagrus pagrus* | PAGRPAG_IS | 2014 | 258 | 277 | **1.07** | 0.32 | 0.32 | 0.59 | **1.83** | 803 | 472 | 0.59 |
| *Palinurus elephas* | PALIELE_IS | 2014 | 333 | 79 | 0.24 | 0.11 | 0.05 | 0.10 | **2.02** | 3,137 | 761 | **0.24** |
| *Parapeneaus longirostris* | PARELON_IS | 2014 | 10,825 | 6,550 | 0.61 | 0.47 | 0.47 | 0.43 | 0.91 | 22,945 | 15,198 | 0.66 |
| *Penaeus kerathurus* | PENAKER_IS | 2014 | 202 | 767 | **3.80** | 0.19 | 0.19 | 1.17 | **6.06** | 1,045 | 655 | 0.63 |
| *Scophthalmus maximus* | PSETMAX_IS | 2013 | 409 | 161 | 0.39 | 0.19 | 0.11 | 0.27 | **2.57** | 2,125 | 588 | **0.28** |
| *Sepia officinalis* | SEPIOFF_IS | 2014 | 5,870 | 6,410 | **1.09** | 0.28 | 0.28 | 0.40 | **1.43** | 20,760 | 15,834 | 0.76 |
| *Solea solea* | SOLEVUL_IS | 2014 | 2,994 | 191 | 0.06 | 0.23 | 0.06 | 0.11 | **1.88** | 13,128 | 1,712 | **0.13** |
| *Squilla mantis* | SQUIMAN_IS | 2014 | 880 | 1,230 | **1.40** | 0.18 | 0.18 | 0.49 | **2.72** | 4,917 | 2,523 | 0.51 |
| *Umbrina cirrosa* | UMBRCIR_IS | 2013 | 1,181 | 1,172 | 0.99 | 0.50 | 0.50 | 0.68 | **1.35** | 2,345 | 1,719 | 0.73 |
| *Belone belone* | BELOBEL_IS | 2014 | 291 | 165 | 0.57 | 0.28 | 0.28 | 0.28 | **1.001** | 1,048 | 593 | 0.57 |
| *Coryphaena hippurus* | CORYHIP_IS | 2014 | 2,118 | 877 | 0.41 | 0.55 | 0.36 | 0.69 | **1.95** | 3,872 | 1,263 | **0.33** |
| *Dicentrarchus labrax* | DICELAB_IS | 2014 | 630 | 91 | 0.14 | 0.26 | 0.09 | 0.22 | **2.57** | 2,436 | 409 | **0.17** |

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Epinephelus marginatus* | EPINGUA_IS | 2014 | 1,770 | 44 | 0.02 | 0.18 | 0.03 | 0.06 | **1.88** | 9,718 | 791 | **0.08** |
| *Merluccius merluccius* | MERLMER_IS | 2014 | 16,888 | 4,882 | 0.29 | 0.22 | 0.09 | 0.30 | **3.24** | 76,686 | 16,186 | **0.21** |
| *Micromesistius poutassou* | MICRPOU_IS | 2014 | 749 | 51 | 0.07 | 0.20 | 0.09 | 0.06 | 0.64 | 3,824 | 882 | **0.23** |
| *Atherina boyeri* | ATHEBOY_IS | 2014 | 391 | 85 | 0.22 | 0.28 | 0.18 | 0.19 | **1.03** | 1,372 | 445 | **0.32** |
| *Boops boops* | BOOPBOO_IS | 2014 | 4,520 | 1,312 | 0.29 | 0.29 | 0.25 | 0.21 | 0.84 | 15,327 | 6,383 | **0.42** |
| *Engraulis encrasicolus* | ENGRENC_IS | 2014 | 12,898 | 6,087 | 0.47 | 0.33 | 0.33 | 0.30 | 0.92 | 39,180 | 20,183 | 0.52 |
| *Sardina pilchardus* | SARDPIL_IS | 2014 | 12,013 | 5,160 | 0.43 | 0.29 | 0.21 | 0.34 | **1.62** | 42,041 | 15,331 | **0.36** |
| *Scomber colias* | SCOMPNE_IS | 2014 | 794 | 935 | **1.18** | 0.39 | 0.39 | 0.88 | **2.27** | 2,043 | 1,062 | 0.52 |
| *Scomber scombrus* | SCOMSCO_IS | 2014 | 3,222 | 489 | 0.15 | 0.26 | 0.13 | 0.17 | **1.31** | 12,284 | 2,961 | **0.24** |
| *Trachurus mediterraneus* | TRACHMED_IS | 2014 | 487 | 179 | 0.37 | 0.50 | 0.38 | 0.49 | **1.27** | 968 | 368 | **0.38** |

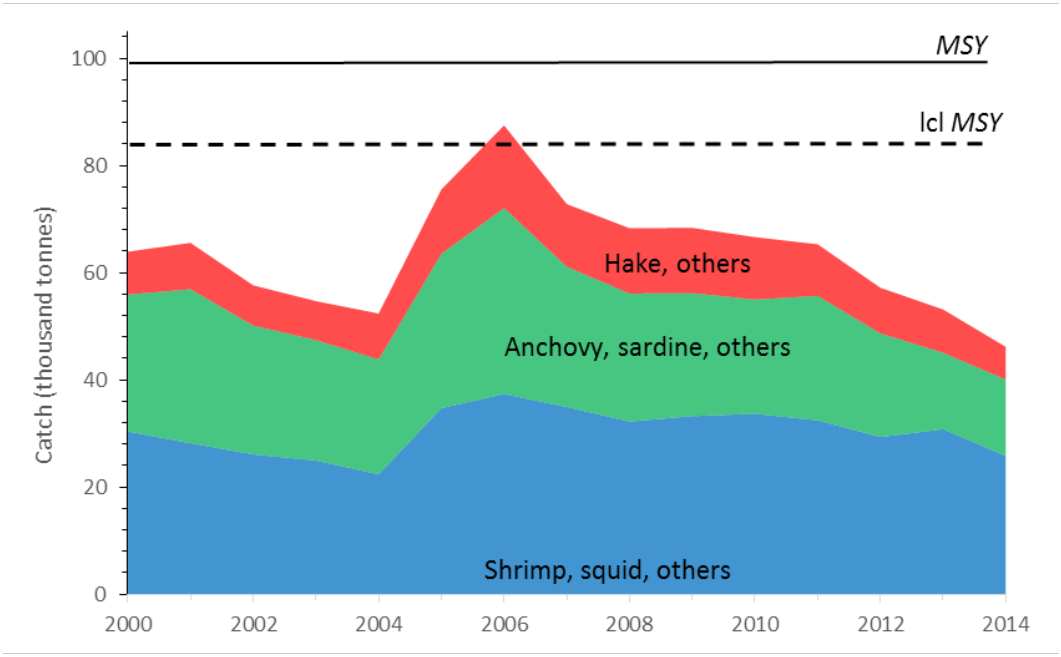



*Figure 94. Cumulative catches, including discards and recreational catch if available, for 31 stocks in the Ionian Sea, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [Ionian_Oct13_16.xlsx]*

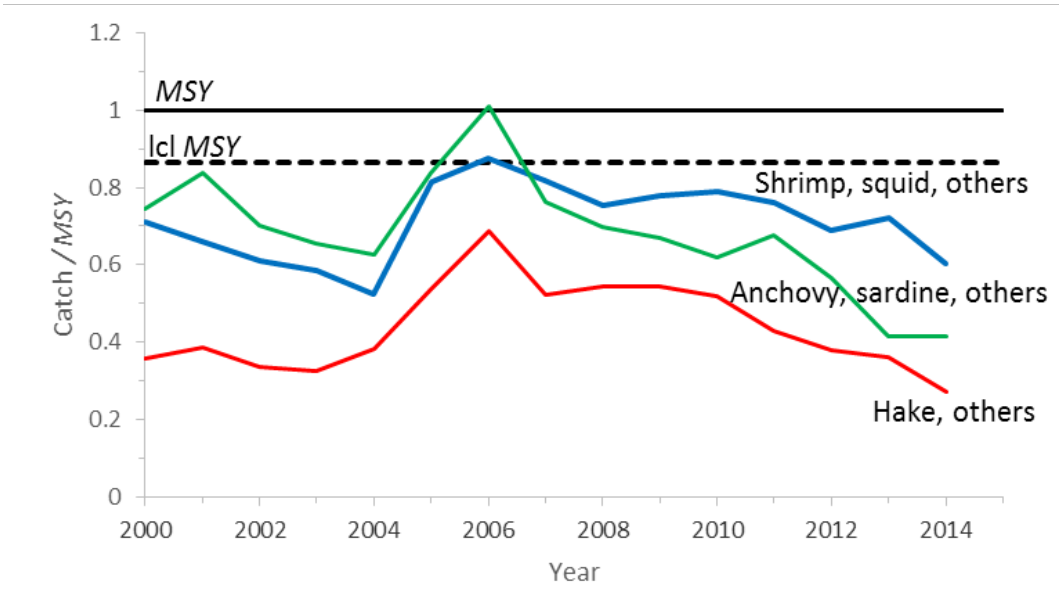



*Figure 95. Catches by main functional group relative to their maximum sustainable yield (MSY, black), for 31 stocks in the Ionian Sea. Pelagic plankton feeders (green), benthic organisms (blue), and large predators (red) have all supported catches well below MSY, with a declining trend since 2010. [Ionian_Oct13_16.xlsx]*

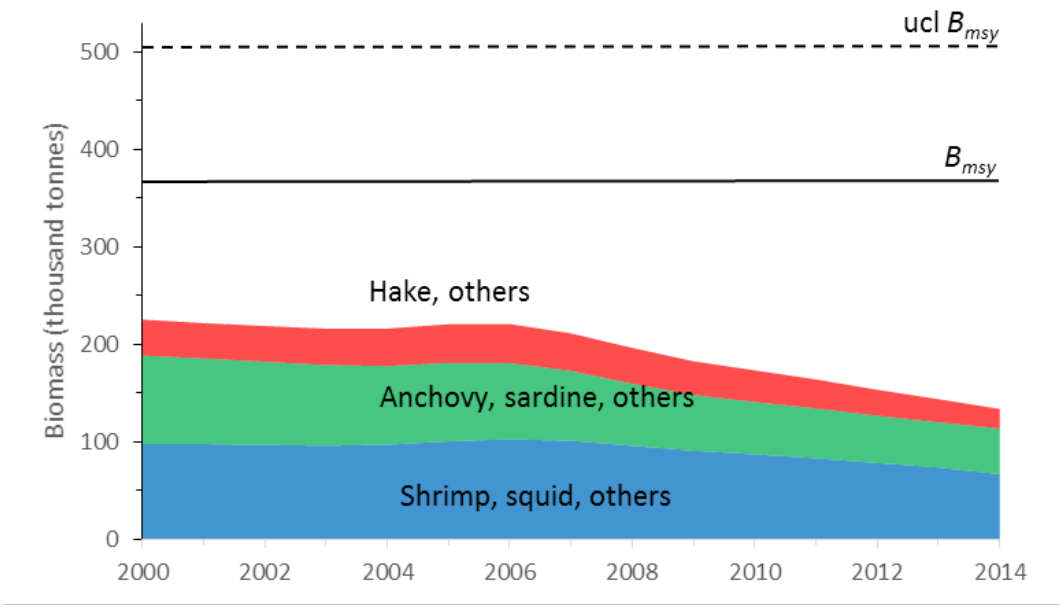



*Figure 96. Cumulative total biomass of 31 stocks in the Ionian Sea relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of $B_{msy}$ (dashed line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. The low biomass is the reason for the low catches relative to MSY. [Ionian_Oct13_16.xlsx]*

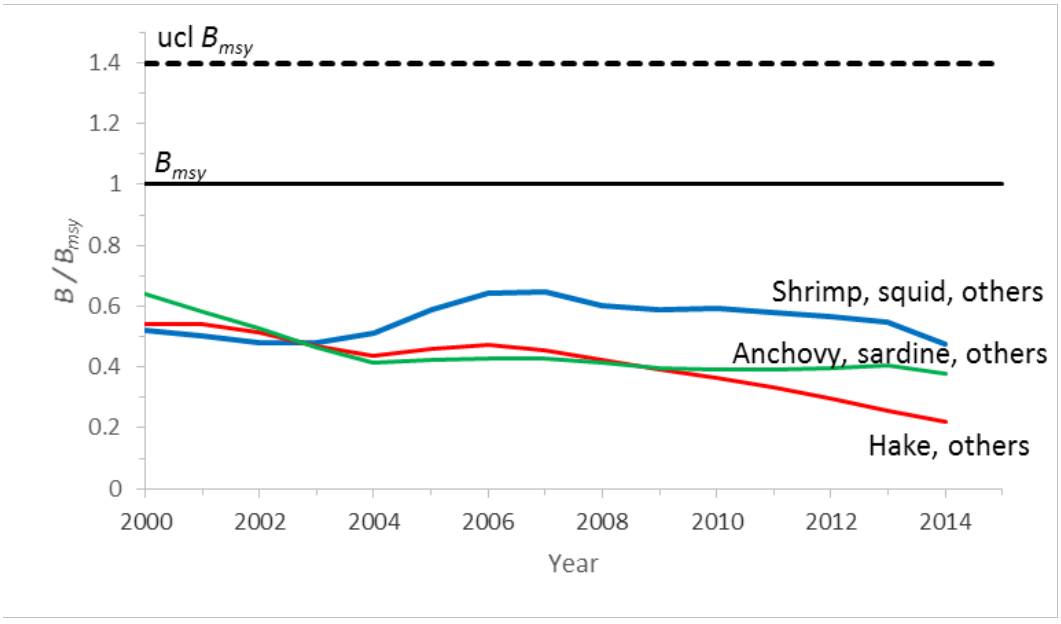



*Figure 97. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 31 stocks in the Ionian Sea assigned to main functional groups. Pelagic plankton feeders (green) and benthic organisms (blue) have biomass levels well below $B_{msy}$. Large predators (red) are severely depleted and in danger of reduced recruitment. [Ionian_Oct13_16.xlsx]*

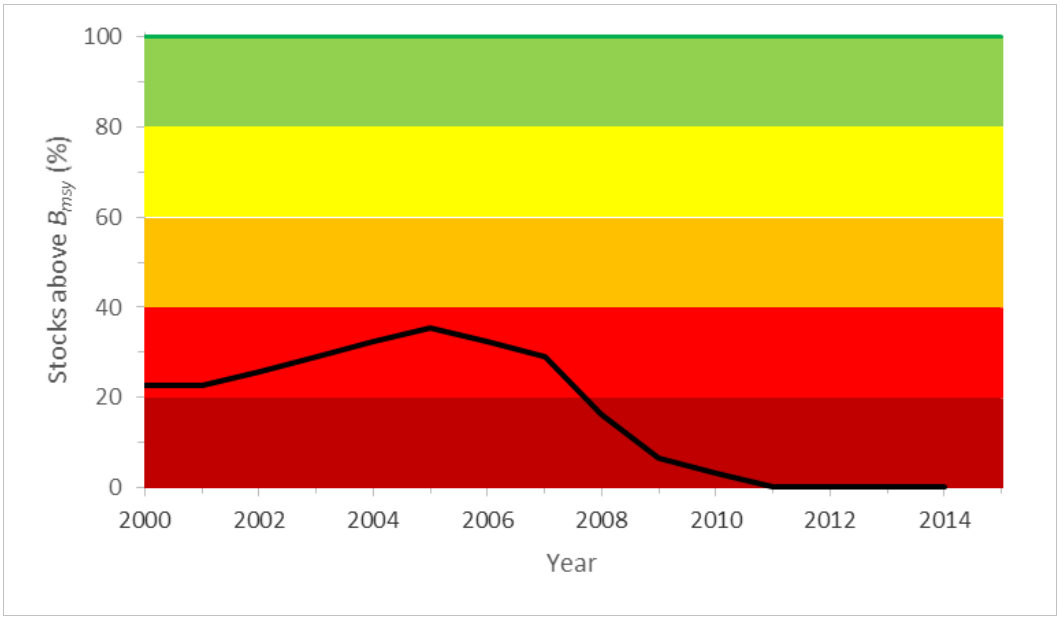



*Figure 98. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 31 stocks in the Ionian Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2014, no stocks fulfilled that requirement. [Ionian_Oct13_16.xlsx]*

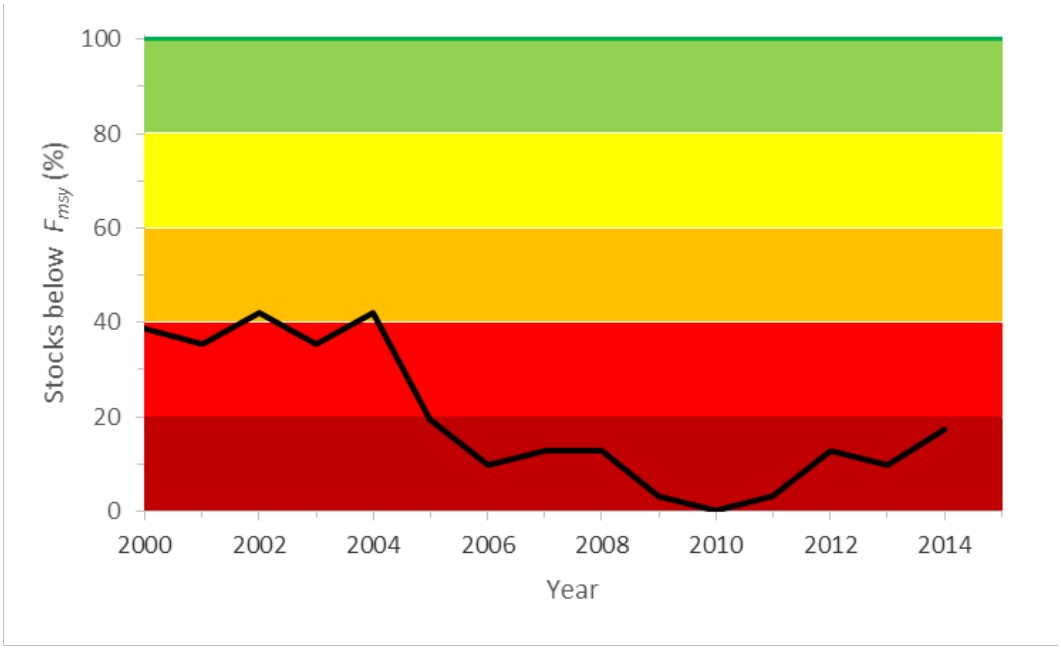



*Figure 99. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 31 stocks in the Ionian Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{msy}$ in 2015, latest in 2020. In 2014, five stocks (17%) fulfilled that requirement. [Ionian_Oct13_16.xlsx]*

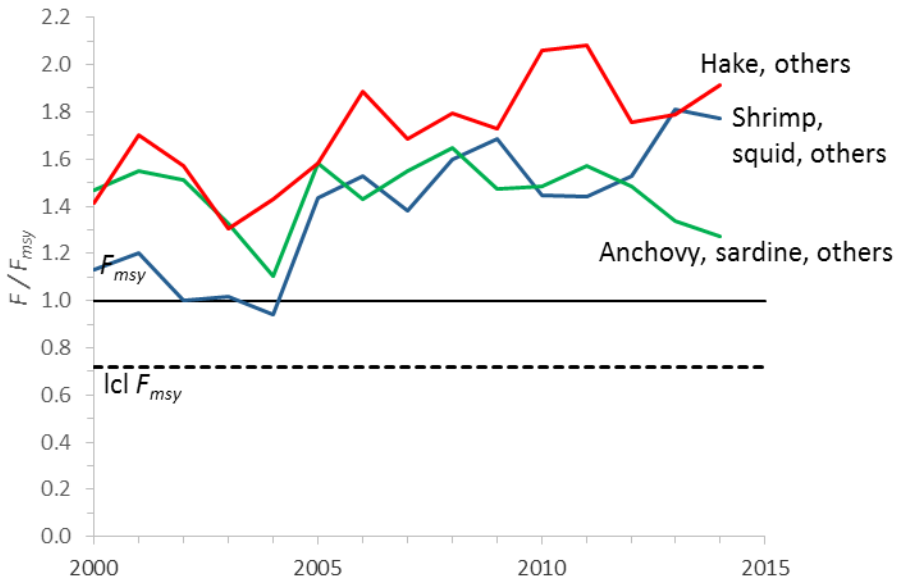



*Figure 100. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 31 stocks in the Ionian Sea assigned to main functional groups. All groups were exploited far above the maximum sustainable level (black line indicating $F_{msy}$). [Ionian_Oct13_16.xlsx]*

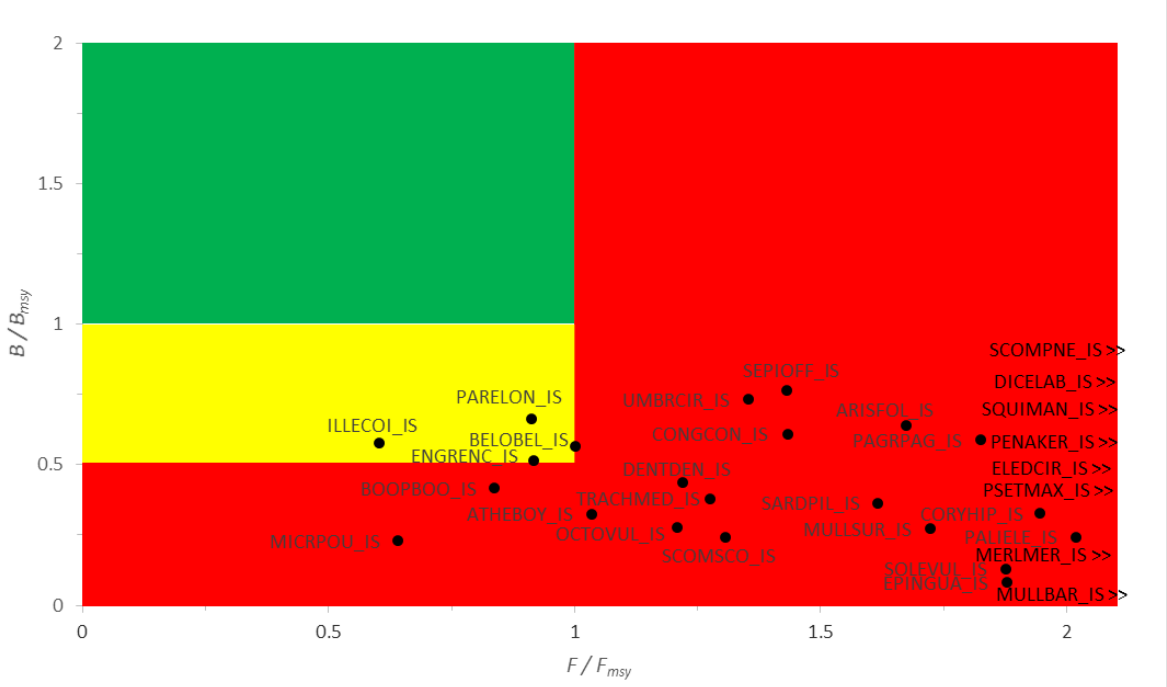



*Figure 101. Presentation of 31 Ionian Sea stocks in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Several stocks were exploited above the range of this chart, indicated by >> along the right margin. [Ionian_Oct13_16.xlsx]*

**Aegean Sea**

The following three paragraphs describing the Aegean Sea (GSA 22) were taken from the website http://www.indiseas.org/ecosystems/north-aegean-sea.

"The Aegean Sea is an oligotrophic region in the Eastern Mediterranean Sea. Despite the fact that the Aegean Sea is an oligotrophic region, it is among the most productive areas in the Eastern Mediterranean. This is due to (a) the influence of nutrient rich, low saline, Black Sea Water occupying the surface water layers, (b) river flows that locally enhance the productivity of the coastal zone, and (c) the extended continental shelf. Wide *Posidonia oceanica* meadows extend up to a maximum depth of 25 m while other macrophytes are also found at slightly deeper bottoms. Sand (approximately with 40-90% content) and mud (approximately with 10-60% content) dominate the surface sediments in the area.

In the oligotrophic environment of this area, the phytoplankton is dominated by small sized cells belonging to the pico- and nano- fractions, which are grazed by ciliates. Anchovy are the most abundant fish species. Several parts of the North Aegean Sea have been identified as important habitats, such as spawning and nursery grounds, for small pelagic and demersal fish.

The relatively high productivity of the area is reflected in its high fisheries catch. The fishing activity is dynamic and intense in the North Aegean Sea. Small pelagic fish (anchovy *Engraulis encrasicolus* and sardine *Sardina pilchardus*) dominate the landings of the area and are mainly caught by purse seiners. Several stocks are considered fully exploited, while the probability of the ecosystem being sustainably fished is low. Total catch has been relatively constant over the recent years."

JRC-STEFC assessment reports and FAO-GFCM landings with data until 2014 were analyzed for 42 stocks in the Aegean Sea (GFCM subarea 3.1). The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 16. Detailed assessments for every stock are available in Appendix 2 and in the spreadsheet AegeanSea_Oct04_16.xlsx.

Of the 42 stocks, 37 (88%) were subject to ongoing overfishing ($F > F_{msy}$) and 23 stocks (55%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). In two stocks (5%) catches exceeded the maximum sustainable yield ($C/MSY > 1$). Twenty-two stocks (52%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing or being severely depleted ($B < 0.2\ B_{msy}$). The scientific names of these stocks are marked red in Table 16. Altogether, 37 stocks (88%) were subject to unsustainable exploitation (catch > *MSY* or $F > Fmsy$ or $B < 0.2\ Bmsy$), with the too high catches marked red in Table 16. No stocks could be considered healthy, defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 42 stocks of 192 thousand tonnes in 2014 was well below the biomass level of 384 tonnes that can produce maximum yields. Summed catches of 70 thousand tonnes were below the summed maximum sustainable yield of 112 tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above *Bmsy*. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

Table 16. Analysis of 42 stocks in the Aegean Sea, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$), $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches ($F > F_{msy}$ or catch > *MSY* or $B < 0.2\ B_{msy}$) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. *Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red) and pelagic plankton feeders (green). [AegeanSea_Oct04_16.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Dentex dentex* | DENTDEN_AL | 2014 | 233 | 123 | 0.53 | 0.15 | 0.14 | 0.16 | **1.18** | 1,608 | 758 | **0.47** |
| *Dentex macrophthalmus* | DENTMAC_AL | 2014 | 422 | 385 | 0.91 | 0.49 | 0.49 | 0.53 | **1.08** | 862 | 725 | 0.84 |
| *Diplodus annularis* | DIPLANN_AL | 2014 | 338 | 112 | 0.33 | 0.20 | 0.13 | 0.20 | **1.47** | 1,680 | 564 | **0.34** |
| *Diplodus sargus* | DIPLSAR_AL | 2014 | 366 | 136 | 0.37 | 0.27 | 0.15 | 0.37 | **2.51** | 1,368 | 372 | **0.27** |
| *Eledone moschata* | ELEDMOS_AL | 2014 | 661 | 430 | 0.65 | 0.27 | 0.27 | 0.23 | 0.86 | 2,461 | 1,852 | 0.75 |
| *Illex coindetii* | ILLECOI_AL | 2014 | 966 | 1,015 | **1.05** | 0.28 | 0.28 | 0.36 | **1.27** | 3,417 | 2,827 | 0.83 |
| *Loligo vulgaris* | LOLIVUL_AL | 2014 | 607 | 494 | 0.81 | 0.23 | 0.23 | 0.30 | **1.29** | 2,649 | 1,665 | 0.63 |
| *Lophius budegassa* | LOPHBUD_AL | 2014 | 826 | 557 | 0.67 | 0.21 | 0.21 | 0.29 | **1.39** | 3,942 | 1,938 | **0.49** |
| *Mullus barbatus* | MULLBAR_AL | 2014 | 3,199 | 1,920 | 0.60 | 0.26 | 0.21 | 0.40 | **1.97** | 12,159 | 4,747 | **0.39** |
| *Mullus surmuletus* | MULLSUR_AL | 2014 | 2,092 | 1,474 | 0.70 | 0.34 | 0.30 | 0.53 | **1.75** | 6,212 | 2,787 | **0.45** |
| *Nephrops norvegicus* | NEPRNOR_AL | 2014 | 798 | 228 | 0.29 | 0.19 | 0.07 | 0.29 | **4.01** | 4,127 | 778 | **0.19** |
| *Octopus vulgaris* | OCTOVUL_AL | 2014 | 3,420 | 1,992 | 0.58 | 0.35 | 0.35 | 0.40 | **1.15** | 9,731 | 4,939 | 0.51 |
| *Pagellus erythrinus* | PAGEERY_AL | 2014 | 648 | 421 | 0.65 | 0.23 | 0.23 | 0.24 | **1.06** | 2,808 | 1,727 | 0.62 |
| *Pagrus pagrus* | PAGRPAG_AL | 2014 | 783 | 630 | 0.80 | 0.26 | 0.26 | 0.34 | **1.30** | 3,031 | 1,869 | 0.62 |
| *Palinurus elephas* | PALIELE_AL | 2014 | 122 | 116 | 0.95 | 0.14 | 0.14 | 0.17 | **1.23** | 880 | 678 | 0.77 |
| *Parapeneaus longirostris* | PARELON_AL | 2014 | 1,145 | 749 | 0.65 | 0.50 | 0.35 | 0.93 | **2.62** | 2,289 | 808 | **0.35** |
| *Penaeus kerathurus* | PENAKER_AL | 2014 | 1,939 | 1,450 | 0.75 | 0.28 | 0.28 | 0.29 | **1.03** | 6,857 | 4,980 | 0.73 |
| *Scophthalmus maximus* | PSETMAX_AL | 2014 | 93 | 82 | 0.88 | 0.25 | 0.25 | 0.36 | **1.45** | 373 | 228 | 0.61 |
| *Raja clavata* | RAJACLA_AL | 2014 | 654 | 368 | 0.56 | 0.13 | 0.13 | 0.13 | 0.99 | 4,980 | 2,843 | 0.57 |
| *Sarpa salpa* | SARPSAL_AL | 2014 | 458 | 180 | 0.39 | 0.37 | 0.22 | 0.48 | **2.15** | 1,245 | 376 | **0.30** |
| *Sepia officinalis* | SEPIOFF_AL | 2014 | 1,749 | 1,031 | 0.59 | 0.28 | 0.28 | 0.27 | 0.94 | 6,200 | 3,872 | 0.62 |

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Solea solea* | SOLEVUL_AL | 2014 | 1,279 | 420 | 0.33 | 0.25 | 0.13 | 0.31 | **2.32** | 5,151 | 1,369 | **0.27** |
| *Spondyliosoma cantharus* | SPODCAN_AL | 2014 | 294 | 80 | 0.27 | 0.26 | 0.12 | 0.31 | **2.59** | 1,136 | 260 | **0.23** |
| *Squalus acanthias* | SQUAACA_AL | 2014 | 135 | 103 | 0.76 | 0.13 | 0.13 | 0.18 | **1.38** | 1,050 | 577 | 0.55 |
| *Umbrina cirrosa* | UMBRCIR_AL | 2014 | 43 | 14 | 0.32 | 0.48 | 0.25 | 0.61 | **2.46** | 90 | 23 | **0.26** |
| *Belone belone* | BELOBEL_AL | 2014 | 259 | 57 | 0.22 | 0.24 | 0.11 | 0.23 | **2.19** | 1,102 | 247 | **0.22** |
| *Dicentrarchus labrax* | DICELAB_AL | 2014 | 470 | 221 | 0.47 | 0.29 | 0.16 | 0.49 | **3.06** | 1,612 | 447 | **0.28** |
| *Epinephelus marginatus* | EPINGUA_AL | 2014 | 82 | 49 | 0.60 | 0.17 | 0.11 | 0.31 | **2.73** | 479 | 158 | **0.33** |
| *Merluccius merluccius* | MERLMER_AL | 2014 | 3,196 | 2,610 | 0.82 | 0.33 | 0.33 | 0.52 | **1.57** | 9,680 | 5,041 | 0.52 |
| *Micromesistius poutassou* | MICMPOU_AL | 2014 | 1,324 | 524 | 0.40 | 0.22 | 0.12 | 0.31 | **2.51** | 6,011 | 1,688 | **0.28** |
| *Pomatomus saltatrix* | POMTSAL_AL | 2014 | 250 | 110 | 0.44 | 0.35 | 0.26 | 0.42 | **1.61** | 704 | 260 | **0.37** |
| *Zeus faber* | ZEUSFAB_AL | 2014 | 310 | 269 | 0.87 | 0.38 | 0.37 | 0.70 | **1.92** | 805 | 382 | **0.48** |
| *Atherina boyeri* | ATHEBOY_AL | 2014 | 595 | 45 | 0.08 | 0.34 | 0.13 | 0.14 | **1.09** | 1,731 | 322 | **0.19** |
| *Boops boops* | BOOPBOO_AL | 2014 | 8,500 | 4,387 | 0.52 | 0.29 | 0.29 | 0.29 | **1.01** | 29,074 | 14,880 | 0.51 |
| *Engraulis encrasicolus* | ENGRENC_AL | 2014 | 19,258 | 20,320 | **1.06** | 0.42 | 0.42 | 0.64 | **1.54** | 46,034 | 31,551 | 0.69 |
| *Sardina pilchardus* | SARDPIL_AL | 2014 | 25,401 | 18,130 | 0.71 | 0.29 | 0.29 | 0.32 | **1.07** | 86,308 | 57,380 | 0.66 |
| *Sardinella aurita* | SARIAUR_AL | 2014 | 2,784 | 2,407 | 0.86 | 0.42 | 0.42 | 0.48 | **1.15** | 6,699 | 5,029 | 0.75 |
| *Scomber colias* | SCOMPNE_AL | 2014 | 8,866 | 2,237 | 0.25 | 0.31 | 0.17 | 0.30 | **1.82** | 28,230 | 7,426 | **0.26** |
| *Scomber scombrus* | SCOMSCO_AL | 2014 | 1,808 | 109 | 0.06 | 0.25 | 0.08 | 0.09 | **1.09** | 7,319 | 1,216 | **0.17** |
| *Spicara smaris* | SPICSMA_AL | 2014 | 6,415 | 1,274 | 0.20 | 0.20 | 0.09 | 0.19 | **2.18** | 31,556 | 6,738 | **0.21** |
| *Trachurus mediterraneus* | TRACHMED_AL | 2014 | 7,750 | 1,720 | 0.22 | 0.22 | 0.15 | 0.14 | 0.92 | 35,370 | 12,299 | **0.35** |
| *Trachurus trachurus* | TRACTRA_AL | 2014 | 1,618 | 700 | 0.43 | 0.33 | 0.33 | 0.23 | 0.71 | 4,900 | 3,002 | 0.61 |

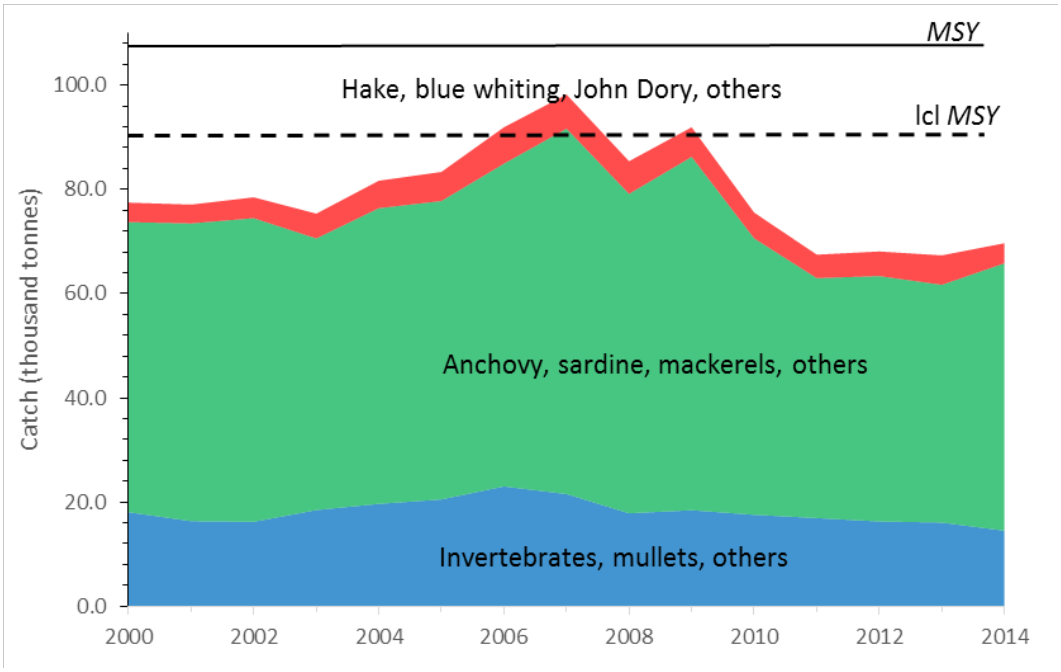



*Figure 102. Cumulative catches for 42 stocks in the Aegean Sea, with indication of main functional groups. The continuous black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [AegeanSea_Oct04_16.xlsx]*

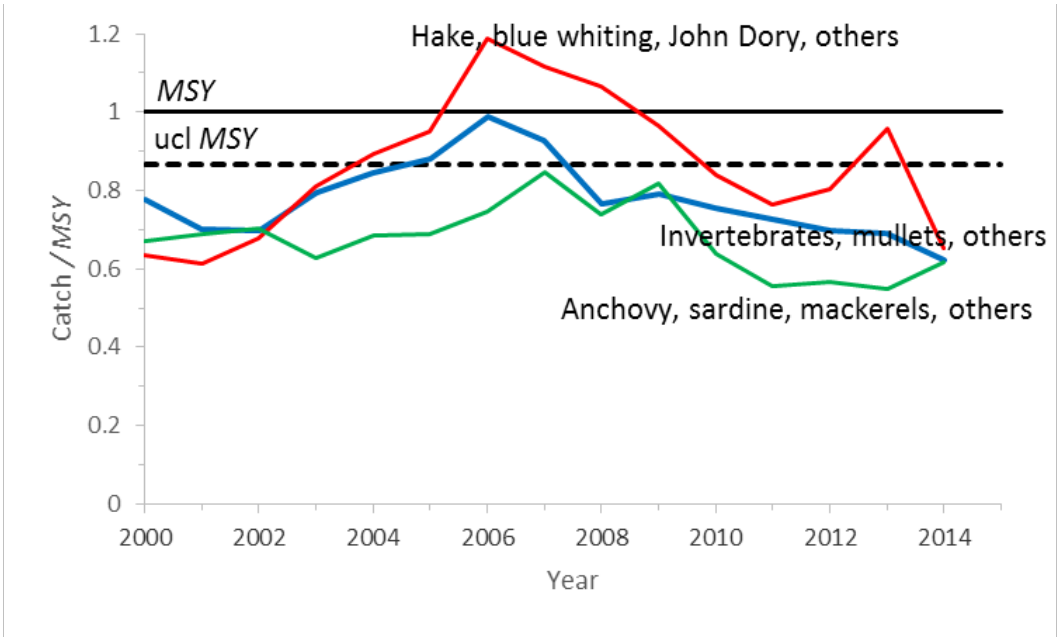



*Figure 103. Catches by main functional group relative to their maximum sustainable yield (MSY, black), for 42 stocks in the Aegean Sea. All functional groups were exploited below MSY in 2014 with a declining trend since 2006. [AegeanSea_Oct04_16.xlsx]*

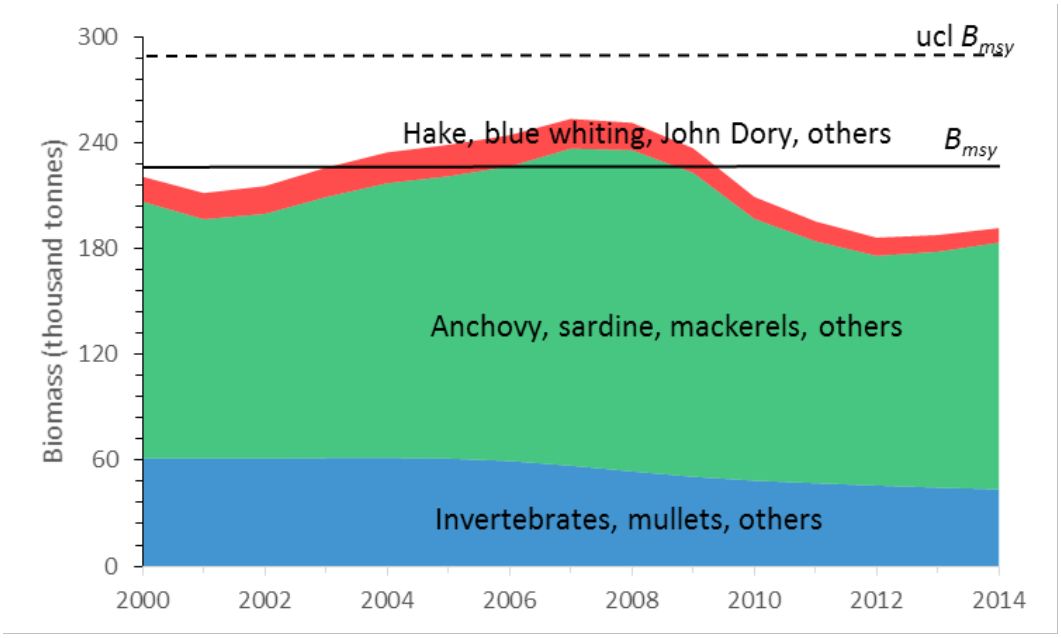



*Figure 104. Cumulative total biomass of 42 stocks in the Aegean Sea relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = continuous black line). The upper 95% confidence limit of $B_{msy}$ (dashed line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. All groups (blue: benthic organisms, green: pelagic plankton feeders, red: large predators) were below the $B_{msy}$ level. [AegeanSea_Oct04_16.xlsx]*

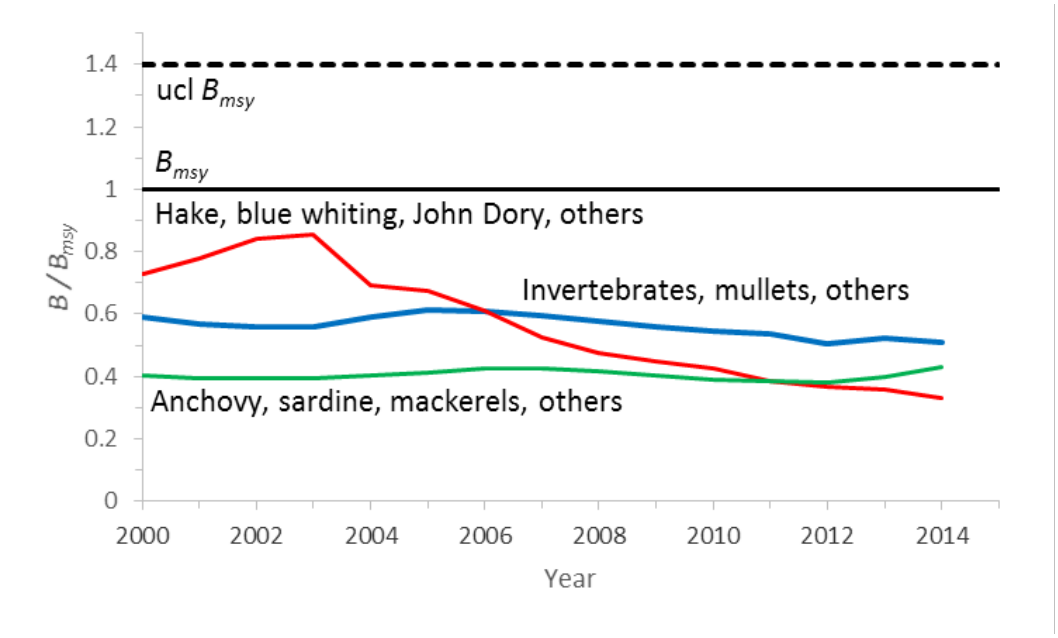



*Figure 105. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 42 stocks in the Aegean Sea assigned to main functional groups. All functional groups (blue: benthic organisms, green: pelagic plankton feeders, red: large predators) have biomass levels well below $B_{msy}$ in recent years. [AegeanSea_Oct04_16.xlsx]*

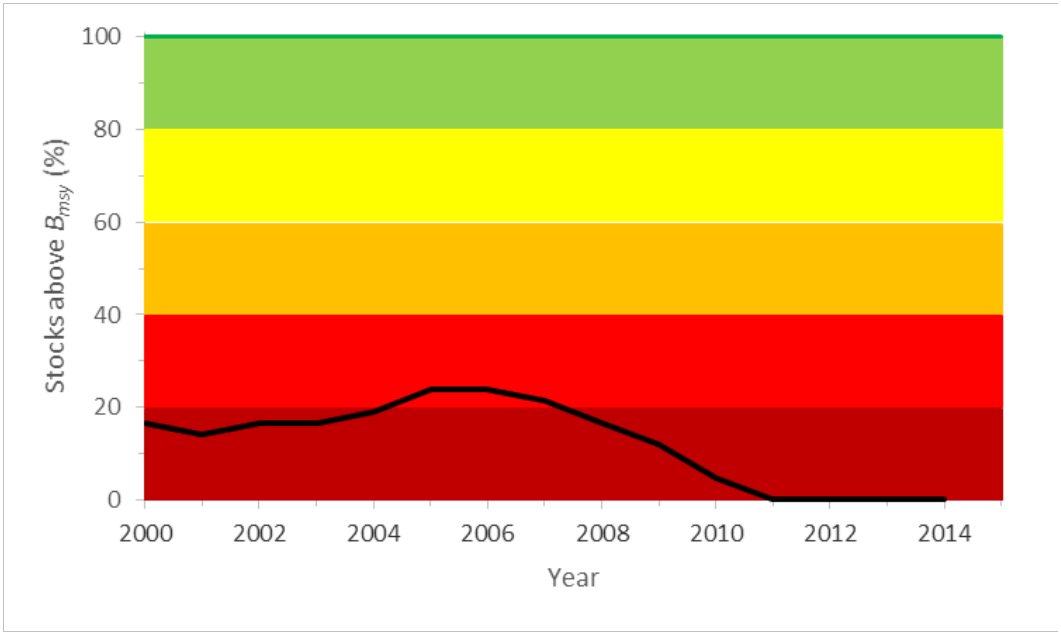



*Figure 106. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 42 stocks in the Aegean Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2014, no stock fulfilled that requirement. [AegeanSea_Oct04_16.xlsx]*

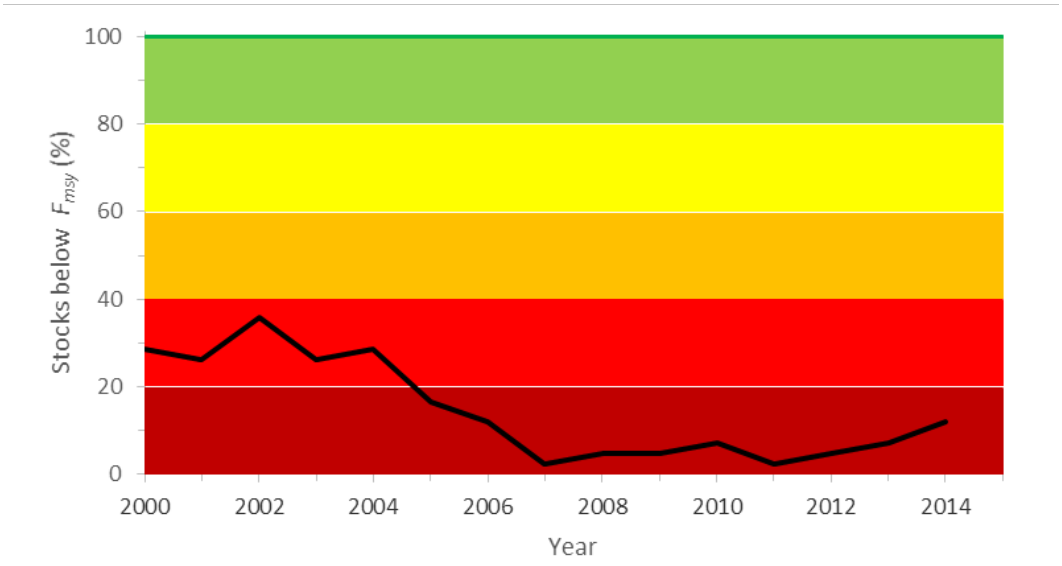



*Figure 107. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 42 stocks in the Aegean Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{msy}$ in 2015, latest in 2020. In 2014, only 12% of the stocks fulfilled that requirement. [AegeanSea_Oct04_16.xlsx]*

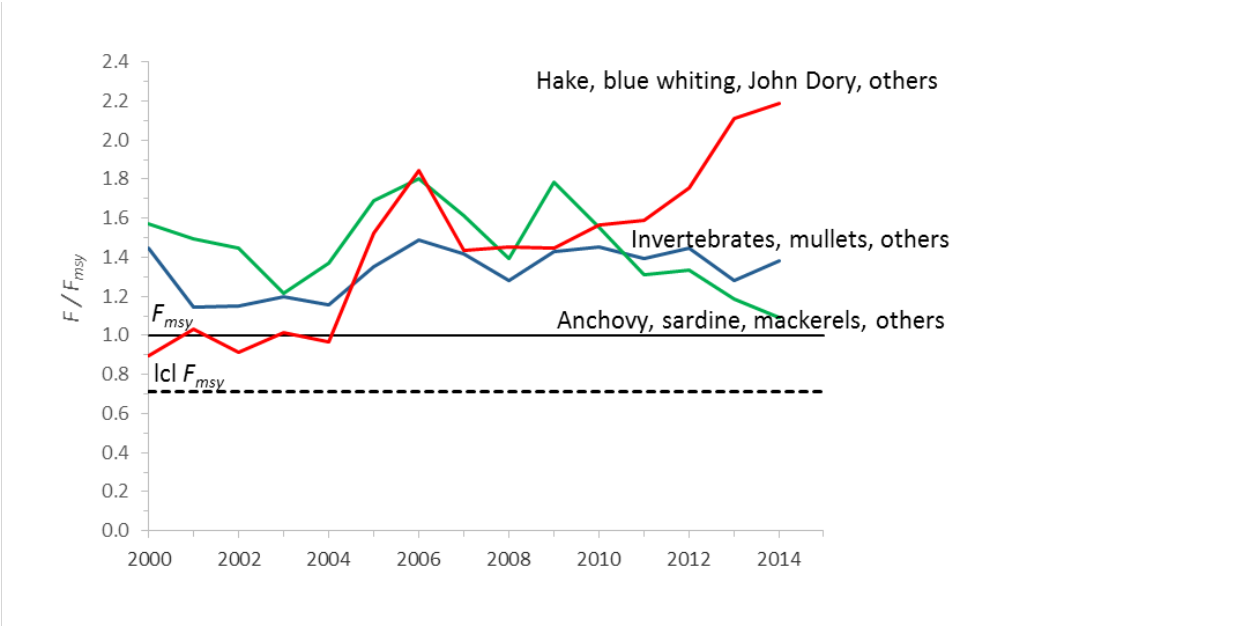



*Figure 108. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 42 stocks in the Aegean Sea assigned to main functional groups. All functional groups have been strongly overfished since 2005. [AegeanSea_Oct04_16.xlsx]*

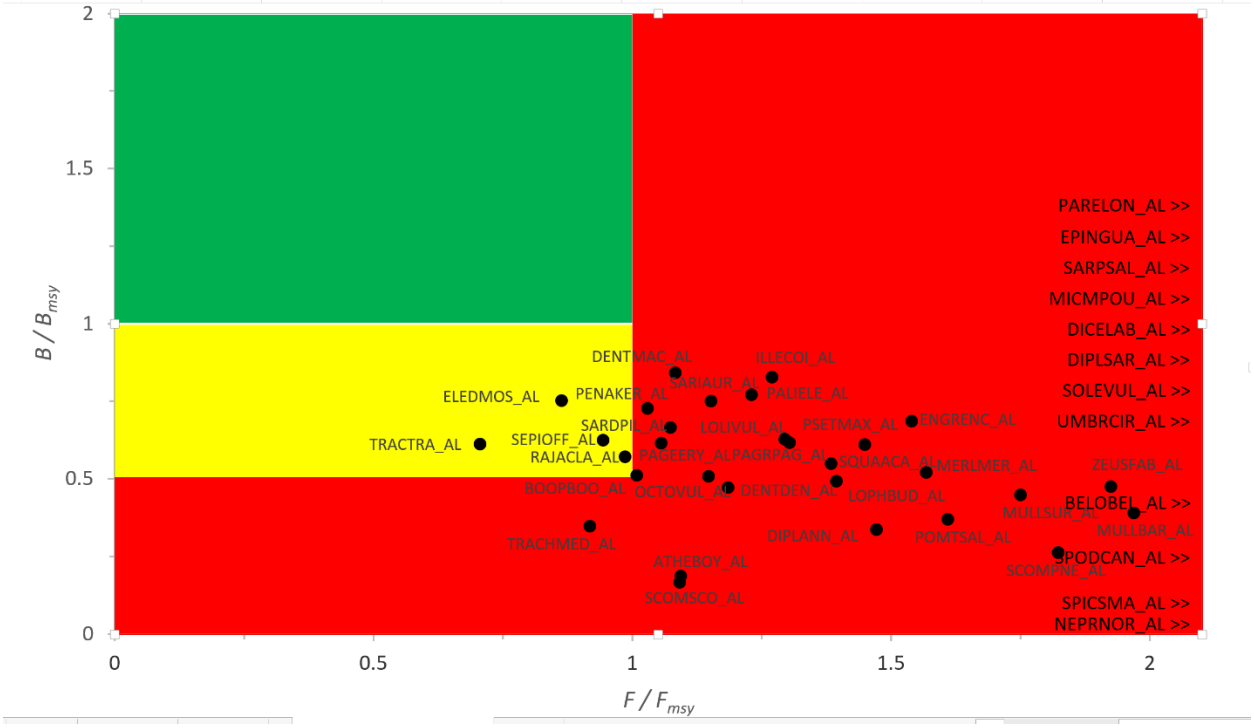



*Figure 109. Presentation of 42 Aegean Sea stocks in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Several stocks were exploited above the range of this chart, indicated by >> along the right margin. [AegeanSea_Oct04_16.xlsx]*

**Cyprus**

The following two paragraphs about the waters around Cyprus (GSA 25) were taken from

http://www.moa.gov.cy/moa/dfmr/dfmr.nsf/All/6561CB64C528ECFA42257F370041F296?OpenDocument.

"Cyprus is located in the Levantine Basin - Eastern Mediterranean which is one of the most oligotrophic seas in the world, characterized by very low nutrient availability and hence very low primary production. The special hydrological conditions of Levant Sea and the small width of the continental shelf in combination with low concentrations of available nutrients (in particular phosphorus), have as a result a very low primary production, that is low concentration of chlorophyll / phytoplankton in seawater. As a result of the oligotrophic character of the Eastern Mediterranean, the quantities of zooplankton and the larger invertebrate and vertebrate organisms (e.g. fish) that rely on it for their diet is also limited compared to other regions. The extended continental shelf, the higher productivity and lower temperature- less saline waters prevailing along the northern Aegean coast create favorable conditions for the dominance of anchovy (*Engraulis encrasicolus*) and sardine (S*ardina pilchardus*). In contrast, the demersal bogue (B*oops boops)* and picarel (S*picara smaris)* are generally characterized by a more southerly distribution than the aforementioned small pelagic species and dominate the landings of the southern Aegean Sea, Crete and Cyprus that are characterized by oligotrophic, more saline and higher temperature waters as well as narrower continental shelf (Stergiou et al. 2007).

Many marine species which are found in Cyprus, such as sea turtles (*Chelonia mydas, Caretta caretta*), the pen shell (*Pinna nobilis*), the Mediterranean monk seal (*Monachus monachus*) etc., are considered endangered and in need of protection, and therefore included in the list of high biodiversity and ecological importance for the Mediterranean. In addition, there are several important and sensitive bio-communities and habitats such as the meadows of the marine angiosperms *Posidonia oceanica* and *Cymodocea nodosa*, forests of the brown algae of the genus *Cystoseira*, underwater caves etc., which they are also objects of protection zone and conservation in the framework of European and national laws and international and regional conventions."

JRC-STEFC assessment reports and FAO-GFCM landings with data until 2014 were analyzed for 10 stocks in the Cyprus waters. The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 17. Detailed assessments for every stock are available in Appendix 2 and in the spreadsheet Cyprus_Oct13_16.xlsx.

Of the 10 stocks, all (100%) were subject to ongoing overfishing ($F > Fmsy$) and 9 stocks (90%) were outside of safe biological limits ($B < 0.5\ Bmsy$). Nine stocks in the Cyprus waters (90%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing (marked red in Table 17). All stocks (100%) were subject to unsustainable exploitation (catch > *MSY* or $F > Fmsy$ or $B < 0.2\ Bmsy$), with the too high catches marked red in Table 17. No stock could be considered healthy, defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 10 stocks of 1,318 tonnes in 2014 was well below the biomass level of 5,210 tonnes that can produce maximum yields. Summed catches of 368 tonnes were below (25%) the summed maximum sustainable yield of 1,456 tonnes. See legends of Figures for more comments.

*Table 17. Analysis of 10 stocks in the Cyprus waters, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$) , $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold.* Unsustainable catches (*F* > $F_{msy}$ or catch > *MSY* or *B* < 0.2 $B_{msy}$) are marked red. *Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red) and pelagic plankton feeders (green). [Cyprus_Oct13_16.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Dentex dentex* | DENTDEN_CY | 2014 | 27 | 4 | 0.15 | 0.17 | 0.06 | 0.14 | **2.32** | 164 | 29 | **0.18** |
| *Mullus barbatus* | MULLBAR_CY | 2014 | 118 | 32 | 0.27 | 0.31 | 0.18 | 0.28 | **1.53** | 385 | 115 | **0.30** |
| *Mullus surmuletus* | MULLSUR_CY | 2014 | 181 | 35 | 0.19 | 0.44 | 0.19 | 0.41 | **2.19** | 408 | 86 | **0.21** |
| *Pagellus acarne* | PAGEACA_CY | 2014 | 28 | 26 | 0.94 | 0.29 | 0.29 | 0.47 | **1.62** | 94 | 55 | 0.58 |
| *Pagellus erythrinus* | PAGEERY_CY | 2014 | 50 | 12 | 0.24 | 0.23 | 0.11 | 0.25 | **2.31** | 213 | 49 | **0.23** |
| *Pagrus pagrus* | PAGRPAG_CY | 2014 | 36 | 9 | 0.25 | 0.27 | 0.13 | 0.27 | **2.10** | 135 | 33 | **0.24** |
| *Sepia officinalis* | SEPIOFF_CY | 2014 | 106 | 22 | 0.21 | 0.27 | 0.12 | 0.24 | **1.92** | 398 | 93 | **0.23** |
| *Seriola dumerili* | SERIDUM_CY | 2014 | 20 | 8 | 0.40 | 0.31 | 0.18 | 0.43 | **2.40** | 65 | 19 | **0.29** |
| *Boops boops* | BOOPBOO_CY | 2014 | 240 | 111 | 0.46 | 0.36 | 0.24 | 0.49 | **2.00** | 670 | 228 | **0.34** |
| *Spicara smaris* | SPICSMA_CY | 2014 | 649 | 109 | 0.17 | 0.24 | 0.11 | 0.18 | **1.59** | 2,668 | 613 | **0.23** |

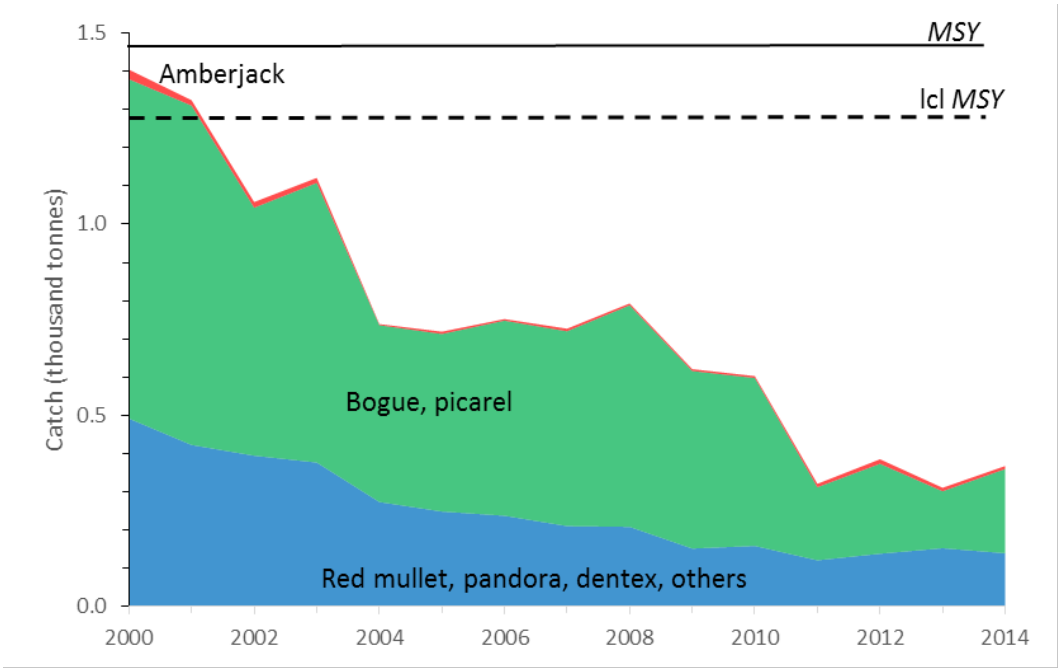



*Figure 110. Cumulative catches for 10 stocks in the Cyprus waters, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [Cyprus_Oct13_16.xlsx]*

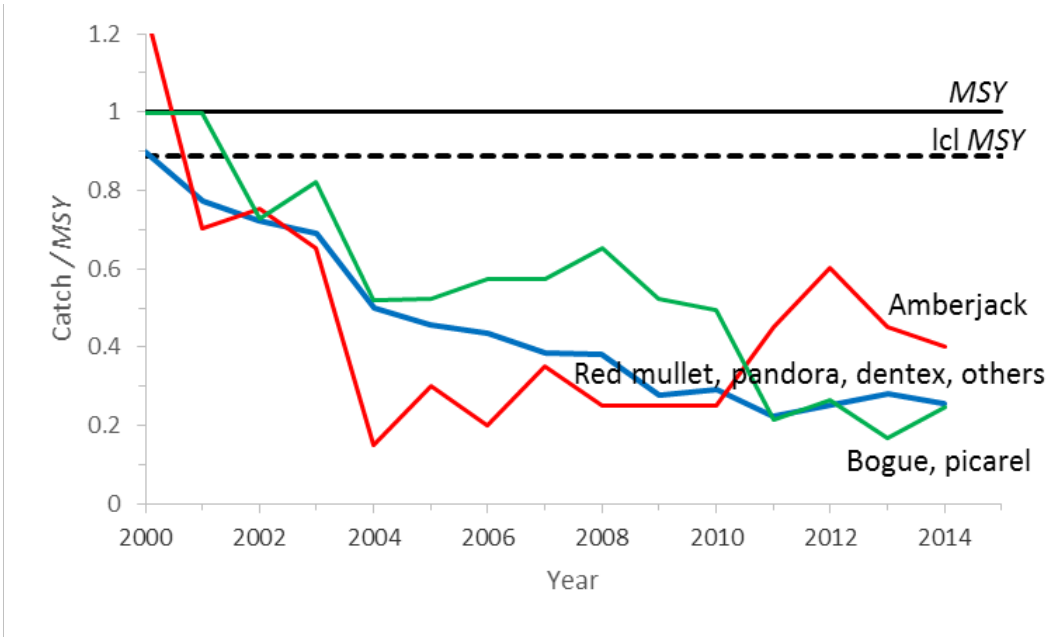



*Figure 111. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 10 stocks in the Cyprus waters. Due to low biomass (see below), catches of all groups are well below the precautionary over all lower 95% confidence limit of MSY (dashed line). [Cyprus_Oct13_16.xlsx]*

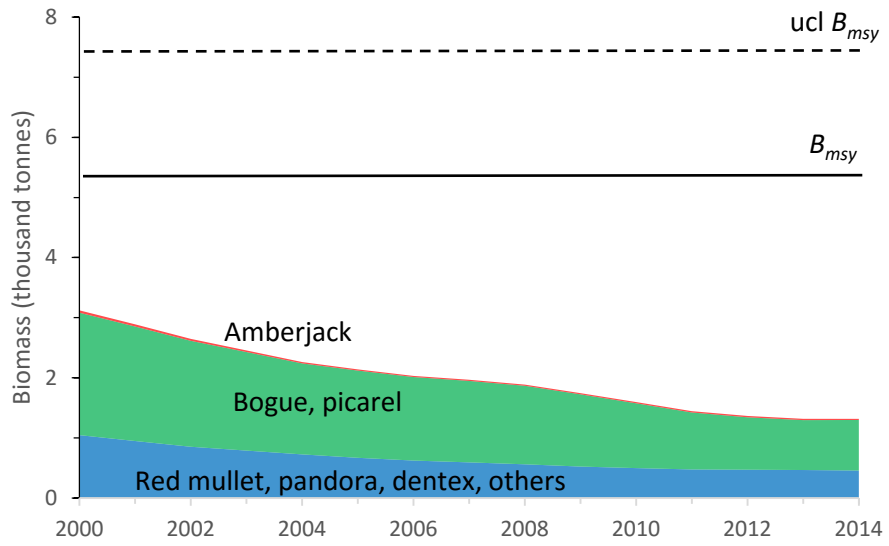



*Figure 112. Cumulative total biomass of 10 stocks in the Cyprus waters relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of $B_{msy}$ (dashed line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. The functional groups of pelagic plankton feeders (green), large predators (red), and benthic organisms (blue) are indicated, with listing of main species. All functional groups were far below the $B_{msy}$ level. [Cyprus_Oct13_16.xlsx]*

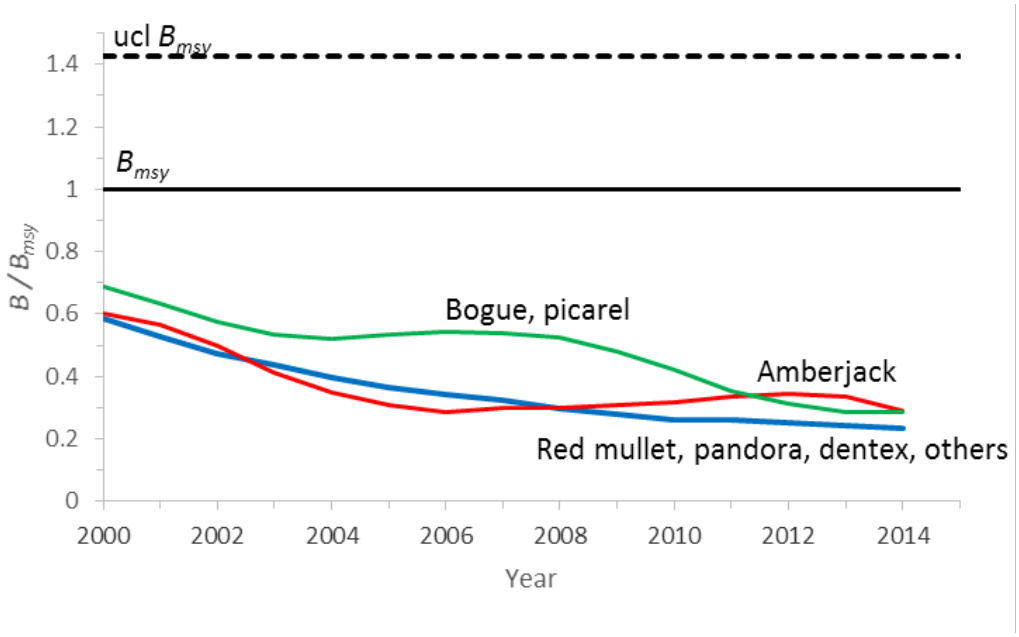



*Figure 113. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 10 stocks in the Cyprus waters assigned to main functional groups. All functional groups have biomass levels well below $B_{msy}$, in the area where recruitment may be impaired, without a clear upward trend. [Cyprus_Oct13_16.xlsx]*

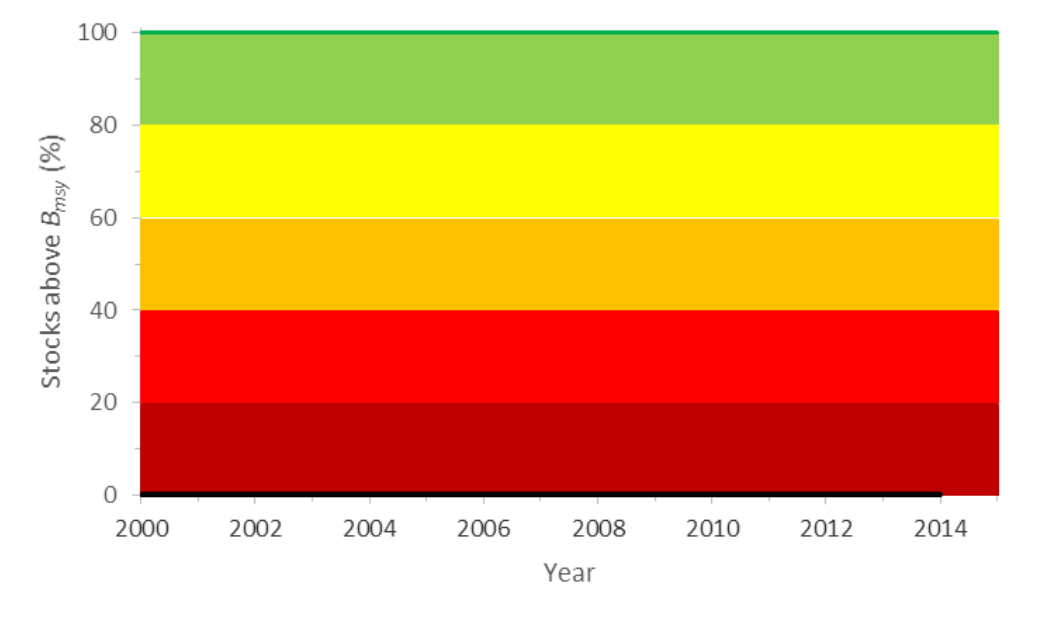



*Figure 114. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 10 stocks in the Cyprus ecoregion (black curve at zero level). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. Throughout the time series, no stock fulfilled that requirement. [Cyprus_Oct13_16.xlsx]*

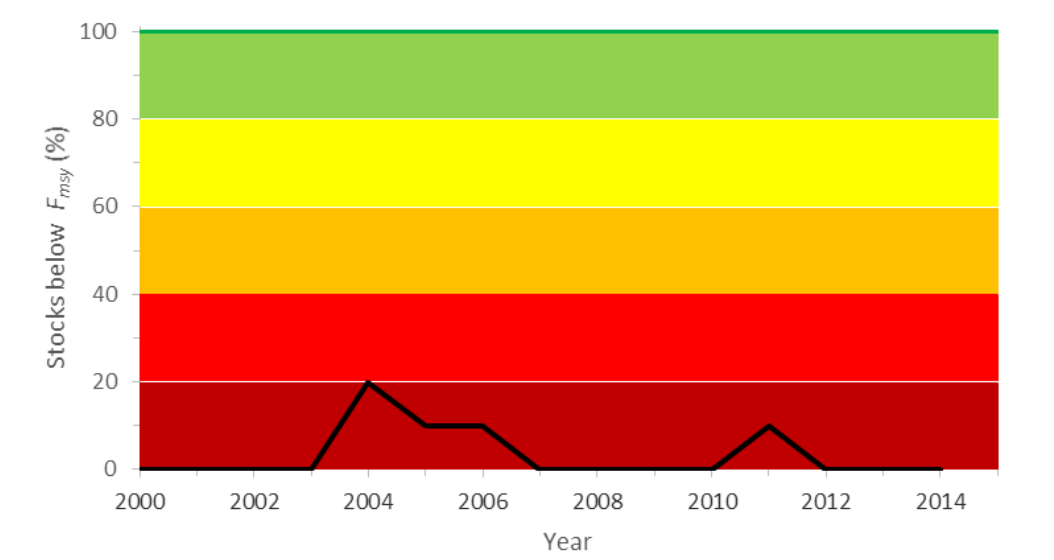



*Figure 115. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 10 stocks in the Cyprus ecoregion (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{msy}$ in 2015, latest in 2020. In 2014, no stock fulfilled that requirement. [Cyprus_Oct13_16.xlsx]*

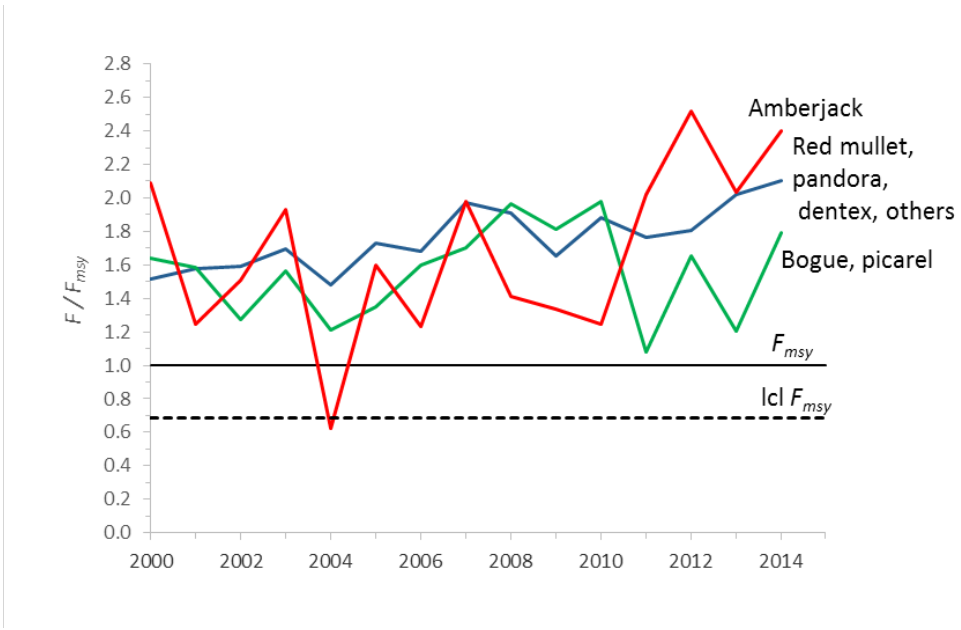



*Figure 116. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 10 stocks in the Cyprus waters assigned to main functional groups. All groups were strongly overfished. [Cyprus_Oct13_16.xlsx]*

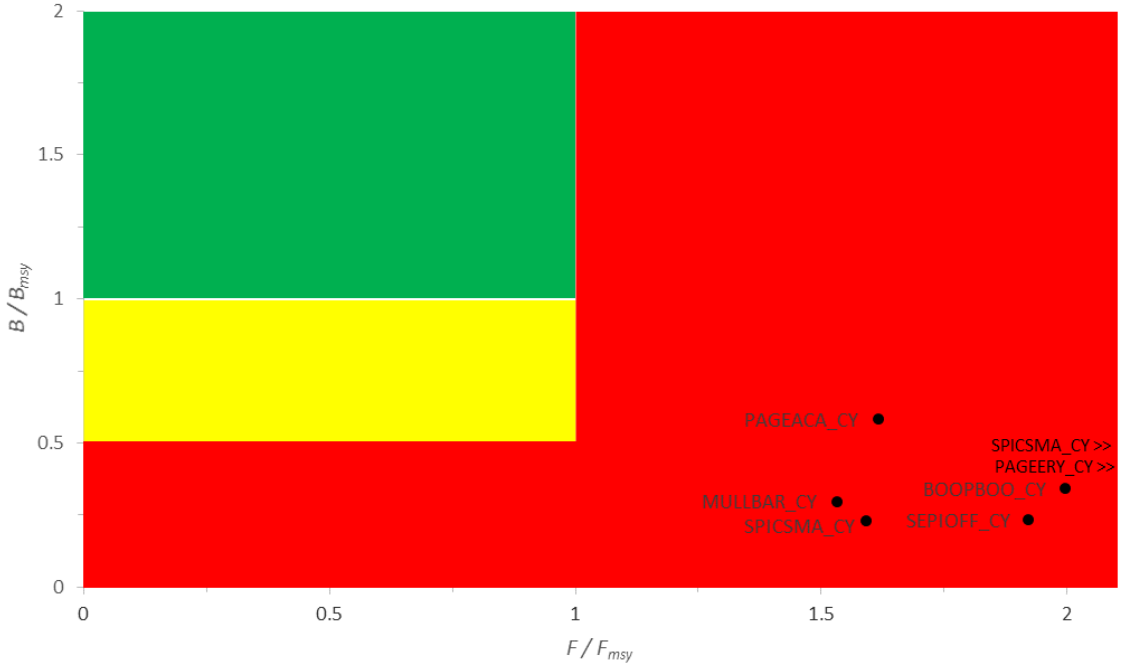



*Figure 117. Presentation of 10 stocks from Cyprus waters in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Two stocks were exploited above the range of this chart, indicated by >> at the right margin. [Cyprus_Oct13_16.xlsx]*

**Black Sea**

The following three paragraphs describing the Black Sea (GSAs 29 & 30) were taken from the website www.blacksea-commision.org.

"The Black Sea is the most isolated from the World Ocean - connected to the Oceans via the Mediterranean Sea through Istanbul, Canakkale (Turkish Straits) and Gibraltar straits and with the Sea of Azov in the northeast through the Kerch Strait. The ratio of its surface and its catchment area exceeds 6. For this reason, the Black Sea is very vulnerable to pressure from land based human activity and its health is equally dependent from the coastal and non-coastal states of its basin.

The seabed is divided into the shelf, the continental slope and the deep-sea depression. The shelf occupies a large area in the north-western part of the Black Sea, where it is over 200 km wide and has a depth ranging from 0 to 160 meters. In other parts of the sea it has a depth of less than 100 m and a width of 2.2 to 15 km. Near the Caucasian and Anatolian coasts the shelf is only a narrow intermittent strip.

The thin upper layer of marine water (up to 150 m) supports the unique biological life in the Black Sea ecosystem. The deeper and dense water layers are saturated with hydrogen sulfide, that over thousands years, accumulated from decaying organic matter in the Black Sea. Due to the unique geomorphological structure and specific hydro chemical conditions, specific organisms, basically on the level of protozoa, bacteria, and some multi-cellular invertebrates inhabit the deep-sea waters. Knowledge about biological forms of life in the deep waters of the Black Sea is very limited. The disturbance of the natural balance between the two layers could trigger irreversible damage to the people and ecosystem of the Black Sea."

JRC-STEFC assessment reports with data until 2014 were analyzed for 7 stocks in the Black Sea. The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 18. Detailed assessments for every stock are available in Appendix 2 and in the spreadsheet BlackSea_Oct14_16.xlsx.

Of the 7 stocks, 6 (86%) were subject to ongoing overfishing ($F > F_{msy}$) and 3 stocks (43%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). In one stock (14%) catches exceeded the maximum sustainable yield ($C/MSY > 1$). Three stocks (43%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing (marked red in Table 18). Altogether, six stocks (86%) were subject to unsustainable exploitation (catch > *MSY* or $F > Fmsy$ or $B < 0.2\ Bmsy$), with the too high catches marked red in Table 18. In contrast, only one stock (Black Sea sprat, Spr_BS, 14%) could be considered healthy, defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 7 stocks of 678 thousand tonnes in 2014 was well below the summed biomass level of 1.3 million tonnes that can produce maximum yields. Summed catches of 242 thousand tonnes were below the summed maximum sustainable yield of 403 thousand tonnes. This is mainly caused by the sharp decline in anchovy catch in the last year. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but sustained catches of near the lower confidence limit or near 90% of *MSY* (whichever is lower) would be possible if all stocks have recovered above *Bmsy*. Because of more fish in the water, such catches could be obtained with much less fishing effort and much less impact on the ecosystem. See legends of Figures for more comments.

*Table 18. Analysis of 7 stocks in the Black Sea, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$) , $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), and relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) or severe depletion (B < 0.2 Bmsy) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold.* Unsustainable catches (*F* > $F_{msy}$ or catch > *MSY* or *B* < 0.2 $B_{msy}$) are marked red. *Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red) and pelagic plankton feeders (green). [BlackSea_Oct14_16.xlsx]*

| SciName | Stock | Year | *MSY* | Catch | C/*MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Mullus barbatus barbatus* | RMullet_BS | 2014 | 3,205 | 3,899 | **1.22** | 0.43 | 0.43 | 0.93 | **2.19** | 7,505 | 4,170 | 0.56 |
| *Squalus acanthias* | PDogfish_BS | 2014 | 2,804 | 75 | 0.03 | 0.07 | 0.01 | 0.02 | **1.51** | 39,817 | 3,752 | **0.09** |
| *Scophthalmus maximus* | Tur_BS | 2014 | 1,967 | 1,159 | 0.59 | 0.21 | 0.10 | 0.51 | **5.31** | 9,569 | 2,254 | **0.24** |
| *Merlangius merlangus* | Whiting_BS | 2014 | 11,033 | 8,861 | 0.80 | 0.28 | 0.28 | 0.42 | **1.49** | 38,999 | 21,080 | 0.54 |
| *Sprattus sprattus* | Spr_BS | 2014 | 64,277 | 58,380 | 0.91 | 0.40 | 0.40 | 0.33 | 0.83 | 161,197 | 177,005 | 1.10 |
| *Trachurus mediterraneus* | MHMackerel_BS | 2014 | 66,770 | 12,357 | 0.19 | 0.30 | 0.07 | 0.51 | **7.57** | 220,611 | 24,391 | **0.11** |
| *Engraulis encrasicolus* | BS_anch | 2014 | 253,599 | 157,462 | 0.62 | 0.29 | 0.29 | 0.35 | **1.23** | 878,375 | 444,922 | 0.51 |

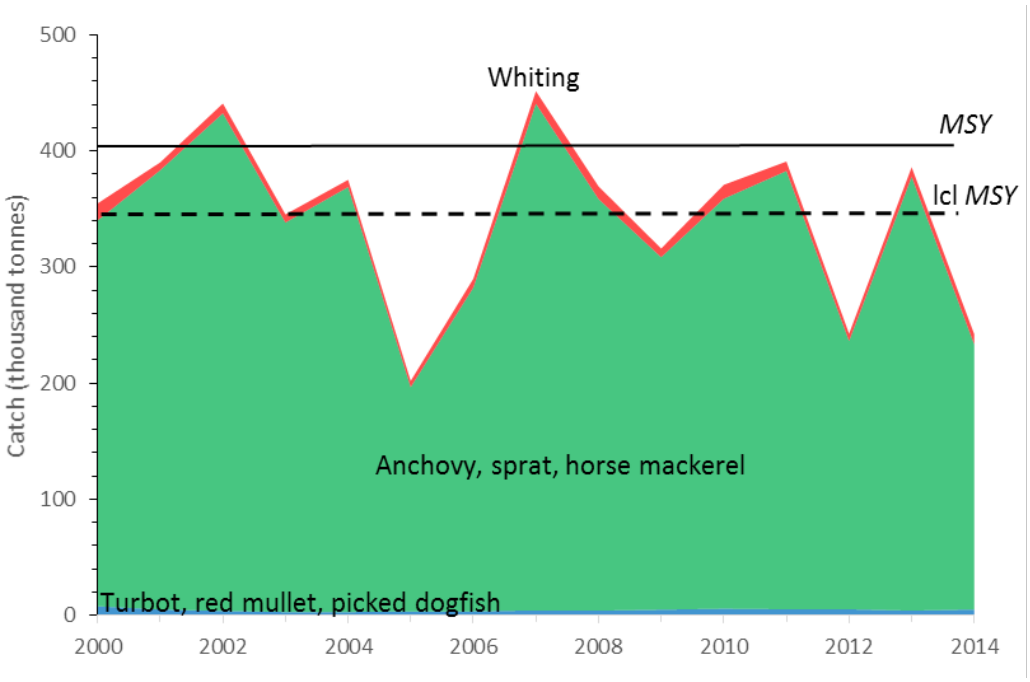



*Figure 118. Cumulative catches for 7 stocks in the Black Sea, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. While total catches fluctuate around the precautionary target (lcl MSY), they are obtained with too much effort and cost and are unsustainable because of the reduced biomass of most stocks (see below). [BlackSea_Oct14_16.xlsx]*

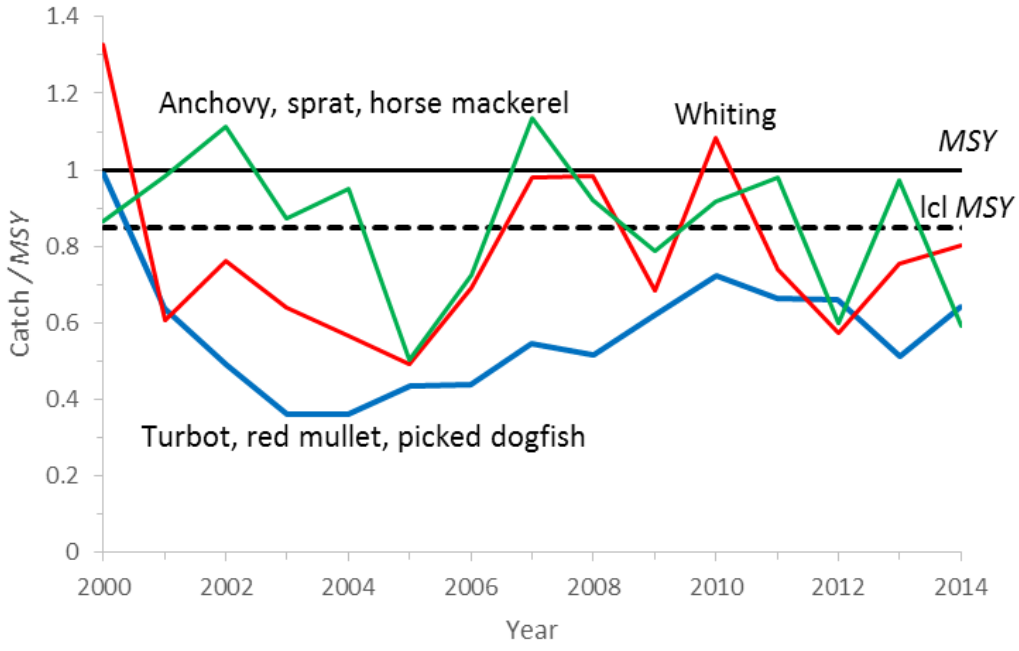



*Figure 119. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 7 stocks in the Black Sea. See legend of previous Figure for interpretation. [BlackSea_Oct14_16.xlsx]*

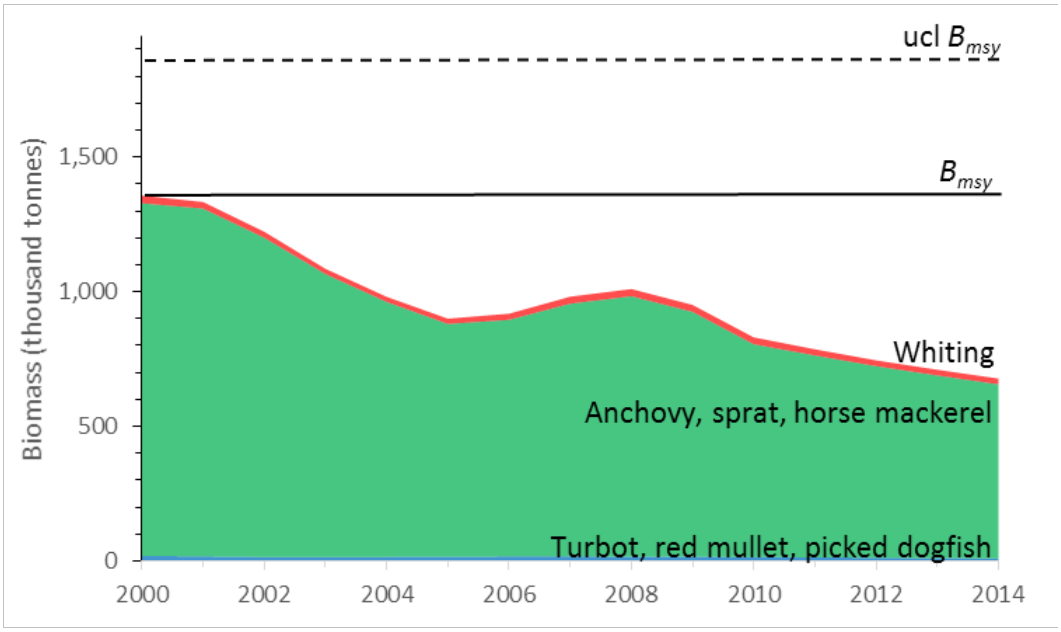



*Figure 120. Cumulative total biomass of 7 stocks in the Black Sea relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of $B_{msy}$ (dashed line) would present a precautionary target biomass above Bmsy. This is also the area where the maximum economic yield could be obtained. The functional groups of large predators (red), pelagic plankton feeders (green), and benthic organisms (blue) are indicated, with listing of main species. All functional groups were far below the $B_{msy}$ level. [BlackSea_Oct14_16.xlsx]*

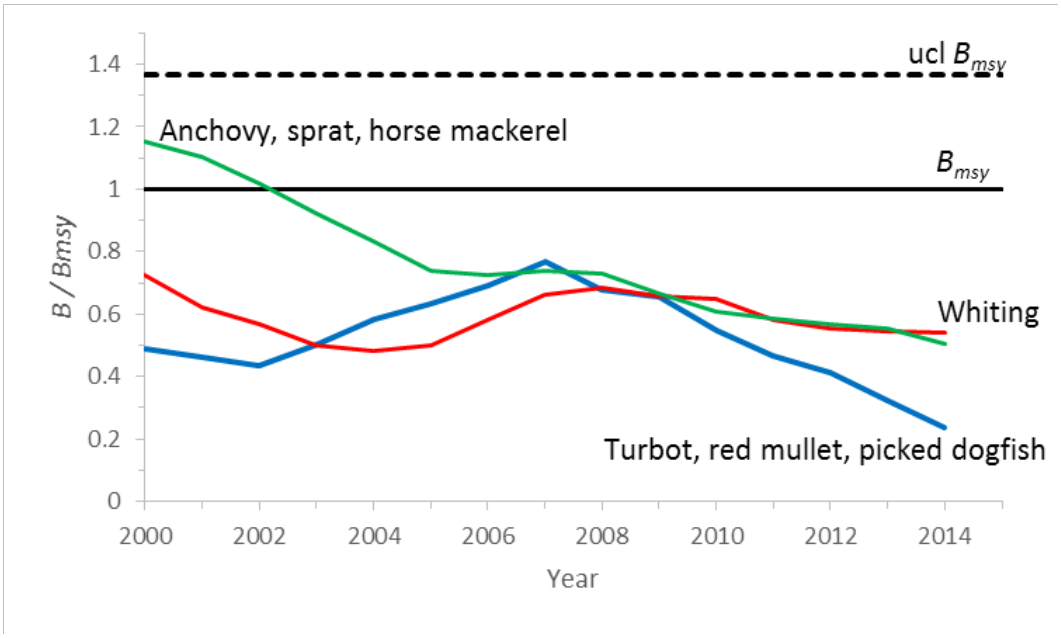



*Figure 121. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 7 stocks in the Black Sea assigned to main functional groups. All functional groups have biomass levels well below $B_{msy}$, without a clear upward trend. Benthic organisms are far outside of safe biological limits ($B << 0.5\ B_{msy}$). [BlackSea_Oct14_16.xlsx]*

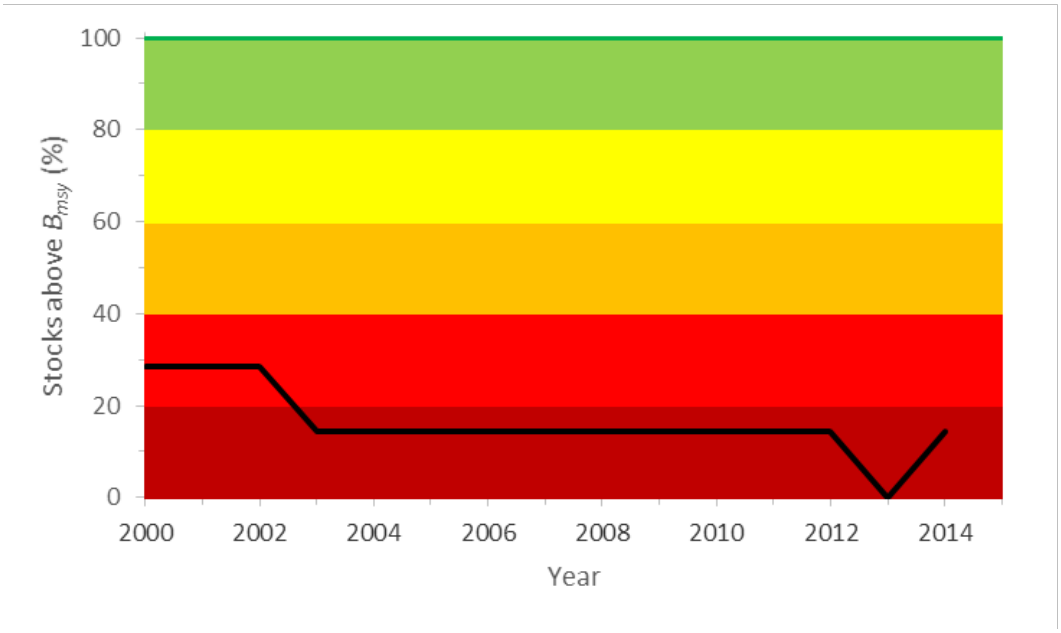



*Figure 122. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 7 stocks in the Black Sea (black curve at zero level). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2014, only one stock (Black Sea sprat, Spr_BS, 14%) fulfilled that requirement. [BlackSea_Oct14_16.xlsx]*

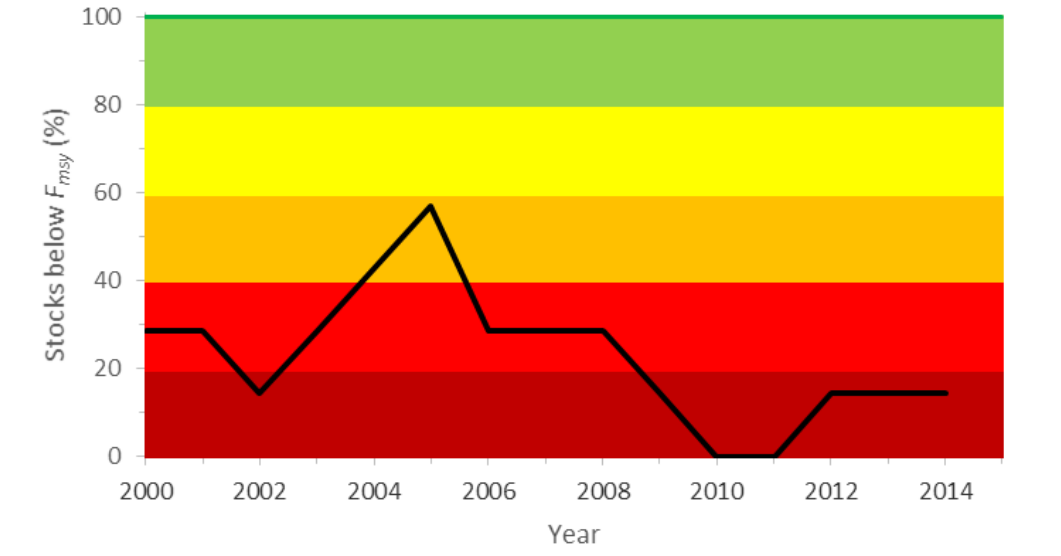



*Figure 123. Percentage of stocks where fishing pressure is at or below the maximum sustainable level ($F_{msy}$) for 7 stocks in the Black Sea (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be fished at or below $F_{msy}$ in 2015, latest in 2020. In 2014, only one stock (Black Sea sprat, Spr_BS, 14%) fulfilled that requirement. [BlackSea_Oct14_16.xlsx]*

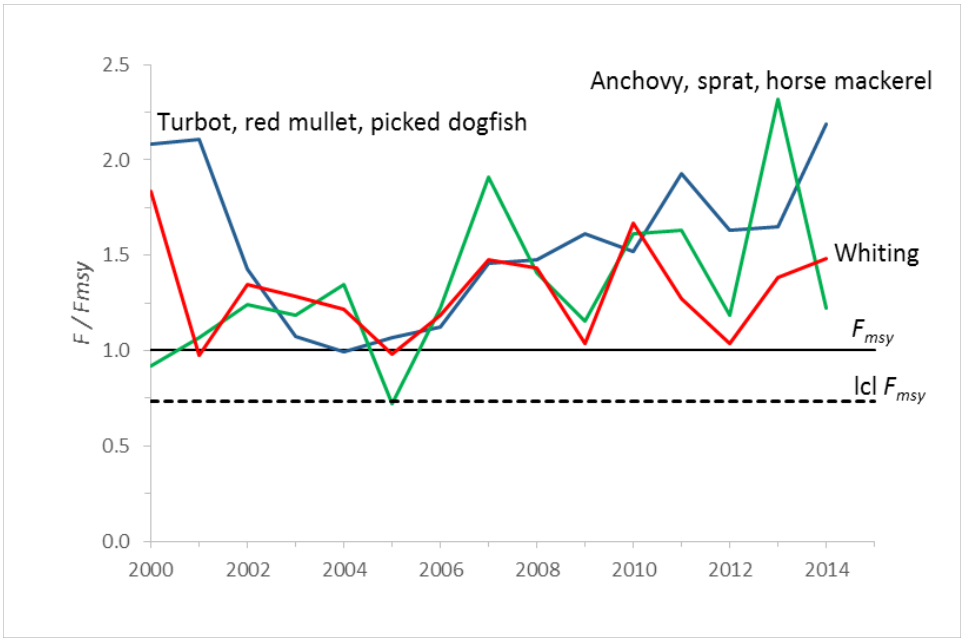



*Figure 124. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 7 stocks in the Black Sea assigned to main functional groups. All groups were exploited far above the maximum sustainable level. [BlackSea_Oct14_16.xlsx]*

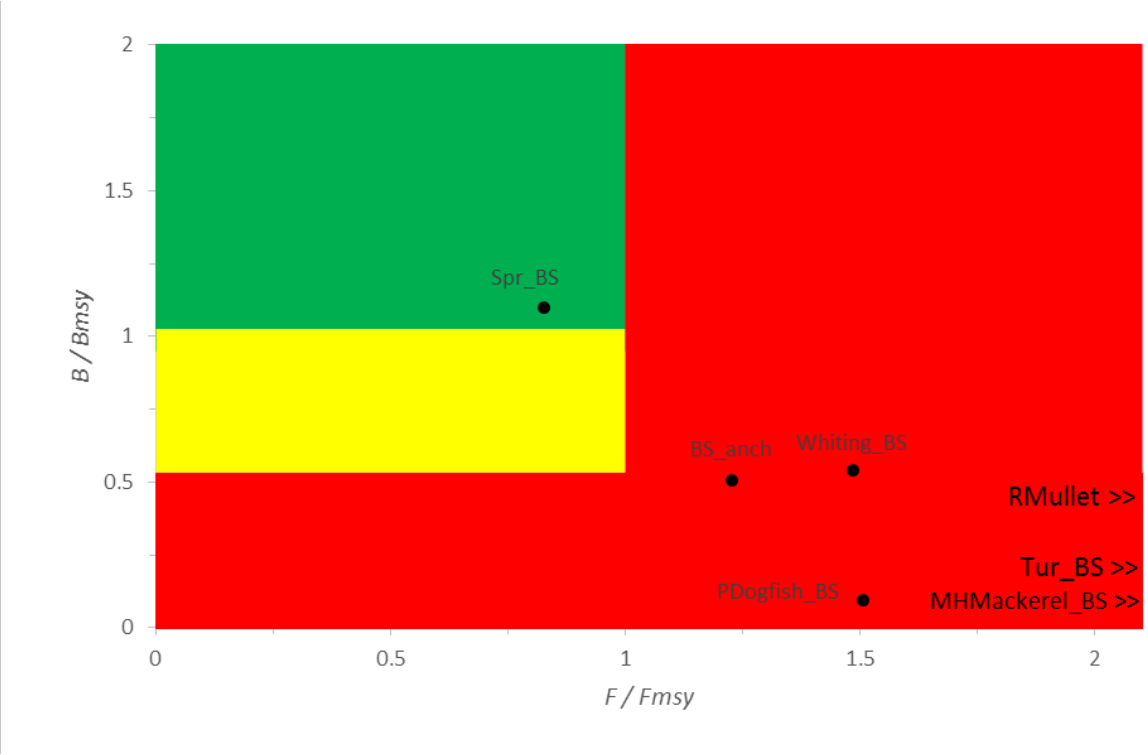



*Figure 125. Presentation of 7 Black Sea stocks in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Three stocks were exploited beyond the scale of this graph, indicated by >> in the lower right corner. [BlackSea_Oct14_16.xlsx]*

**WIDE RANGING**

**ICCAT Stocks**

As per legal definition, highly migratory species are listed in Annex 1 of UNCLOS. These species are generally capable of migrating relatively long distances, and stocks of these species are likely to occur both within EEZs and on the high seas (Maguire et al. 2006), straddling multiple ecoregions. The here assessed highly migratory species of the North-East Atlantic and the Mediterranean Sea include tuna, swordfish and oceanic sharks. Formal stock delamination was adapted from ICCAT (www.iccat.es).

ICCAT databases and assessment reports with data until 2014 were analyzed for 10 stocks in the Northeast Atlantic and Mediterranean. The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 19. Detailed assessments for every stock are available in Appendix 3 and in the spreadsheet ICCAT_Oct05_16.xlsx.

Of the 10 stocks, 5 (50%) were subject to ongoing overfishing (F > Fmsy) and 1 stock (POR_NEA, 10%) was outside of safe biological limits (B < 0.5 $B_{msy}$). Two stocks (20%) were in critical condition, defined by being outside of safe biological limits and/or subject to severe overfishing ($F/F_{msy} > 2$) (marked red in Table 19). In contrast, four stocks (40%) could be considered healthy, defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield. Additionally, one stock (10%) could be considered as recovering, defined by not being subject to overfishing and having a biomass close to the one that can produce the maximum sustainable yield.

Assessment of blue shark (*Prionace glauca*) may be too optimistic, as the Atlantic and Mediterranean stocks were still treated as one by the available data, and the Mediterranean stock is known to be in bad condition. Similarly, the very strong recovery of bluefin tuna (*Thunnus thynnus*) is surprising and stretches the limits of what seems plausible given the biology of this species. According to the available data, catches have not exceeded *MSY* since 2000 and exploitation was very light (17-31% of $F_{msy}$) since 2010. This is very much in contrast to the public perception of strong overfishing of bluefin tuna. Overall, there seems to have been notable improvement in the stock status since 2004, when all 10 stocks were overfished with $B/B_{MSY} < 1$.

Summed biomass of the 10 stocks of 1 million tonnes in 2014 was slightly above the biomass level of 0.96 million tonnes that can produce maximum yields. Summed catches of 128 thousand tonnes were below the summed maximum sustainable yield of 185 thousand tonnes. See legends of Figures for more comments.

*Table 19. Analysis of 10 ICCAT stocks in the Northeast Atlantic and the Mediterranean, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$) , $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) or severe overfishing ($F/F_{msy} > 2$) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by phylogenic groups as indicated by the color of the stock IDs: sharks (blue), swordfish (red), tunas & bonito (green). [ICCAT_Oct05_16.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Prionace glauca* | BSH_ATN | 2014 | 30,050 | 36,516 | **1.22** | 0.10 | 0.10 | 0.11 | **1.10** | 314,635 | 346,979 | 1.10 |
| *Lamna nasus* | POR_NEA | 2014 | 711 | 18 | 0.03 | 0.01 | 0.00 | 0.01 | **3.20** | 48,075 | 3,051 | **0.06** |
| *Isurus oxyrinchus* | SMA_ATN | 2014 | 2,647 | 2,899 | **1.10** | 0.02 | 0.02 | 0.03 | **1.39** | 118,432 | 93,363 | 0.79 |
| *Thunnus thynnus* | BFT_ATE | 2014 | 40,488 | 13,250 | 0.33 | 0.32 | 0.32 | 0.08 | 0.26 | 126,851 | 160,029 | 1.26 |
| *Xiphias gladius* | SWO_MED | 2014 | 16,281 | 9,794 | 0.60 | 0.28 | 0.28 | 0.22 | 0.79 | 58,792 | 44,633 | 0.76 |
| *Xiphias gladius* | SWO_ATN | 2014 | 14,278 | 10,813 | 0.76 | 0.34 | 0.34 | 0.21 | 0.62 | 42,549 | 51,827 | 1.22 |
| *Thunnus alalunga* | ALB_ATN | 2014 | 47,223 | 26,539 | 0.56 | 0.38 | 0.38 | 0.16 | 0.41 | 124,129 | 169,220 | 1.36 |
| *Thunnus alalunga* | ALB_MED | 2014 | 4,909 | 2,373 | 0.48 | 0.37 | 0.37 | 0.15 | 0.41 | 13,144 | 15,380 | 1.17 |
| *Euthynnus alletteratus* | LTA_MED | 2014 | 2,290 | 3,443 | **1.50** | 0.42 | 0.42 | 1.03 | **2.47** | 5,497 | 3,343 | 0.61 |
| *Sarda sarda* | BON_MED | 2014 | 23,621 | 22,823 | 0.97 | 0.21 | 0.21 | 0.21 | **1.01** | 115,039 | 109,579 | 0.95 |

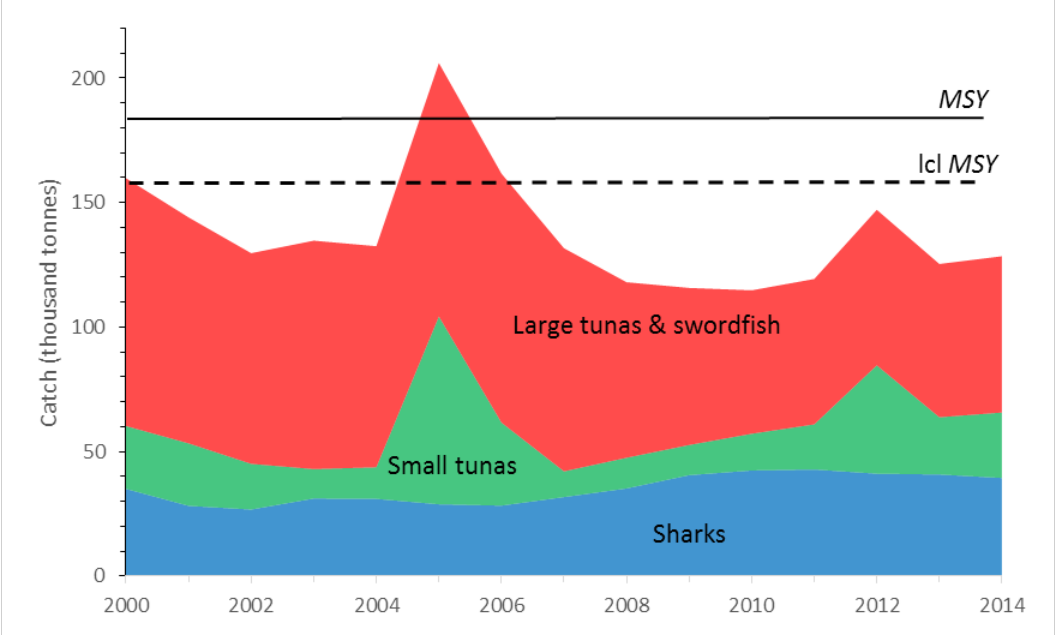



*Figure 126. Cumulative catches, including discards and recreational catch if available, for 10 ICCAT stocks in the Northeast Atlantic and Mediterranean, with indication of phylogenic/functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. [ICCAT_Oct05_16.xlsx]*

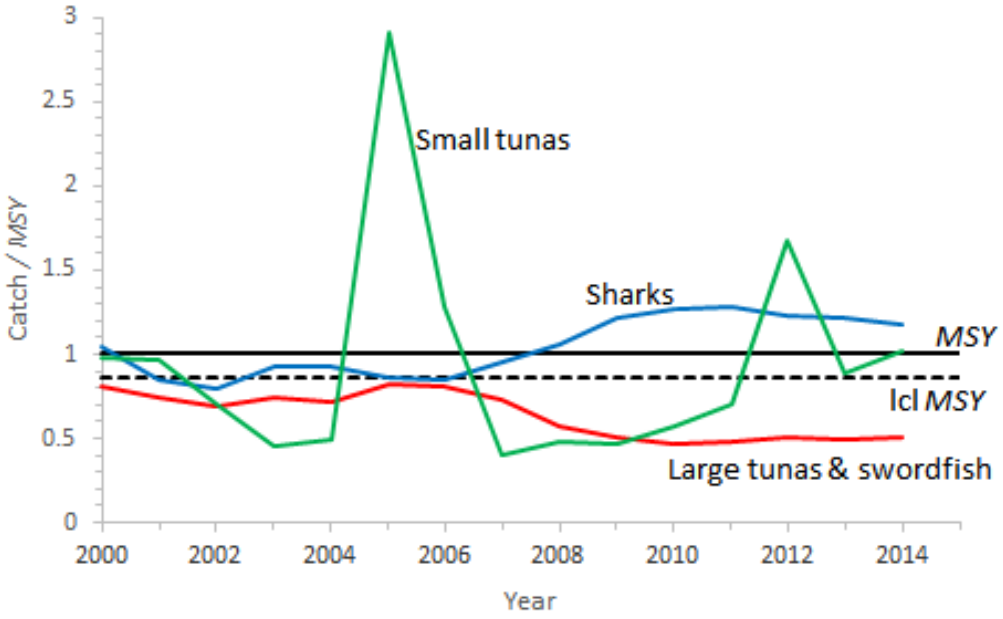



*Figure 127. Median catches by phylogenic group relative to their maximum sustainable yield (MSY, black line), for 10 ICCAT stocks in the Northeast Atlantic and Mediterranean. Sharks (blue curve) were subject to catches above MSY level since 2008. Relative catches of tunas seem surprisingly low, see comment above. [ICCAT_Oct05_16.xlsx]*

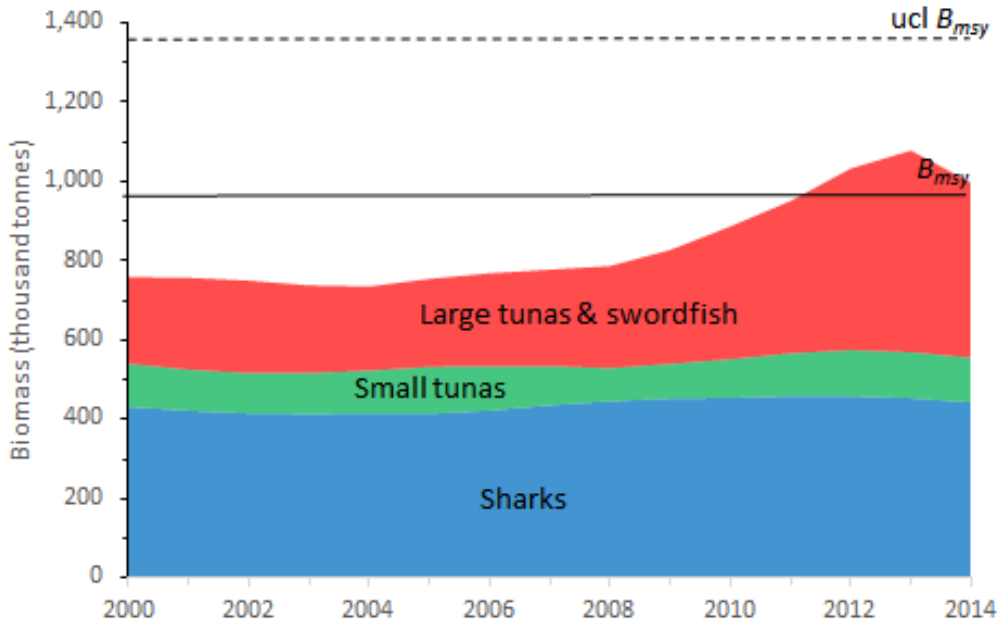



*Figure 128. Cumulative total biomass of 10 ICCAT stocks in the Northeast Atlantic and Mediterranean, with indication of the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of $B_{msy}$ (dashed line) would present a precautionary target biomass above $B_{msy}$. The strong increase in biomass of large tunas & swordfish after 2010 is surprising. [ICCAT_Oct05_16.xlsx]*

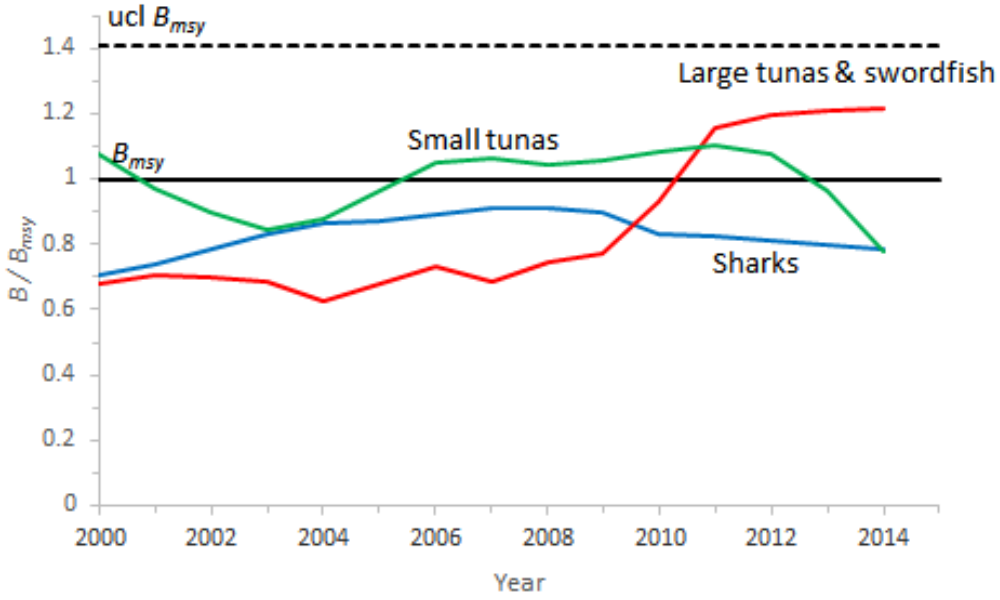



*Figure 129. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 10 ICCAT stocks in the Northeast Atlantic and Mediterranean assigned to phylogenic groups. The strong increase of large tunas & swordfish above $B_{msy}$ since 2010 and the stable high biomass of sharks are surprising, given the public perception of these stocks. [ICCAT_Oct05_16.xlsx]*

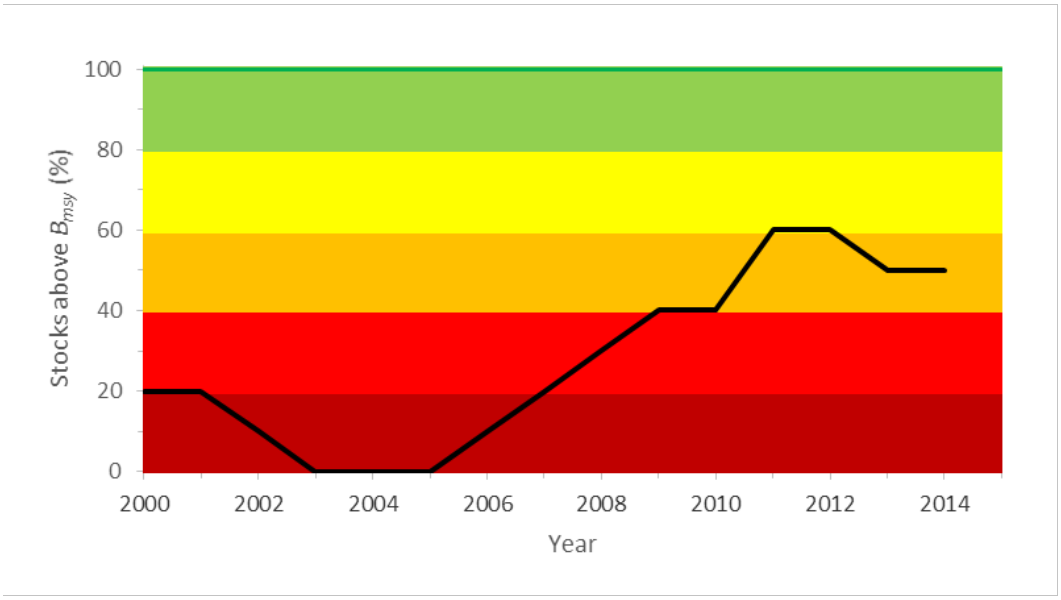



*Figure 130. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 10 stocks in the Northeast Atlantic and Mediterranean (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. Based on the available data, 50% of the stocks fulfilled that requirement in 2014. [ICCAT_Oct05_16.xlsx]*

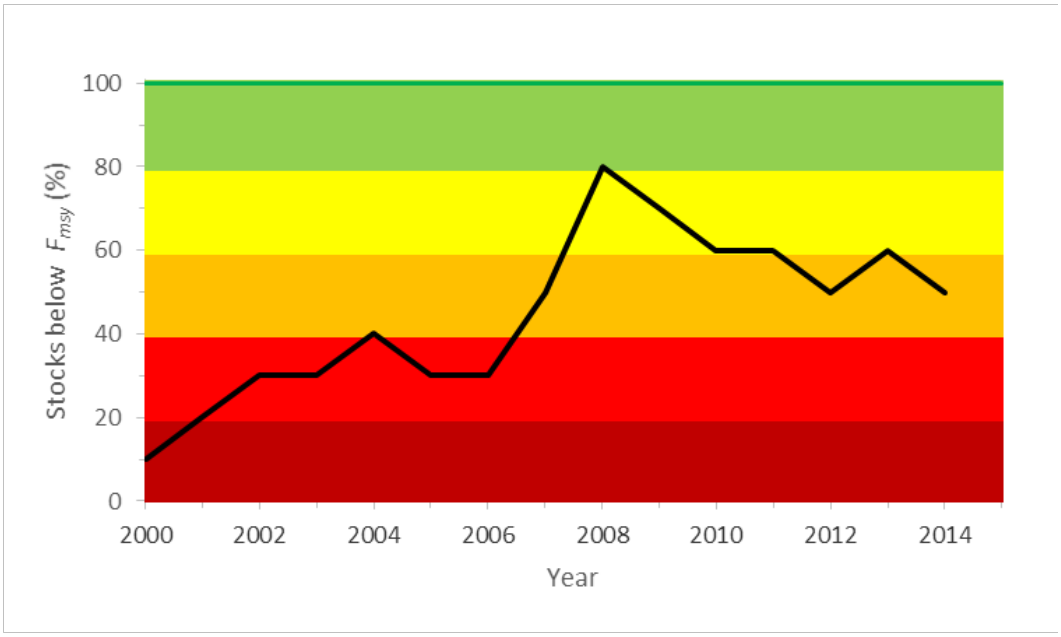



*Figure 131. Percentage of stocks where fishing mortality F is at or below the level that can produce the maximum sustainable yield ($F_{msy}$) for 10 ICCAT stocks in the Northeast Atlantic and Mediterranean (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be at or below $F_{msy}$ in 2015, latest in 2020. In 2014, 50% of the stocks fulfilled that requirement. [ICCAT_Oct05_16.xlsx]*

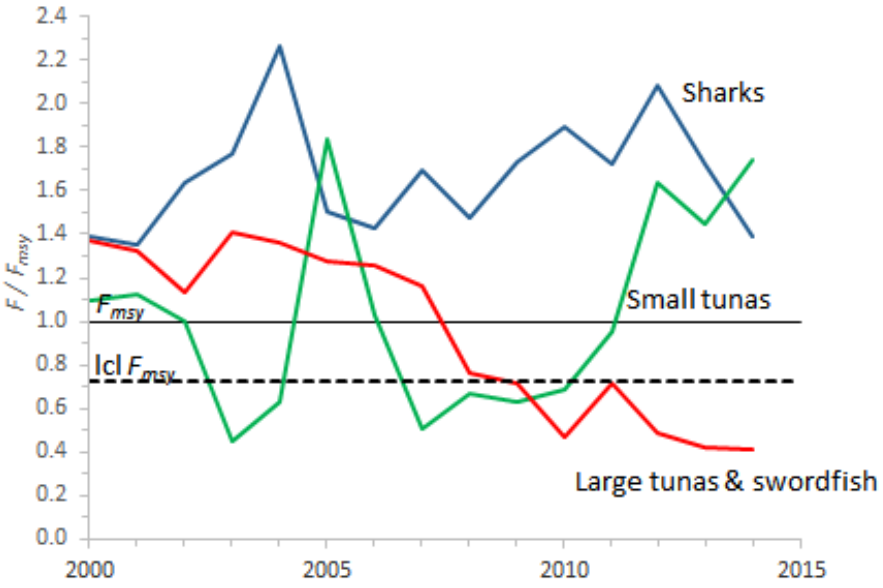



*Figure 132. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 10 ICCAT stocks in the Northeast Atlantic and Mediterranean assigned to phylogenic groups. Sharks (blue curve) were strongly overfished before 2000 and they are still subject to overfishing throughout the shown time series. According to the available data, exploitation of large tunas & swordfish is much lighter than expected. [ICCAT_Oct05_16.xlsx]*

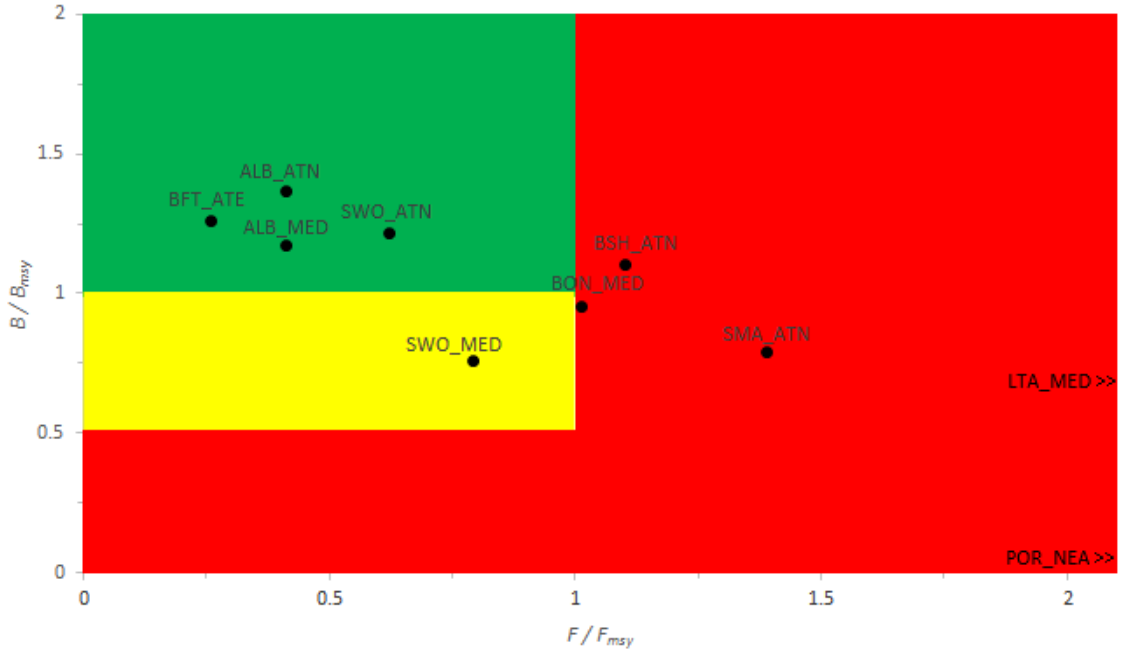



*Figure 133. Presentation of 10 ICAAT stocks in the Northeast Atlantic and Mediterranean in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. [ICCAT_Oct05_16.xlsx]*

**ICES Stocks**

The following three paragraphs describing the area utilized by widely distributed and migratory stocks within the ICES area were taken from the ICES Advice 2008, Book 9,

http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2008/2008/9.3.1%20Assessment%20and%20advice%20regarding%20fisheries.pdf.

"Due to the heterogeneous nature of the waters used by widely distributed and migratory stocks, the ecosystem descriptions are split into two between the continental shelf and its pelagic zone and the oceanic and deep sea area.

Most of the surface of the advisory region K [Oceanic northeast Atlantic] is abyssal plain with average depth >ca 4000 m. To the east the continental slope of Europe is mainly rocky and hard from the latitude of Ireland southwards, further north sediment cover occurs to the west of the British Isles. To the west of Scotland, topography is variable with two portions of detached continental shelf – Rockall and Hatton Banks – separated from the European continental shelf by the Rockall Trough. The northern part of this advisory region is marked by the Wyville Thomson and the Iceland–Faroe Ridges. In the west, the major topographical feature is the mid-Atlantic Ridge (MAR) that follows a sinuous course southwards from Iceland (where it is known as Reykjanes Ridge), to the Azores. At the ridge new oceanic floor is formed and the western and eastern parts of the North Atlantic basin are separating at a speed of 2–6 m/year. The MAR has a rugged topography with numerous peaks of variable height. Isolated seamounts occur over the whole basin. The European continental slope is comparatively gentle. The western part of the advisory region extends beyond the MAR over the northwestern Atlantic deep basin. Along the ridge, the Charlie Gibbs Fracture Zone (CGFZ) is a major transversal feature comprising a system of two main parallel deep rift valleys running perpendicular to the main MAR axis at about 52°N. The axis of the ridge south of the CGFZ is about 6° east of that of the ridge to the north. The main flow of deep-water between the western and eastern deep-sea basins of the North Atlantic occurs through these deep channels and affects the whole North Atlantic circulation (see http://www.mar-eco.no). If advisory region K were to be split in the future, the CGFZ might prove a suitable dividing feature.

The general circulation in the epipelagic zone (0–200 m) is well understood. A warm current flows from the southwestern North Atlantic towards the European coast with several side branches. Cold currents flow south from the Labrador Sea and Irminger Sea and also as a strong deep-water flow between Shetland and the Faroes."

ICES assessment reports with data until 2014 or 2015 were analyzed for 30 wide-ranging stocks in the Northeast Atlantic. The graphs below summarize their status and exploitation level within an MSY-framework. The list of species and their current exploitation and status is summarized in Table 20. Detailed assessments for every stock are available in Appendix 3 and in the spreadsheet Wide_Sep29_16.xlsx.

Of the 30 stocks, 17 (57%) were subject to ongoing overfishing ($F > F_{msy}$) and 18 stocks (60%) were outside of safe biological limits ($B < 0.5\ B_{msy}$). In seven stocks (23%) catches exceeded the maximum sustainable yield ($C/MSY > 1$). Ten stocks (33%) were in critical condition, defined by being outside of safe biological limits and subject to overfishing (marked red in Table 20). Altogether, 22 stocks (73%) were subject to unsustainable exploitation (catch > *MSY* or $F > F_{msy}$ or $B < 0.2\ B_{msy}$), with the too high catches marked red in Table 20. Of special concern are the nine severely depleted stocks ($B < 0.2\ B_{msy}$) which show no sign of

recovery. Only two stocks (lin-oth, whb-comb) could be considered healthy, defined by not being subject to overfishing and having a biomass above the one that can produce the maximum sustainable yield.

Summed biomass of the 30 stocks of 10.6 million tonnes in the last year with available data was close to the biomass level of 11.9 million tonnes that can produce maximum yield. Note, however, that this was caused by the good biomass level of the two largest stocks and masks the very low biomass levels of the many small stocks. Summed catches of 2.8 million tonnes exceeded the summed maximum sustainable yield of 2.7 million tonnes and can therefore not be maintained. These catches stem mostly from Atlantic mackerel and Blue whiting, which exceed the catches of all other stocks by orders of magnitude. See legends of Figures for more comments.

*Table 20. Analysis of 30 wide ranging ICES stocks, with indication of last year with available data (Year), maximum sustainable yield (MSY), absolute and relative catch (Catch, C/MSY), maximum sustainable fishing mortality ($F_{msy}$) if the stock is within safe biological limits ($B/B_{msy} > 0.5$) , $F_{msy}$ for current stock size, $F/F_{msy}$ for current stock size, biomass that can produce MSY ($B_{msy}$), relative biomass ($B/B_{msy}$). Scientific names of healthy stocks where F/Fmsy < 1 and B/Bmsy > 1 are marked green and stocks outside of safe biological limits ($B/B_{msy} < 0.5$) with ongoing overfishing ($F/F_{msy} > 1$) are marked red. Catches above MSY are marked bold (C/MSY > 1). Overfishing with $F/F_{msy} > 1$ is marked bold. Stock sizes outside safe biological limits (B/Bmsy < 0.5) are marked bold. Unsustainable catches (catch > MSY, F > Fmsy, B < 0.2 Bmsy) are marked red. Catches are given in tonnes per year. Biomass is given in tonnes as average total biomass during the year. Species are sorted by functional groups as indicated by the color of the stock IDs: benthic fish & invertebrates (blue), large predators (red) and pelagic plankton feeders (green). [Wide_Sep29_16.xlsx]*

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Squatina squatina* | agn-nea | 2011 | 69 | 1 | 0.01 | 0.14 | 0.02 | 0.03 | **1.39** | 504 | 36 | **0.07** |
| *Argentina silus* | arg-123a4 | 2014 | 12,969 | 15,057 | **1.16** | 0.25 | 0.25 | 0.54 | **2.14** | 51,582 | 27,967 | 0.54 |
| *Argentina silus* | arg-rest | 2014 | 2,605 | 1 | 0.00 | 0.11 | 0.06 | 0.00 | 0.00 | 23,110 | 5,796 | **0.25** |
| *Molva dypterygia* | bli-oth | 2014 | 498 | 240 | 0.48 | 0.19 | 0.17 | 0.21 | **1.25** | 2,584 | 1,135 | **0.44** |
| *Aphanopus carbo* | bsf-nea | 2015 | 194 | 508 | **2.62** | 0.06 | 0.06 | 0.13 | **2.09** | 3,193 | 3,994 | 1.25 |
| *Centroscymnus coelolepis* | cyo-nea | 2014 | 7,953 | 5 | 0.00 | 0.02 | 0.01 | 0.00 | 0.01 | 525,521 | 96,273 | **0.18** |
| *Squalus acanthias* | dgs-nea | 2013 | 20,787 | 2,384 | 0.11 | 0.04 | 0.03 | 0.01 | 0.45 | 559,106 | 199,961 | **0.36** |
| *Anguilla anguilla* | eel-eur | 2014 | 14,721 | 3,329 | 0.23 | 0.15 | 0.05 | 0.22 | **4.77** | 96,538 | 14,859 | **0.15** |
| *Phycis blennoides* | gfb-comb | 2015 | 3,353 | 4,243 | **1.27** | 0.29 | 0.29 | 0.59 | **2.04** | 11,508 | 7,149 | 0.62 |
| *Centrophorus squamosus* | guq-nea | 2014 | 4,344 | 33 | 0.01 | 0.07 | 0.01 | 0.00 | 0.33 | 63,397 | 6,758 | **0.11** |
| *Chelidonichthys cuculus* | gur-comb | 2014 | 6,141 | 5,060 | 0.82 | 0.49 | 0.39 | 1.02 | **2.64** | 12,592 | 4,973 | **0.39** |
| *Molva molva* | lin-oth | 2014 | 36,934 | 17,024 | 0.46 | 0.21 | 0.21 | 0.10 | 0.46 | 173,693 | 174,951 | 1.01 |
| *Mullus surmuletus* | mur-west | 2014 | 2,414 | 1,402 | 0.58 | 0.58 | 0.58 | 0.40 | 0.70 | 4,197 | 3,501 | 0.83 |
| *Hoplostethus atlanticus* | ory-comb | 2015 | 3,569 | 90 | 0.03 | 0.14 | 0.03 | 0.04 | **1.57** | 24,913 | 2,233 | **0.09** |
| *Raja clavata* | raj-mar | 2014 | 75 | 187 | **2.49** | 0.17 | 0.17 | 0.79 | **4.56** | 435 | 238 | 0.55 |
| *Macrourus berglax* | rhg-nea | 2014 | 4,143 | 654 | 0.16 | 0.16 | 0.08 | 0.11 | **1.40** | 26,169 | 6,204 | **0.24** |
| *Coryphaenoides rupestris* | rng-1012 | 2014 | 12,988 | 3,481 | 0.27 | 0.16 | 0.06 | 0.24 | **4.32** | 81,020 | 14,267 | **0.18** |
| *Coryphaenoides rupestris* | rng-oth | 2014 | 233 | 51 | 0.22 | 0.21 | 0.10 | 0.19 | **1.80** | 1,101 | 272 | **0.25** |

| Scientific name | Stock | Year | *MSY* | Catch | *C/MSY* | $F_{msy}$ | $F_{msy\ cur}$ | *F* | $F/F_{msy\ cur}$ | $B_{msy}$ | *B* | $B/B_{msy}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Dalatias licha* | sck-nea | 2014 | 594 | 0 | 0.00 | 0.13 | 0.05 | 0.00 | 0.00 | 4,405 | 882 | **0.2002** |
| *Brosme brosme* | usk-mar | 2013 | 26 | 0 | 0.00 | 0.18 | 0.04 | 0.00 | 0.00 | 149 | 16 | **0.11** |
| *Brosme brosme* | usk-oth | 2014 | 8,652 | 4,585 | 0.53 | 0.24 | 0.24 | 0.13 | 0.56 | 36,449 | 34,755 | 0.95 |
| *Galeorhinus galeus* | gag-nea | 2014 | 1,126 | 347 | 0.31 | 0.06 | 0.04 | 0.07 | **2.04** | 17,492 | 4,809 | **0.27** |
| *Merluccius merluccius* | hke-nrtn | 2015 | 83,946 | 101,066 | **1.20** | 0.19 | 0.19 | 0.21 | **1.12** | 449,584 | 483,134 | 1.07 |
| *Lamna nasus* | por-nea | 2014 | 2,085 | 7 | 0.00 | 0.03 | 0.01 | 0.00 | 0.18 | 67,218 | 6,413 | **0.10** |
| *Salmo salar* | salmon-NEAC | 2014 | 6,305 | 938 | 0.15 | 0.14 | 0.05 | 0.10 | **1.87** | 46,267 | 9,227 | **0.199** |
| *Mustelus* spp. | trk-nea | 2014 | 3,586 | 3,690 | **1.03** | 0.14 | 0.14 | 0.17 | **1.18** | 25,408 | 22,145 | 0.87 |
| *Micromesistius poutassou* | whb-comb | 2014 | 1,453,351 | 1,146,000 | 0.79 | 0.23 | 0.23 | 0.17 | 0.77 | 6,404,617 | 6,567,571 | 1.03 |
| *Cetorhinus maximus* | bsk-nea | 2014 | 1,025 | 0 | 0.00 | 0.03 | 0.01 | 0.00 | 0.00 | 29,740 | 3,132 | **0.11** |
| *Trachurus trachurus* | hom-west | 2014 | 303,148 | 129,025 | 0.43 | 0.26 | 0.26 | 0.21 | 0.79 | 1,149,830 | 615,697 | 0.54 |
| *Scomber scombrus* | mac-nea | 2014 | 735,937 | 1,394,454 | **1.89** | 0.36 | 0.36 | 0.61 | **1.70** | 2,057,592 | 2,299,822 | 1.12 |

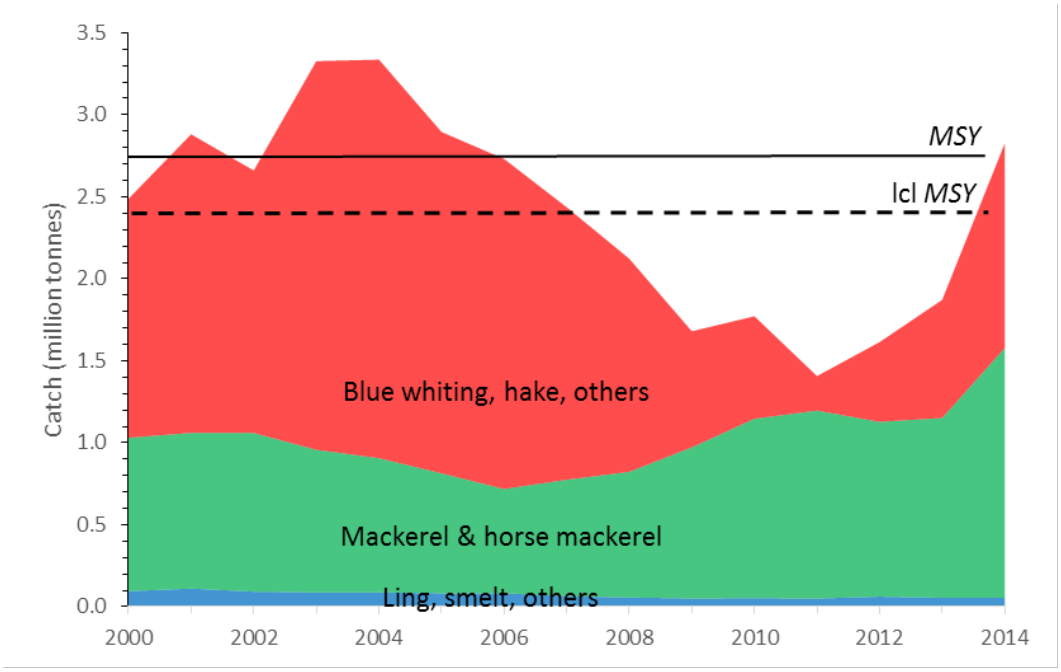



*Figure 134. Cumulative catches, including discards and recreational catch if available, for 30 wide-ranging ICES stocks, with indication of main functional groups. The black line indicates the maximum sustainable yield (MSY) for the ecoregion and the dashed line indicates the lower 95% confidence limit as a precautionary target. Note that, by definition, catches above MSY cannot be maintained. [Wide_Sep29_16.xlsx]*

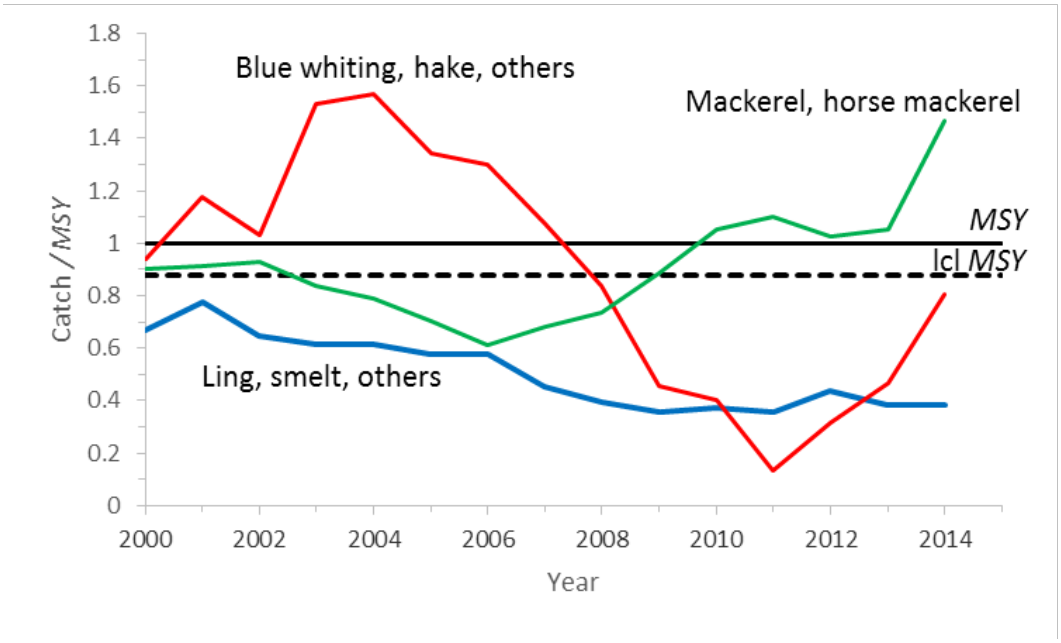



*Figure 135. Catches by main functional group relative to their maximum sustainable yield (MSY, black line), for 30 wide-ranging ICES stocks. The mackerel catches above MSY cannot be maintained. [Wide_Sep29_16.xlsx]*

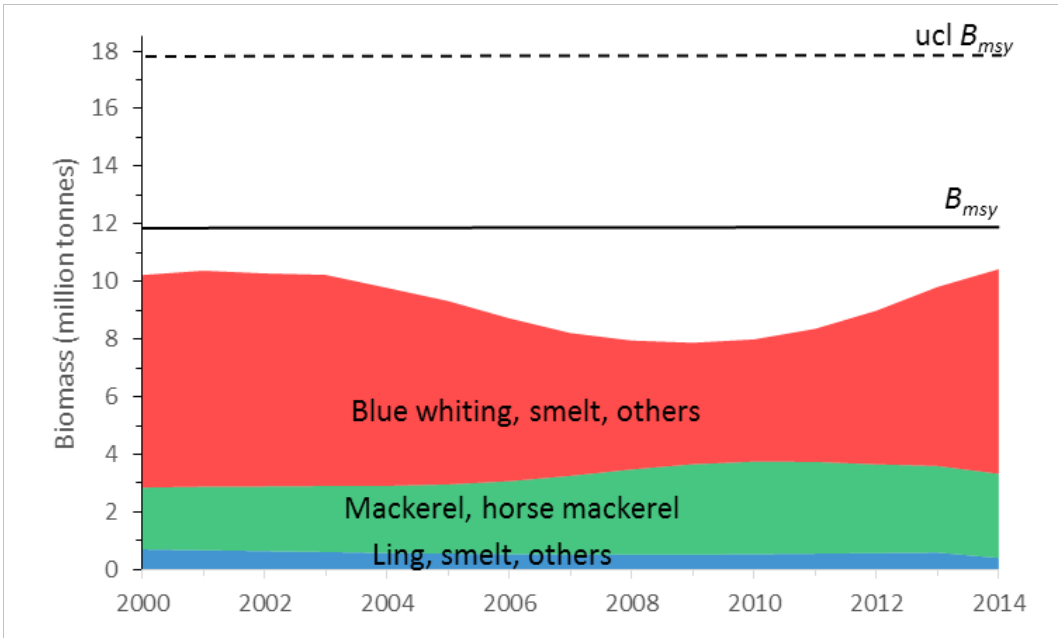



*Figure 136. Cumulative total biomass of 30 wide-ranging ICES stocks relative to the biomass that can produce the maximum sustainable yield ($B_{msy}$ = black line). The upper 95% confidence limit of $B_{msy}$ (dashed line) would present a precautionary target biomass above $B_{msy}$. This is also the area where the maximum economic yield could be obtained. The functional groups of benthic fish (blue), pelagic plankton feeders (green) and large predators (red) are indicated, with listing of main species. The high biomass of blue whiting and mackerel masks the low biomass of the other stocks, see median biomass levels in next graph for comparison. [Wide_Sep29_16.xlsx]*

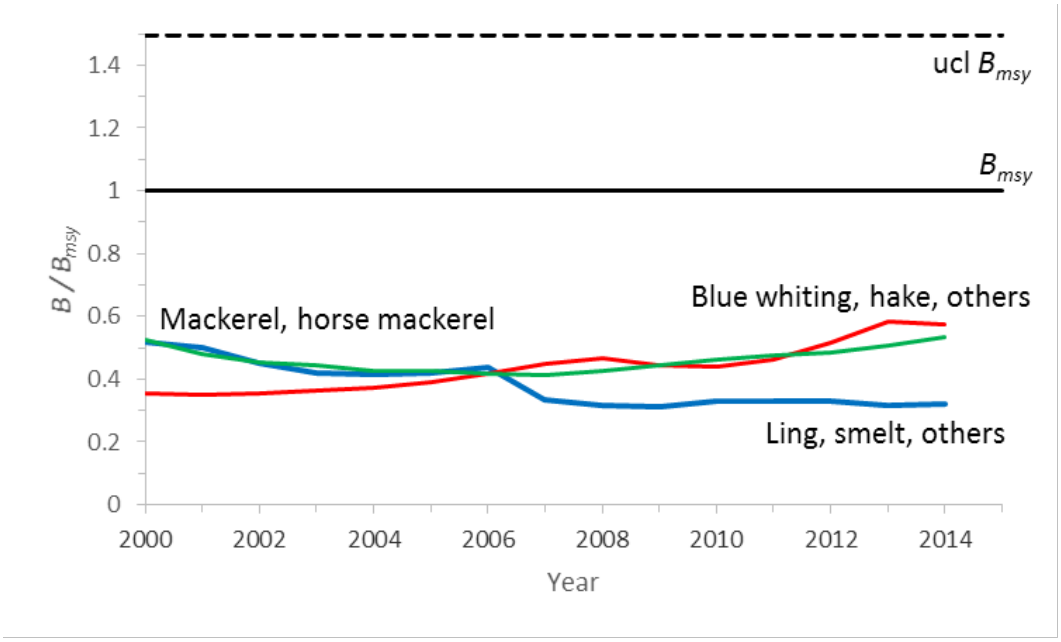



*Figure 137. Median biomass relative to the level that can produce the maximum sustainable yield ($B/B_{msy}$) for 30 wide-ranging ICES stocks assigned to main functional groups. Biomass levels of benthic fish (blue curve) are outside of safe biological limits. [Wide_Sep29_16.xlsx]*

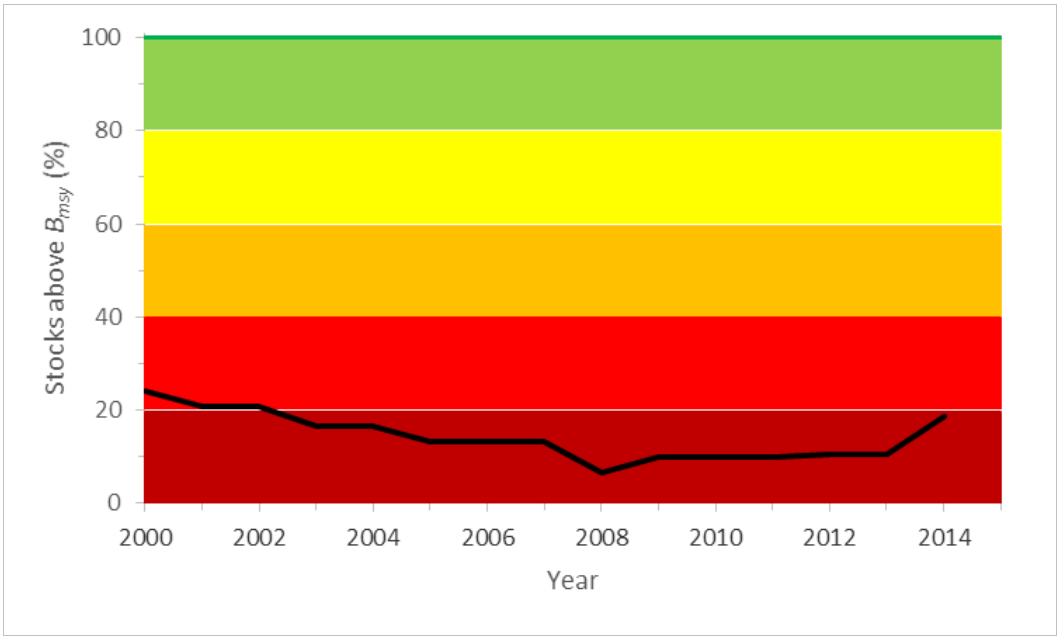



*Figure 138. Percentage of stocks where biomass is above the level that can produce the maximum sustainable yield ($B_{msy}$) for 30 wide-ranging ICES stocks (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be above $B_{msy}$ eventually. In 2014, only 19% of the stocks fulfilled that requirement. [Wide_Sep29_16.xlsx]*

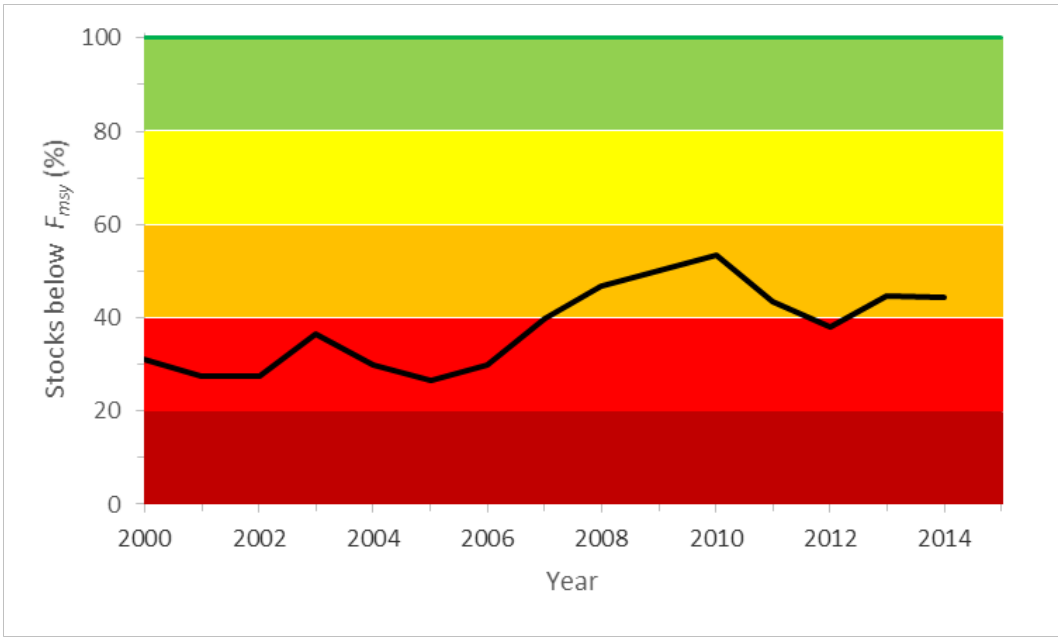



*Figure 139. Percentage of stocks where fishing mortality F is at or below the level that can produce the maximum sustainable yield ($F_{msy}$) for 30 wide-ranging stocks in the ICES area (black curve). The colors indicate visually the compliance with the goals of the Common Fisheries Policy, where all stocks (100%) shall be at or below $F_{msy}$ in 2015, latest in 2020. In 2014, only 44% of the stocks fulfilled that requirement. [Wide_Sep29_16.xlsx]*

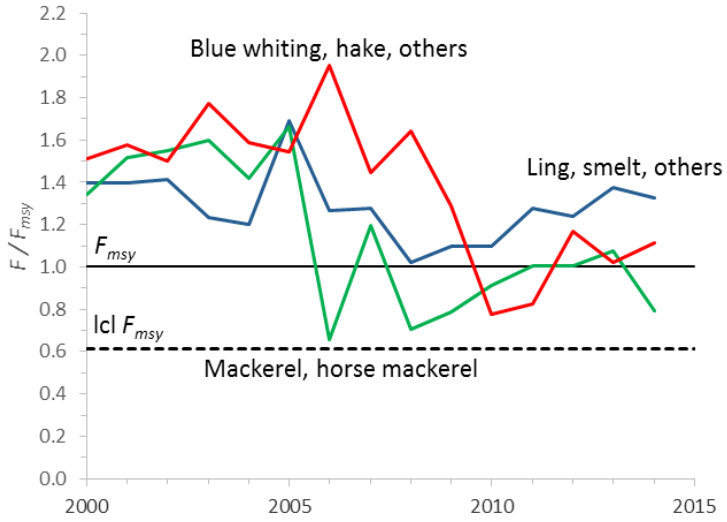



*Figure 140. Median fishing pressure relative to the maximum sustainable level ($F/F_{msy}$) for 30 wide-ranging ICES stocks assigned to main functional groups. The strong decline in fishing pressure on large predators (red curve) is misleading because several of these stocks are depleted and show no signs of recovery despite low fishing pressure. The high fishing pressure on plankton feeders and benthic fish is not sustainable. [Wide_Sep29_16.xlsx]*

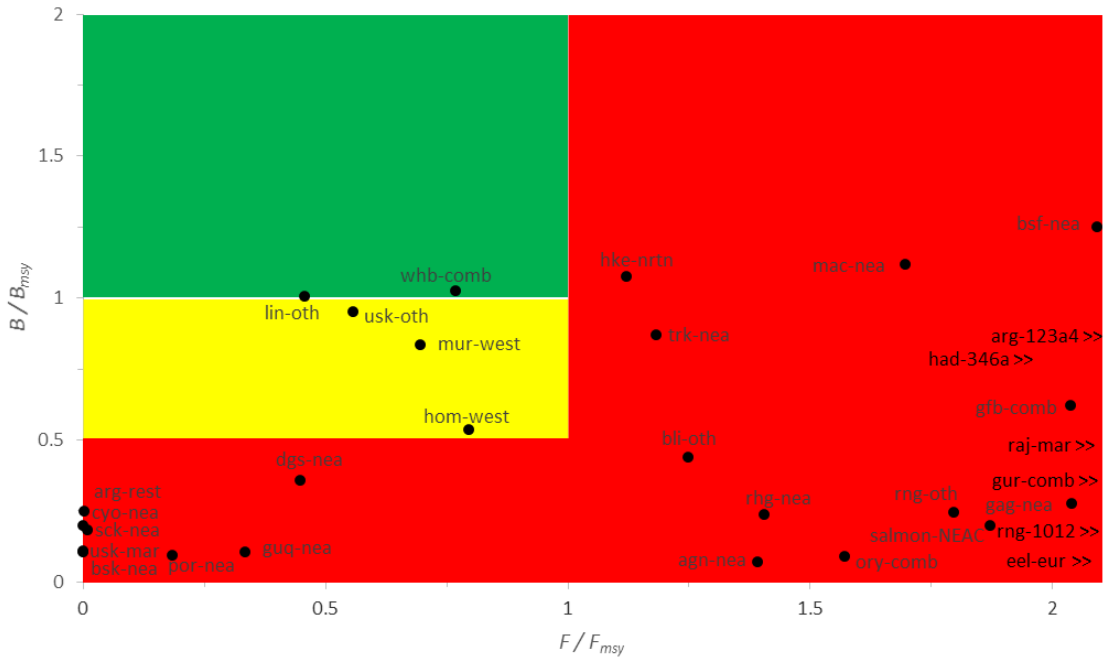



*Figure 141. Presentation of 30 wide-ranging and migratory ICES stocks in a pressure ($F/F_{msy}$) – state ($B/B_{msy}$) plot. The red area indicates stocks that are being overfished or are outside of safe biological limits. The yellow area indicates recovering stocks. The green area indicates stocks subject to sustainable fishing pressure and of a healthy stock size that can produce high yields close to MSY. Several stocks (indicated with ->>) are exploited beyond the upper limit of the X-axis. [Wide_Sep29_16.xlsx]*

**Discussion**

All stocks (397) in European Seas and adjacent waters with available catch data were analyzed with an advanced state-space Bayesian implementation (BSM) and with a simplified Monte-Carlo implementation (CMSY) of a surplus production model (Froese et al. 2016). A comparison of the $F/F_{msy}$ ratios estimated by these models with those estimated by the respective stock assessment working groups showed good agreement, with 67% of the BSM/CMSY estimates deviating less than 50% from the ones of the working groups and with 82% of the BSM/CMSY estimates coming to the same conclusion with regard to overfishing ($F/F_{msy} > 1$). Thus, the results of this study can be considered comparable with the "official" estimates used in statistics by the European Commission. The advantage of the simplified models used in this study is their broad applicability (397 stocks vs 93 stocks with "official" $F/F_{msy}$ estimates) and the estimation of additional reference points (*MSY* and $B_{msy}$) that are crucial for the evaluation of progress towards the goals of the Common Fisheries Policy (CFP 2013).

The map below shows the percentage of stocks that fulfill the requirements of the CFP, by ecoregion. There is a remarkable North-South gradient, with over 60% of the stocks exploited sustainably with a biomass above the one that can produce *MSY* in the Barents Sea and Norwegian Sea, compared to less than 20% of stocks with these properties in most of the Mediterranean Sea.

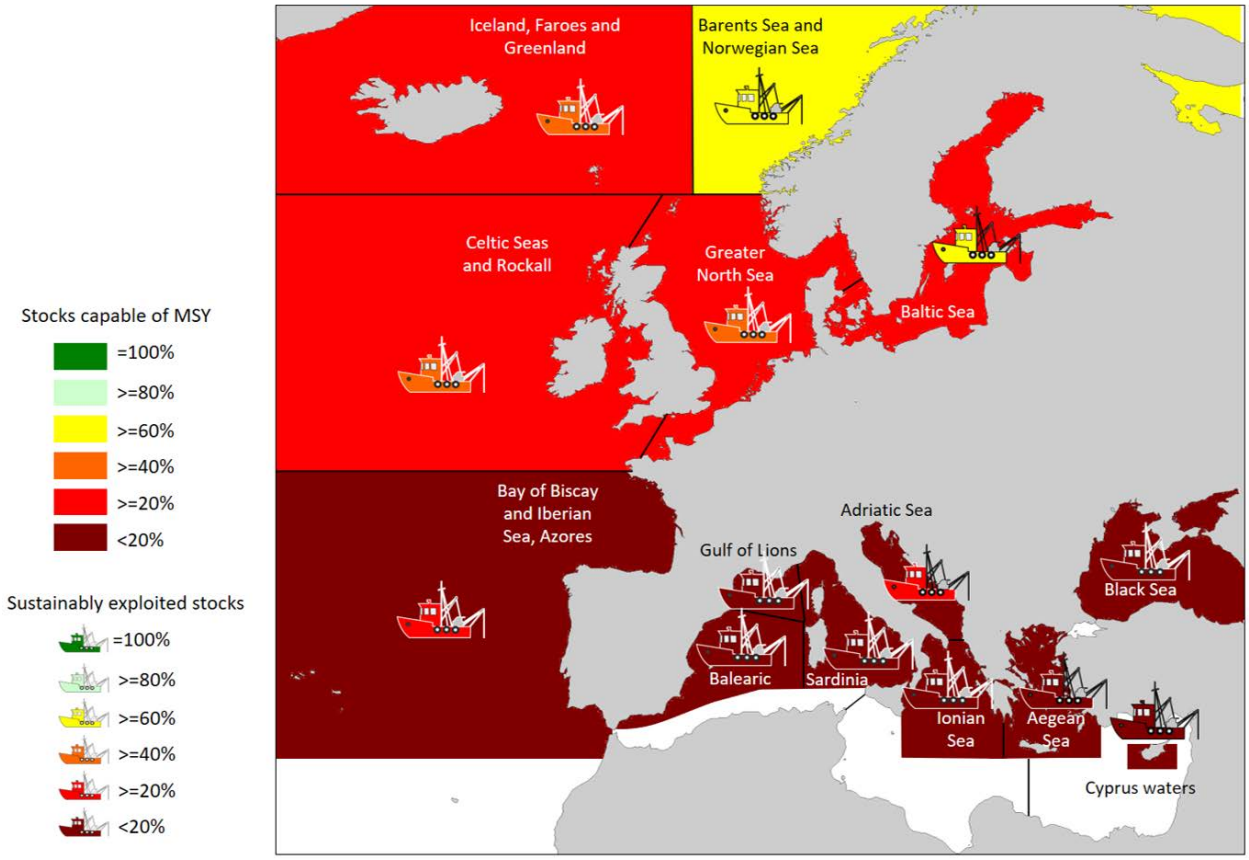



*Figure 5. Map showing the compliance with the Common Fisheries Policy of the EU, for 357 stocks in 12 ecoregions, for the last years (2013-2015) with available data (excluding 40 wide-ranging stocks). The color of the areas indicates the percentage of stocks with sizes that are above the level that can produce maximum sustainable yields (B > Bmsy) and the color of the fishing boats indicates the percentage of stocks that are exploited sustainably ($F <= F_{msy}$, catch < MSY, $B > 0.2\ B_{msy}$).*

Of the 397 stocks with available data, 64% were subject to ongoing overfishing and 51% were outside of safe biological limits, potentially suffering from impaired recruitment. Only 12% of the stocks fulfilled the requirement of the Common Fisheries Policy of Europe as being not subject to overexploitation and having a biomass above the level that can produce maximum sustainable yields.

Biomass in the ecoregions of the Mediterranean and Black Sea was on average less than half (44%) of the level that can produce *MSY*, whereas in the northern ecoregions (Barents Sea to Iberian Sea) biomass was on average about ¾ (73%) of that level. Rebuilding of biomass above the *MSY* level will require a few years in most stocks, depending on the depletion level of the stocks and how far exploitation is reduced below the *MSY*-level during the rebuilding phase. For example, exploitation at half the *MSY*-level should rebuild most stocks in the northern ecoregions in 1-5 years whereas in the more depleted Mediterranean stocks rebuilding may take 1-7 years.

Total catches across all stocks and regions were 8.8 million tonnes whereas the maximum sustainable yield (*MSY*) was estimated at 15.4 million tonnes. Because of trophic interactions it is not possible to achieve *MSY* simultaneously for all stocks, but after rebuilding of the stocks and assuming a precautionary target of 90% of *MSY*, substantial increases in catches could be possible. These potential increases differ widely between ecoregions, from 25% in the Baltic Sea to over 200% in some Mediterranean ecoregions. Across all stocks and ecoregions, potential increases in catch of over 50% would be possible.

Independent assessments of exploitation status were available for 93 (23%) of the examined stocks. A comparison of these exploitation estimates with the results of this study showed good agreement, with 82% of the stocks having the same classification of being overfished or being sustainably exploited. For the stocks with different classifications, this study tended to underestimate exploitation.

In summary, the goal of the Common Fisheries Policy of Europe to reduce exploitation to *MSY*-levels by 2015 (with exceptions until 2020) seems to have been missed by a large margin. Without reduction of exploitation below the *MSY*-level there will be no rebuilding of stocks above the level that can produce *MSY*. Especially the stocks in the Mediterranean need urgent action to stem the widespread collapse of largely unrestricted fisheries.

**Acknowledgements**

FIN acknowledges the generous support of this study and the contributing workshops by Fundacion Oceana, Madrid, Spain. This is FIN contribution number 204.

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