# 10 Striped red mullet in Subareas and Divisions 6, 7a–c, e–k, 8, and 9a

## 10.1 General biology

Striped red mullet (*Mullus surmuletus*) is a predominantly benthic species found along the coasts of Europe, southern Norway, and northern Scotland (northern Atlantic, Baltic Sea, North Sea, and the English Channel), up to the Northern part of West Africa, in the Mediterranean Basin, and in the Black Sea (Mahe *et al.*, 2005). Young fish are distributed in lower salinity coastal areas, while adults have a more offshore distribution.

Adult red mullets feed on small crustaceans, annelid worms, and molluscs, using their chin barbels to detect prey and search the mud. As a consequence, striped red mullets are typically found on sandy, gravelly and shelly sediments where they can excavate sediment with their barbels and dislodge the small invertebrates. The main natural predators of striped red mullet are sea basses, pollacks, barracudas, monkfish, congers, and sharks (Caill-Milly *et al.*, 2017).

Sexual maturity is reached at the beginning of the second year for males, followed by a marked decrease in growth rates, and at the end of the second or beginning of the third year for females which therefore continue their rapid growth a little longer (Déniel, 1991). In the English Channel, this species matures at approximately 16 cm (Mahe *et al.*, 2005), while in the Bay of Biscay, the sizes of first sexual maturity are given by Dorel (1986) as males 16 cm, females 18 cm and a length at which 50% of the individuals are mature (the distinction between the two sexes is not mentioned) of 22 cm.

Spawning occurs in the spring and early summer -May to June according to Desbrosses (1933)- with a spawning peak in June in the northern Bay of Biscay (N'Da and Déniel, 1993). Eggs and larvae average 2.8mm and are pelagic (Sabatés *et al.*, 2015). The hatching takes place after three days at 18°C and after eight days at a temperature of 9°C (Quéro and Vayne, 1997). After metamorphosis, juveniles become first demersal then benthic. At the age of one month, they measure about 5cm and weigh 0.9 to 1.6g. They show rapid growth during their first four months of life between July and October. Increases in length and mass are about 7cm and 25g on average during this period (N'Da and Déniel, 2005). The rate of growth declines sharply in October due to the cooling of water and the scarcity of trophic resources in the environment. These conditions contribute to the initiation of migration of red mullets to greater depths offshore. Until the age of two, there is no significant difference in size between males and females; they then measure 20-23cm. Sexual dimorphism is observed from the age of first maturity due to growth rates that will then differ between the two sexes. From age three, females exceed males in length by 4 cm on average and 7cm beyond 5 years (N'Da *et al.*, 2006).

The maximum reported age of the striped red mullet is 11 years (Quéro and Vayne, 1997; ICES, 2012), while the maximum length given is 44.5cm in the Bay of Biscay (Dorel, 1986) and 40cm elsewhere (Whitehead *et al.*, 1984; Fischer *et al.*, 1987). The maximum reported mass is 1kg (Muus and Nielsen, 1999).

## 10.1 Management regulations

Prior to 2002, France enforced a minimum landing size of 16 cm. Since 2013 minimal size requirement has been established to 15 cm (France, 2013). There is no TAC for this stock.

## 10.2 Stock ID and possible management areas

In 2004 and 2005, a study using fish geometrical morphometry was carried out in the Eastern English Channel and the Bay of Biscay. It pointed out a morphological difference on striped red mullets between those from the Eastern English Channel and those from the Bay of Biscay (Mahe *et al.*, 2014). Benzinou *et al.* (2013) conducted stock identification studies based on otolith and fish shape in European waters and showed that striped red mullet can be geographically divided into three zones:

- The Bay of Biscay (Northern Bay of Biscay – NBB, and Southern Bay of Biscay - SBB)
- A mixing zone composed of the Celtic Sea and the Western English Channel (CS + WEC)
- A northern zone composed of the Eastern English Channel and the North Sea (EEC + NS)

The distinction between the putative Biscay and Western Channel/Celtic Sea populations is supported by the distribution of landings at a statistical rectangle level (Figure 10.3.1). Examination of catch from surveys suggests striped red mullet in division 9a are geographically distinct, with an area of higher abundance between Cabo Sao Vicente and the Tagus estuary, and an area where this species is mostly absent to the north. This assessment treats these putative components as one population. At present there are no management measures in place, however this structuring should be taken into account if measures are considered.

## 10.3 Fisheries data

Official landings have been recorded since 1975 and after early increases they have declined in recent years. Landings are mainly taken from Subarea 7 and 8 and France accounts for the majority of removals (Table 10.4.1-2). The striped red mullet is one species among set of benthic (demersal) species targeted by the French fleet, and is mainly caught by bottom trawlers with a mesh size of 70—99mm. In the Western English Channel striped red mullet is also caught by gillnets. Danish seine appeared in 2008 as a result of some trawlers converting to use seine gears.

The average characteristics of vessels in French fleets that caught red mullet from 2000 to 2015 are: 41.1 GRT, 191.1kW engine power, 12.9m length and 22 years of service. Net vessels are made up of the smallest units (85% are less than 12m long), while 52% of bottom trawlers are less than 15m; the seiners are by far the largest and the oldest vessels (Caill-Milly *et al.*, 2017).

The French activity on this species differs between the area composed by West Scotland/Celtic sea (including West Channel) and the area comprising the Bay of Biscay. In the first one, landings are mainly taken by bottom trawlers, followed by gillnet. In the second one, they are mainly done by bottom trawls, seine and nets. French activity in the Atlantic Iberian waters remains limited. The Spanish activity is located in the north (8a, b) and the south (8c) of the Bay of Biscay.

Discarding represented between 3% and 18% of the total catches in 2014–21 (Table 10.4.3). Since 2018, the discard rates are reported below 5%. However, there are concerns about how these discards have been estimated due to the lack of discards data for some countries. From the data provided to Intercatch in 2020, discards are essentially composed of individuals measuring less than 18 cm (Figure 10.2).

## 10.4 Survey data, recruit series

Exchange data is available in DATRAS during 1997-2021 for the French EVHOE survey, covering the Bay of Biscay and Celtic Sea (fig. 10.5.1), during 2001 – 2016 for the northern Spanish

groundfish survey (SP-NSGFS), and from 2002 onwards for the Portuguese groundfish survey (PT-IBTS), covering the Portuguese coast. Relative total biomass in the EVHOE survey (fig. 10.5.2) are variable around the series mean between 1997 – 2011, before falling to a lower level thereafter. Similarly, catch rates in the PT-IBTS are at a low level in 2005, peak in 2010, before falling back to near the series mean in recent years. The mean stratified abundance from the Spanish NSGFS follows a similar trend: high variability around the mean before 2017, then low level since 2017. (fig. 10.5.3).

Biological sampling in the Bay of Biscay of sexual maturity and length measures were taken in 2009 by AZTI. French sampling started in 2004 in the Eastern Channel and in the south North Sea, and since 2008 in the Bay of Biscay. Since 2004, data (age, length, sexual maturity) are usually collected by France for the Eastern English Channel and the southern North Sea. France started to collect data for 8a, b at the end of 2007. In 2007—2008, the striped red mullet otolith exchange had for goal to optimize age estimation between countries. In 2011, an Otolith Exchange Scheme was carried out, which was the second exercise for the Striped red mullet (Mullus surmuletus). Four readers of this exchange interpreted an images collection coming from the Bay of Biscay, the Spanish coasts and the Mediterranean coasts (Spain and Italy). A set of Mullus surmuletus otoliths (N=75) from the Bay of Biscay presented highest percentage of agreement (82%). On 75 otoliths, 34 were read with 100% agreement (45%) and thus a CV of 0%. Modal age of these fishes was comprised between 0 and 3 years (Mahe *et al.*, 2012).

## 10.5 10.6 Current research programs

Two research projects are currently investigating

(1) the evolution of striped red mullet abundance indices from fishery dependent data and

(2) the temporal evolution of the size and age at maturity for this species in the Bay of Biscay.

The first research project (ACOST) extend the analysis presented in
Caill-Milly *et al.* (2017) and Caill-Milly *et al.* (2019) and computes 4 abundances indices from 2005 to 2021 based on the landings per unit effort for 4 French fleets. The second project (MATO) updates the maturity data for the species in the Bay of Biscay thanks to a monthly longitudinal study over one reproduction cycle done in 2021. The final results will be published in 2022/2023 and the references will be added in the next report.

## 10.6 Analysis of stock trends/ assessment

Currently, an age structured analytical stock assessment has not been developed due to a short time-series of available data.

Data requirements - regular sampling of biological parameters of striped red mullet catches must be continued under DCF. Sampling in the Celtic Sea and in the Bay of Biscay started in 2008. In 2010 and 2011, sampling for age and maturity data was reduced compared to 2009, due to the end of the Nespman project. Since 2009, a concurrent sampling design carried out, should provide more data (length compositions) than in recent years.

## 10.7 References

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**Table 10.4.1: Striped red mullet in Subareas and Divisions 6, 7a-c, e-k, 8 and 9a. Official landings by country in tonnes.**

| Year | Belgium | France | Guernsey | Ireland | Jersey | Netherlands | Portugal | Spain | UK | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | 33 | 1947 | 8 | 16 | 1 | 115 | 10 | 387 | 170 | 2688 |
| 2007 | 43 | 1941 | 9 | 23 | 1 | 148 | 222 | 398 | 194 | 2978 |
| 2008 | 26 | 1394 | 9 | 22 | 0 | 165 | 169 | 394 | 165 | 2345 |
| 2009 | 20 | 1562 | 5 | 16 | 0 | 110 | 199 | 520 | 134 | 2567 |
| 2010 | 20 | 1743 | 5 | 8 | 0 | 128 | 276 | 479 | 133 | 2793 |
| 2011 | 21 | 1740 | 0 | 8 | 0 | 130 | 245 | 508 | 155 | 2806 |
| 2012 | 37 | 1342 | 0 | 7 | 1 | 125 | 217 | 332 | 122 | 2183 |
| 2013 | 28 | 932 | 5 | 4 | 0 | 50 | 187 | 246 | 71 | 1522 |
| 2014 | 12 | 926 | 5 | 2 | 0 | 2 | 221 | 265 | 53 | 1487 |
| 2015 | 23 | 1215 | 5 | 3 | 0 | 111 | 282 | 248 | 102 | 1989 |
| 2016 | 28 | 1179 | 0 | 4 | 0 | 69 | 204 | 194 | 83 | 1761 |
| 2017 | 36 | 997 | 0 | 10 | 0 | 13 | 154 | 327 | 64 | 1601 |
| 2018 | 37 | 896 | 0 | 0 | 0 | 95 | 122 | 321 | 67 | 1538 |
| 2019 | 30 | 1358 | 0 | 12 | 0 | 91 | 159 | 267 | 55 | 1973 |
| 2020 | 50 | 965 | 0 | 6 | 0 | 82 | 109 | 261 | 89 | 1562 |
| 2021 | 53 | 836 | 0 | 18 | 0 | 54 | 117 | 274 | 93 | 1445 |

**Table 10.4.2: Striped red mullet in Subareas and Divisions 6, 7a-c, e-k, 8 and 9a. Official landings by area in tonnes.**

| Year | 6a | 6b | 7a | 7b | 7c | 7e | 7f | 7g | 7h | 7j | 7k | 8a | 8b | 8c | 8d | 8e | 9a | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | 0 | 0 | 1 | 1 | 0 | 869 | 50 | 24 | 103 | 11 | 0 | 1,023 | 468 | 71 | 28 | 0 | 39 | 2688 |
| 2007 | 1 | 0 | 1 | 1 | 1 | 1047 | 54 | 22 | 104 | 24 | 0 | 861 | 473 | 90 | 32 | 0 | 267 | 2978 |
| 2008 | 0 | 0 | 1 | 1 | 0 | 880 | 46 | 16 | 72 | 26 | 0 | 639 | 246 | 86 | 35 | 0 | 296 | 2345 |
| 2009 | 2 | 0 | 1 | 2 | 2 | 592 | 25 | 9 | 74 | 35 | 0 | 879 | 460 | 156 | 88 | 0 | 243 | 2567 |
| 2010 | 2 | 0 | 1 | 3 | 2 | 642 | 26 | 10 | 59 | 32 | 1 | 1,033 | 467 | 146 | 38 | 0 | 331 | 2793 |
| 2011 | 1 | 1 | 1 | 0 | 0 | 665 | 20 | 10 | 55 | 11 | 0 | 970 | 513 | 214 | 35 | 0 | 310 | 2806 |
| 2012 | 0 | 0 | 0 | 0 | 0 | 493 | 23 | 7 | 34 | 9 | 0 | 696 | 387 | 200 | 53 | 0 | 280 | 2183 |

| Year | 6a | 6b | 7a | 7b | 7c | 7e | 7f | 7g | 7h | 7j | 7k | 8a | 8b | 8c | 8d | 8e | 9a | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013 | 0 | 0 | 0 | 1 | 0 | 232 | 23 | 7 | 36 | 4 | 0 | 473 | 328 | 166 | 12 | 0 | 241 | 1522 |
| 2014 | 1 | 0 | 0 | 0 | 0 | 192 | 15 | 3 | 40 | 3 | 0 | 523 | 240 | 151 | 23 | 0 | 297 | 1487 |
| 2015 | 0 | 0 | 0 | 1 | 0 | 595 | 10 | 2 | 36 | 2 | 0 | 506 | 327 | 126 | 15 | 0 | 369 | 1989 |
| 2016 | 0 | 0 | 0 | 2 | 0 | 417 | 21 | 7 | 35 | 5 | 0 | 548 | 311 | 117 | 21 | 0 | 277 | 1761 |
| 2017 | 0 | 0 | 0 | 1 | 0 | 277 | 27 | 21 | 37 | 3 | 0 | 514 | 324 | 160 | 5 | 0 | 231 | 1601 |
| 2018 | 0 | 0 | 0 | 0 | 0 | 361 | 26 | 7 | 39 | 1 | 0 | 453 | 276 | 144 | 2 | 0 | 226 | 1538 |
| 2019 | 0 | 0 | 1 | 1 | 0 | 377 | 23 | 20 | 35 | 1 | 0 | 770 | 388 | 123 | 4 | 0 | 229 | 1973 |
| 2020 | 0 | 0 | 2 | 1 | 0 | 386 | 43 | 18 | 40 | 4 | 0 | 502 | 265 | 128 | 3 | 0 | 170 | 1562 |
| 2021 | 0 | 0 | 1 | 0 | 0 | 302 | 52 | 30 | 54 | 3 | 0 | 416 | 281 | 114 | 2 | 0 | 188 | 1445 |

**Table 10.4.3: Striped red mullet in Subareas and Divisions 6, 7a-c, e-k, 8 and 9a. Official discards by country in tonnes. Total is presented with the total discards rates in %**

| Year | UK | France | Belgium | Portugal | Spain | Ireland | Netherlands | Total |
|---|---|---|---|---|---|---|---|---|
| 2013 | 0 | | | | | | | 0 (0%) |
| 2014 | | 98 | | | | | | 98 (6.2%) |
| 2015 | 77 | 115 | | | | | | 192 (8.8%) |
| 2016 | 171 | 213 | 1 | 0 | 8 | | | 394 (18.3%) |
| 2017 | 11 | 74 | 2 | 0 | 0 | 0 | | 87 (5.1%) |
| 2018 | 14 | 35 | 3 | 0 | 2 | 0 | | 53 (3.3%) |
| 2019 | 29 | 67 | 3 | | 1 | 0 | | 100 (4.8%) |
| 2020 | 39 | 28 | 4 | | 1 | 9 | 0 | 82 (5%) |
| 2021 | 9 | 49 | 4 | | 0 | 6 | 0 | 67 (4.5%) |

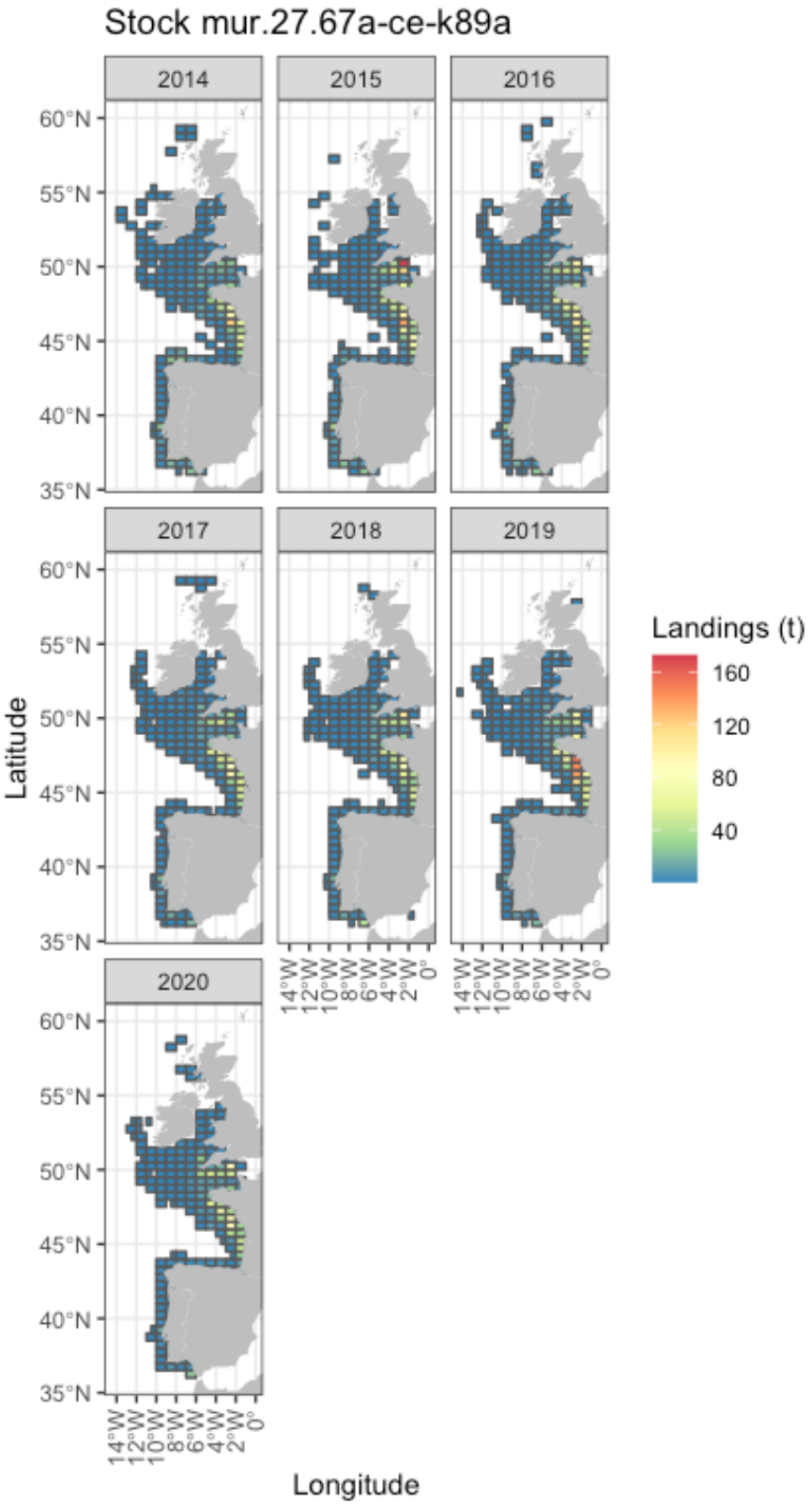


**Figure 10.3.1: Striped red mullet in Subareas and Divisions 6, 7a-c, e-f, 8 and 9a. Landings by statistical rectangle for BEL, FRA, IRE, PT, UK (E&W), UK (SCO) from 2014 to 2020 (Fishery Dependent Information database 2021).**

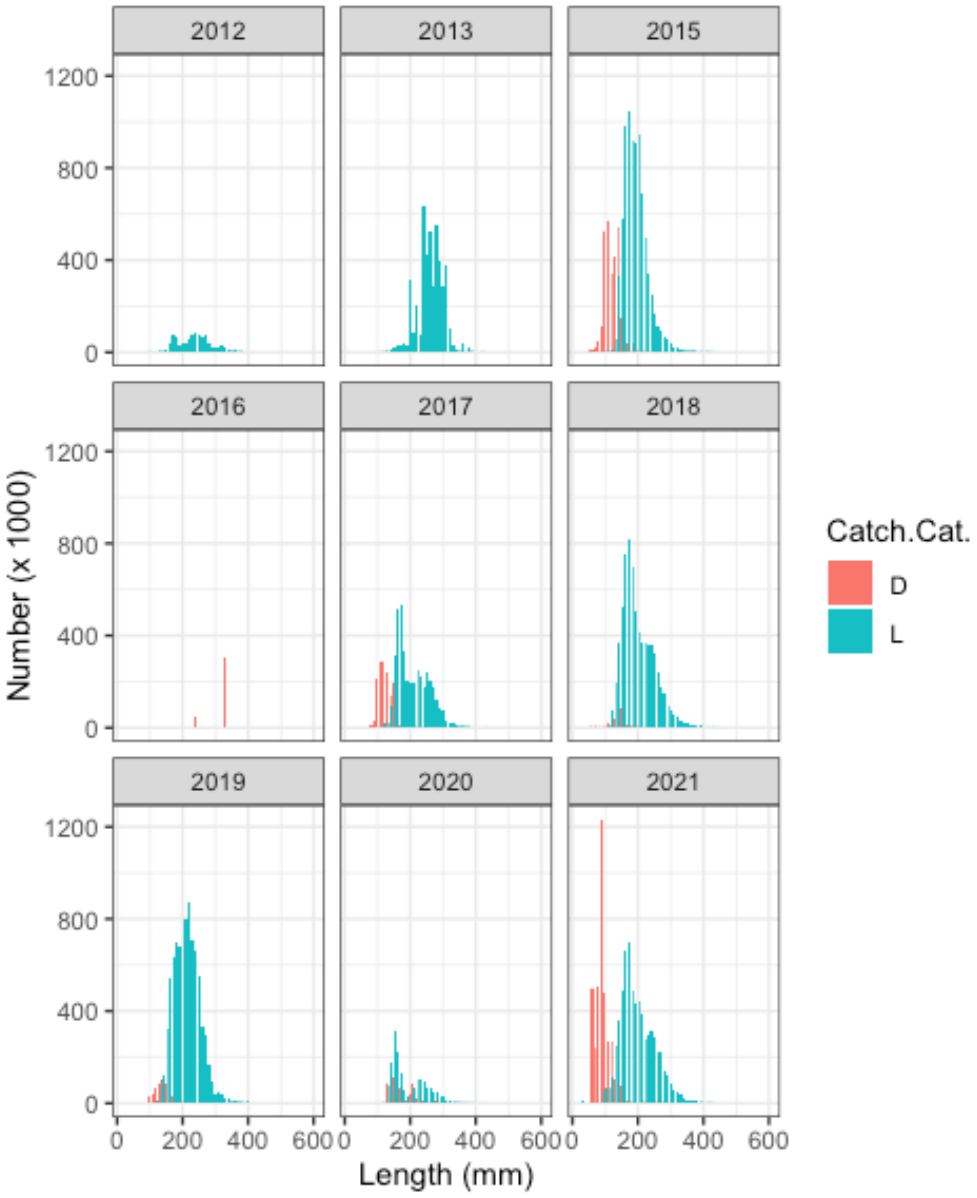


**Figure 10.2: Striped red mullet in Subareas and Divisions 6, 7a-c, e-f, 8 and 9a. Length distribution from 2014 to 2021 from Intercatch (D: Discards, L: Landings)**

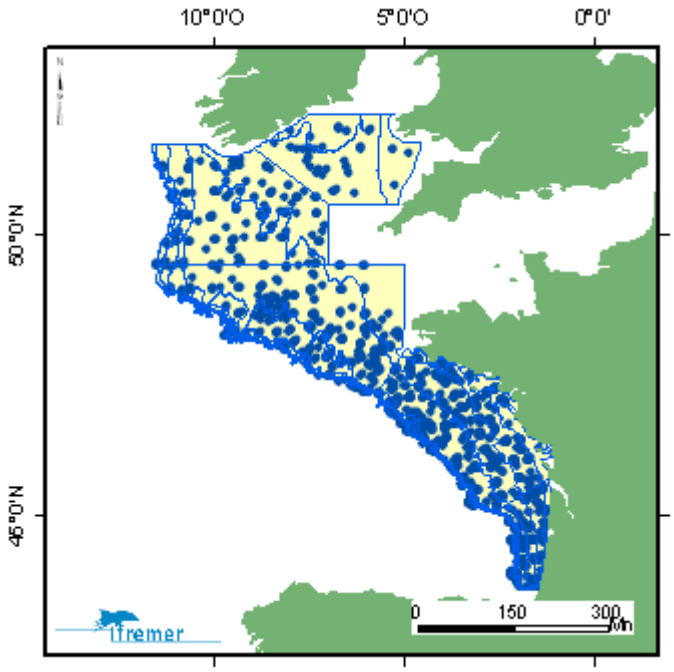


**Figure 10.5.1: EVHOE survey station map**

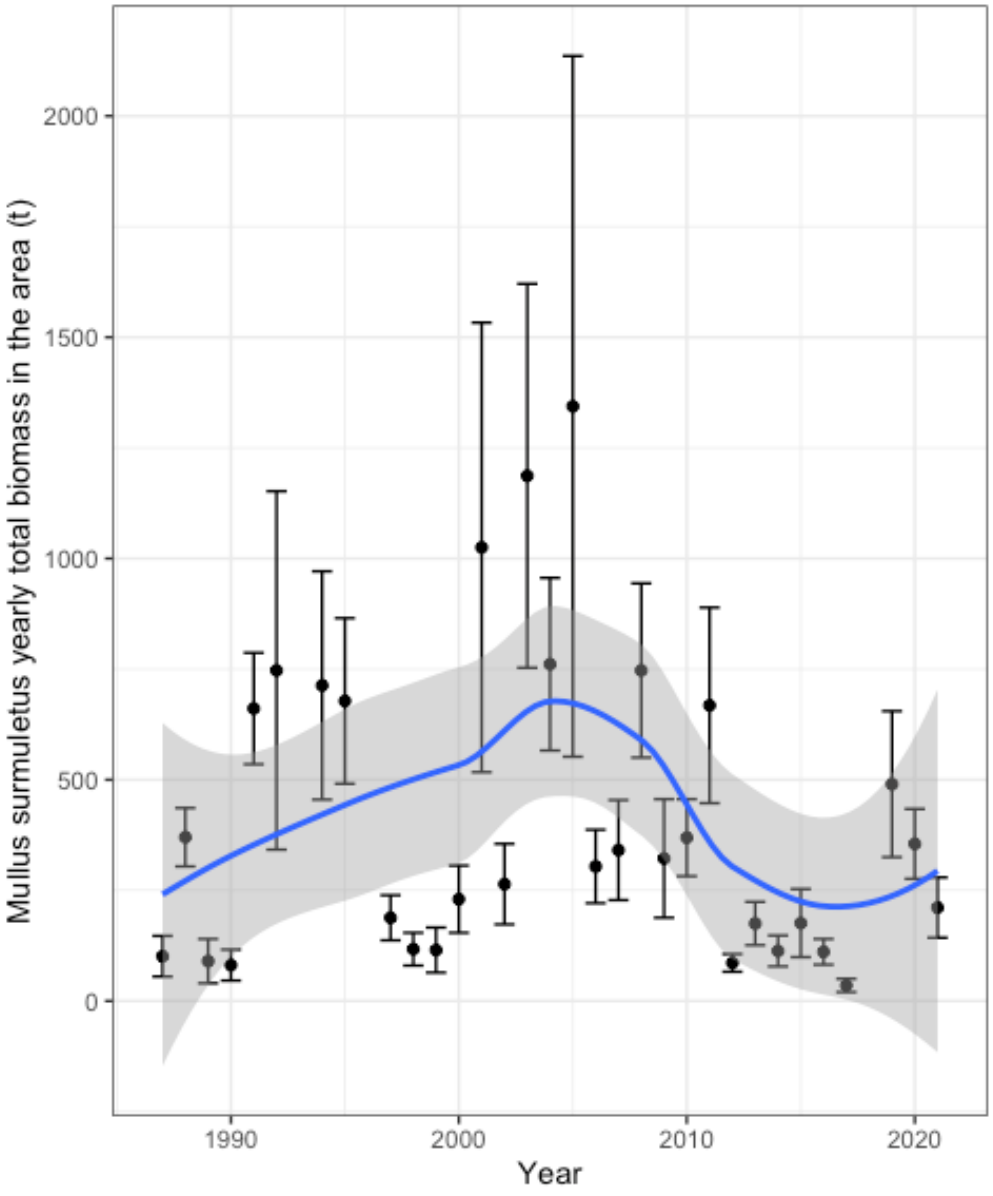


**Figure 10.5.2: Total biomass of striped red mullet in Subareas and Divisions 6, 7a-c, e-f, 8 and 9a., estimated from the EVHOE survey in tons, 1997-2021**

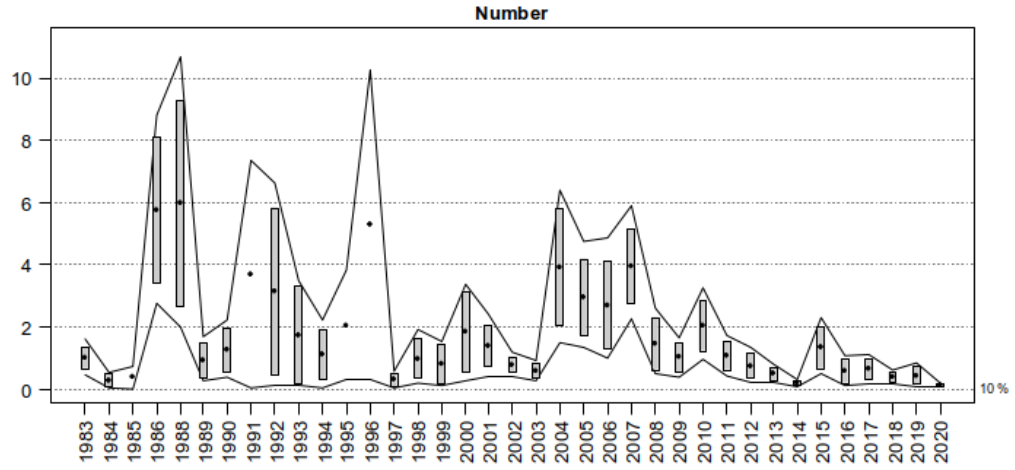


**Figure 10.5.3: Striped red mullet in Subareas and Divisions 6, 7a-c, e-f, 8 and 9a. Spain NSGFS mean stratified abundance in northern Spanish Shelf 1983-2020**