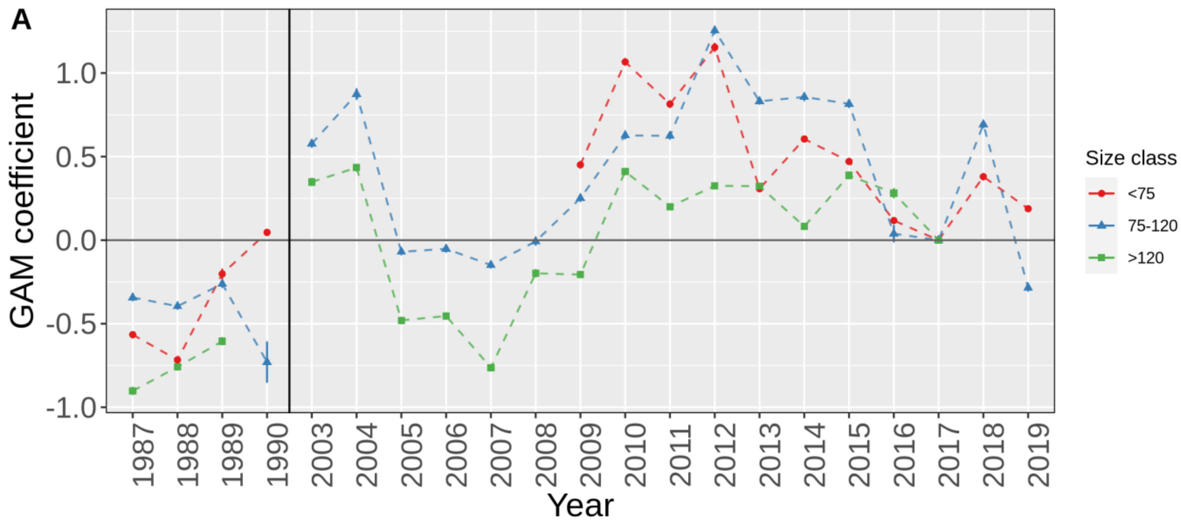
Section S1.

Table S1: Number of sampled yellowfin tuna per school type per year.

Year	FOB-associated	Free school	Unknown	Total
1987	0	0	659	659
1988	0	0	664	664
1989	0	0	401	401
1990	279	119	407	805
2003	78	75	343	496
2004	0	82	691	773
2005	235	10	979	1,224
2006	105	337	3,339	3,781
2007	61	34	1,524	1,619
2008	9	27	926	962
2009	513	100	2,008	2,621
2010	433	123	944	1,500
2011	629	591	604	1,824
2012	233	510	2,688	3,431
2013	381	36	944	1,361
2014	523	178	402	1,103
2015	598	37	425	1,060
2016	0	0	294	294
2017	114	0	140	254
2018	165	0	251	416
2019	0	0	666	666
Total	**4,356**	**2,259**	**19,299**	**25,914**

Table S2: Number of sampled yellowfin tuna per size class per year.

Year	**< 75 cm**	**75 – 120 cm**	**> 120 cm**
1987	13	423	223
1988	11	254	399
1989	19	189	193
1990	804	1	0
2003	0	166	330
2004	0	157	616
2005	0	1,089	135
2006	0	2,670	1,111
2007	0	960	659
2008	0	163	799
2009	158	1,244	1,219
2010	331	304	865
2011	31	752	1,041
2012	16	1,781	1,634
2013	189	462	710
2014	678	272	153
2015	751	229	80
2016	230	4	60
2017	197	24	33
2018	342	74	0
2019	640	26	0
Total	**4,410**	**11,244**	**10,260**


A
GAM coefficient
1.0
0.5
0.0
-0.5
-1.0
1987
1988
1989
1990
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year
Size class
<75
75-120
>120

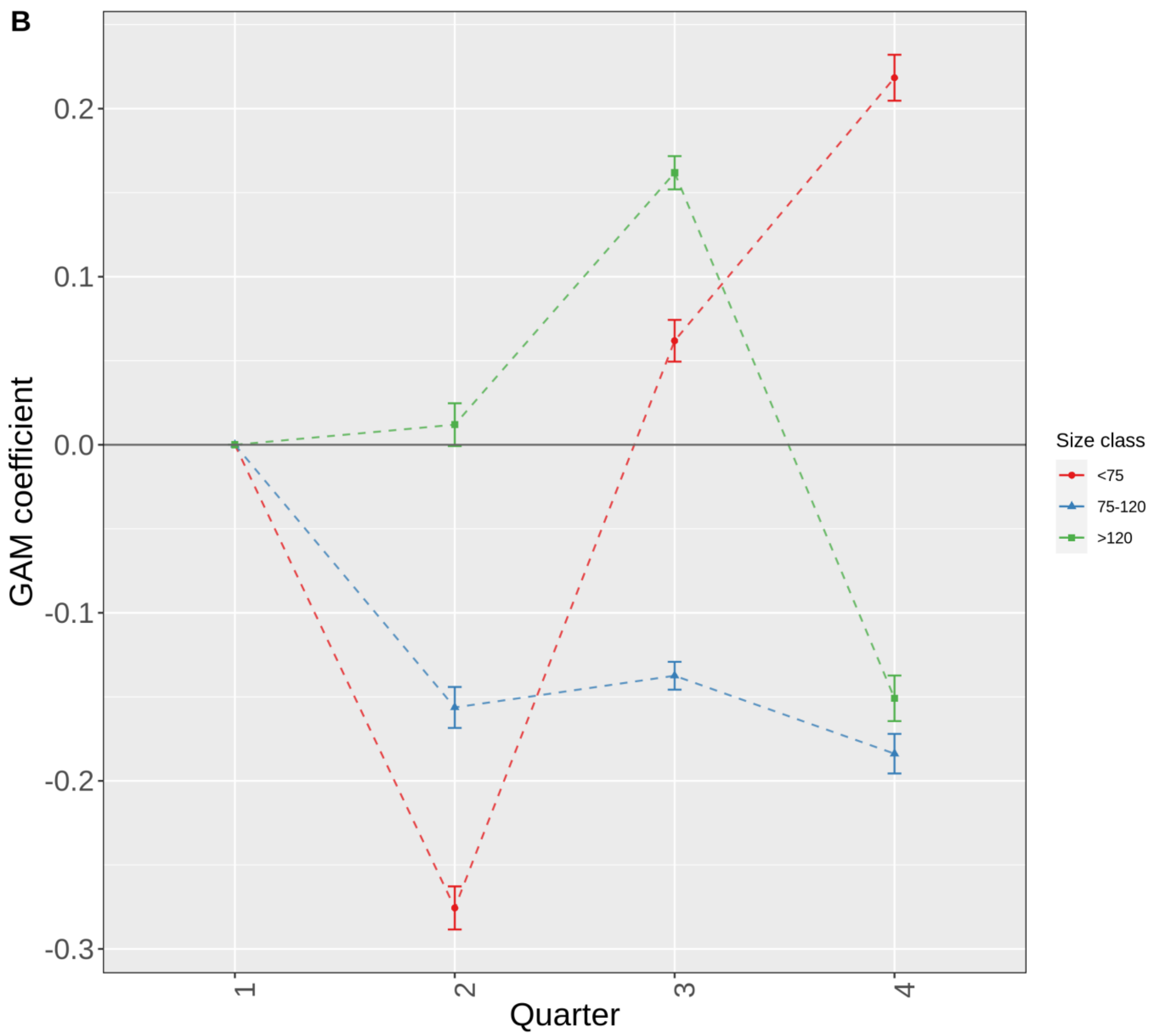

B
GAM coefficient
0.2
0.1
0.0
-0.1
-0.2
-0.3
1
2
3
4
Quarter
Size class
<75
75-120
>120

Figure S1: Coefficients of the Generalized Additive Models considering a subset of data. Only small fish (<75cm, red circles), only medium fish (75-120cm, blue triangles) or only large fish (>120cm, green squares). Coefficients of the fishing year (A) and of the quarter (B). Each coefficient represent the mean deviation of T (K_n) from the values at a given level of reference. The error bars represent the standard deviation. Considered categories of reference: Y: 2017; Q: Q1. The year 2017 was chosen as the reference year because it is the most recent year with all size classes measured.

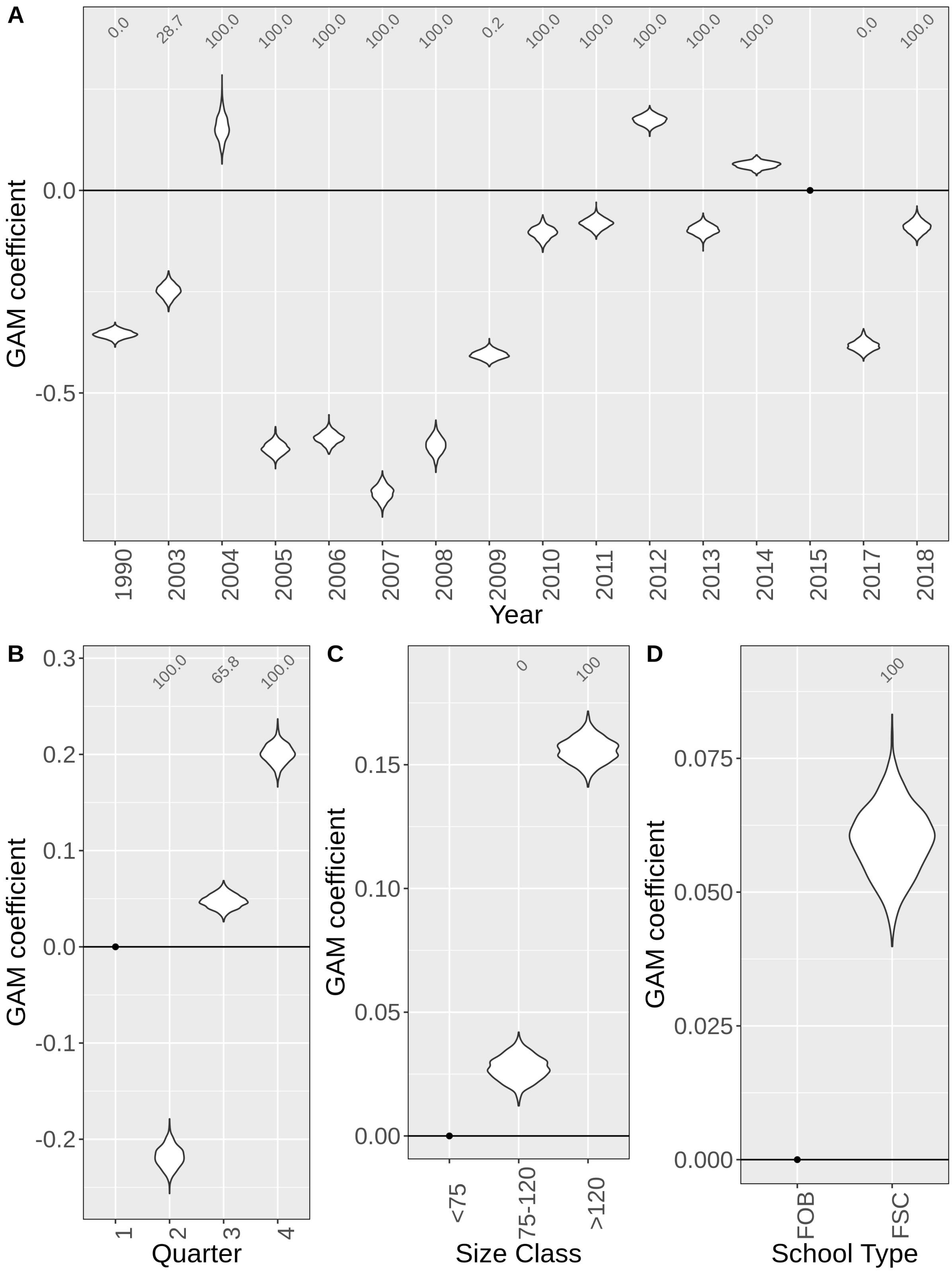


Figure S2: Coefficients of the Generalized Additive Model with fishing mode as an explanatory variable. Coefficients of the fishing year (A), of the quarter (B), of the size class (C) and of the fishing mode (D). Please note that each coefficient represents the mean deviation of $T(K_n)$ from the values for a given category of reference. The shape of the point represents the distribution of the obtained values.

The numbers in grey in the upper part of the panels represent the percentage of the models generated in the bootstrap for which the given category was significantly different from the category of reference. Considered categories of reference, represented by a black dot: Y: 2015; Q: Q1; SC: <75 cm, FM: FOB. 2015 was chosen as the reference year because it is the most recent year with both FOB-associated and FSC tuna, as only FOB-associated tuna were sampled in 2016 and 2017. The $T(K_n)$ of FSC was significantly higher than that of FOB-associated tuna in all the models generated in the bootstrap (see panel D).

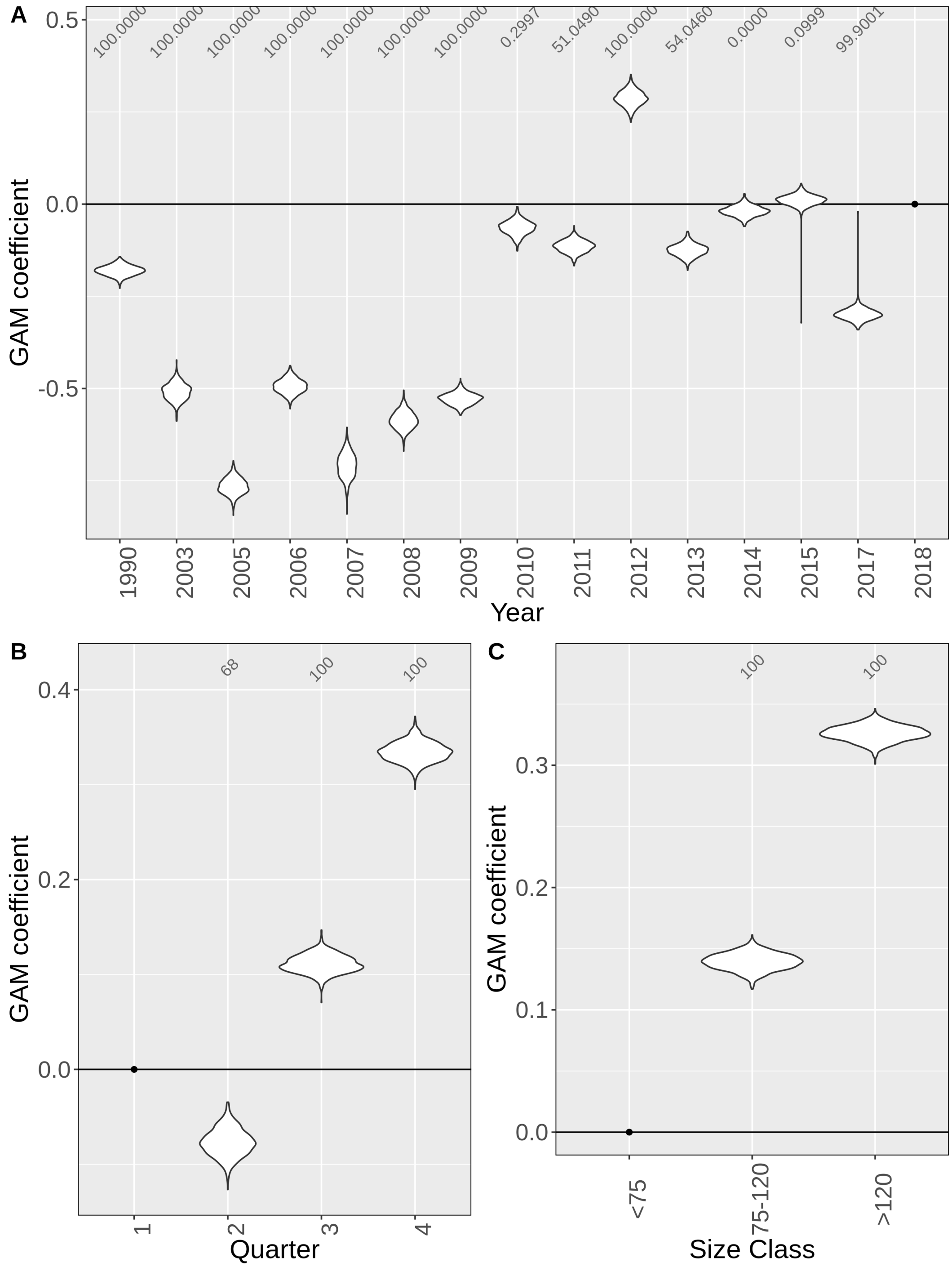


Figure S3: Coefficients of the Generalized Additive Models considering only fish caught in FOB-associated schools. Coefficients of the fishing year (A) of the quarter (B) and of the size class (C). Each coefficient represent the mean deviation of T (K_n) from the values for a given category of reference. The shape of the point represents the distribution of the obtained values. The numbers in grey in the upper part of the panels represent the percentage of the models generated in the bootstrap for which the given category was significantly different from the category of reference. Considered categories of reference: Y: 2018; Q: Q1; SC: <75 cm.

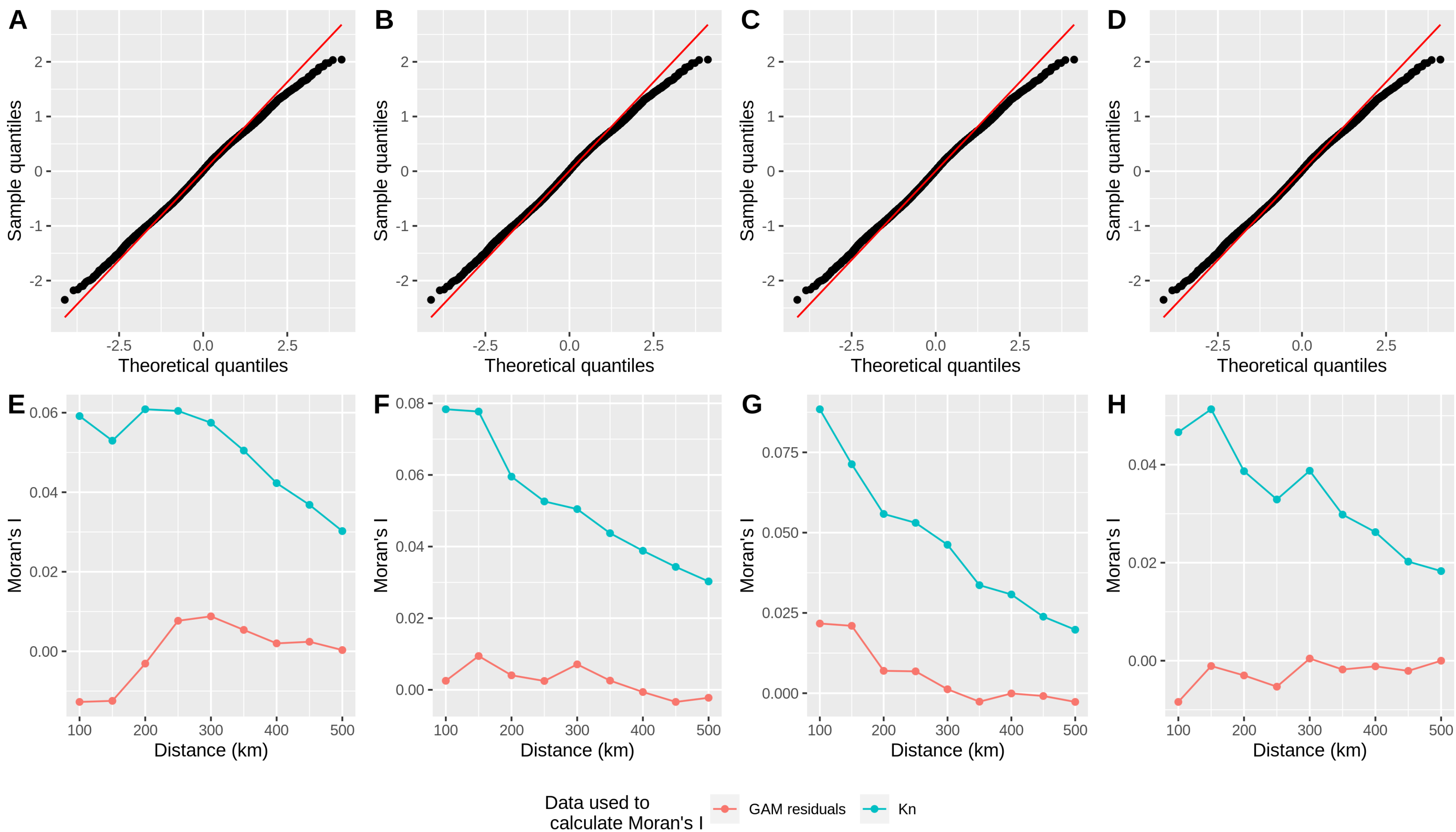


Figure S4: Diagnostic plots of the residuals of 4 randomly picked Generalized Additive Models performed. (A-D) Quantile-quantile plots of the residuals. (E-H) Plot of the Moran's I in the data, in blue, and in the model residuals, in red. Distances on x axis is the distance used to define two points as "linked" in the Moran's I calculation (see details of the *dnearneigh* function in the *spdep* package in R).

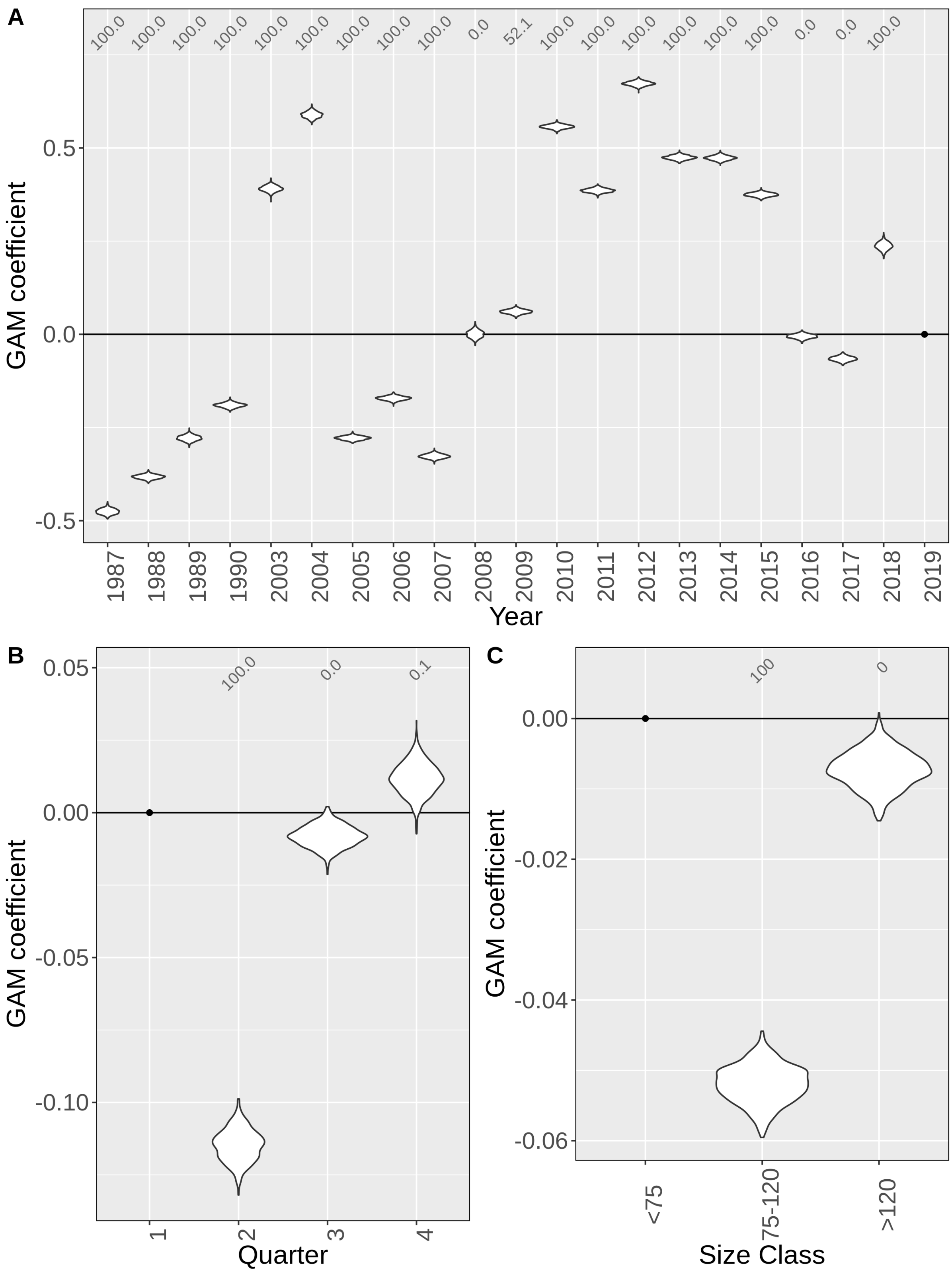


Figure S5: Coefficients of the Generalized Additive Model presented in the main manuscript. Coefficients of the fishing year (A) (same as panel B of Figure 2), of the quarter (B) and of the size class (C). Each coefficient represents the mean deviation of $T(K_n)$ from the values for a category of reference. The shape of the points represents the distribution of the values obtained with the bootstrap process. Numbers in grey in the upper part of the panels represent the percentage of the models generated in the bootstrap for which a given category was significantly different from the category of reference. Considered category of reference, represented by a black dot: Y: 2019; Q: Q1; SC: <75 cm.

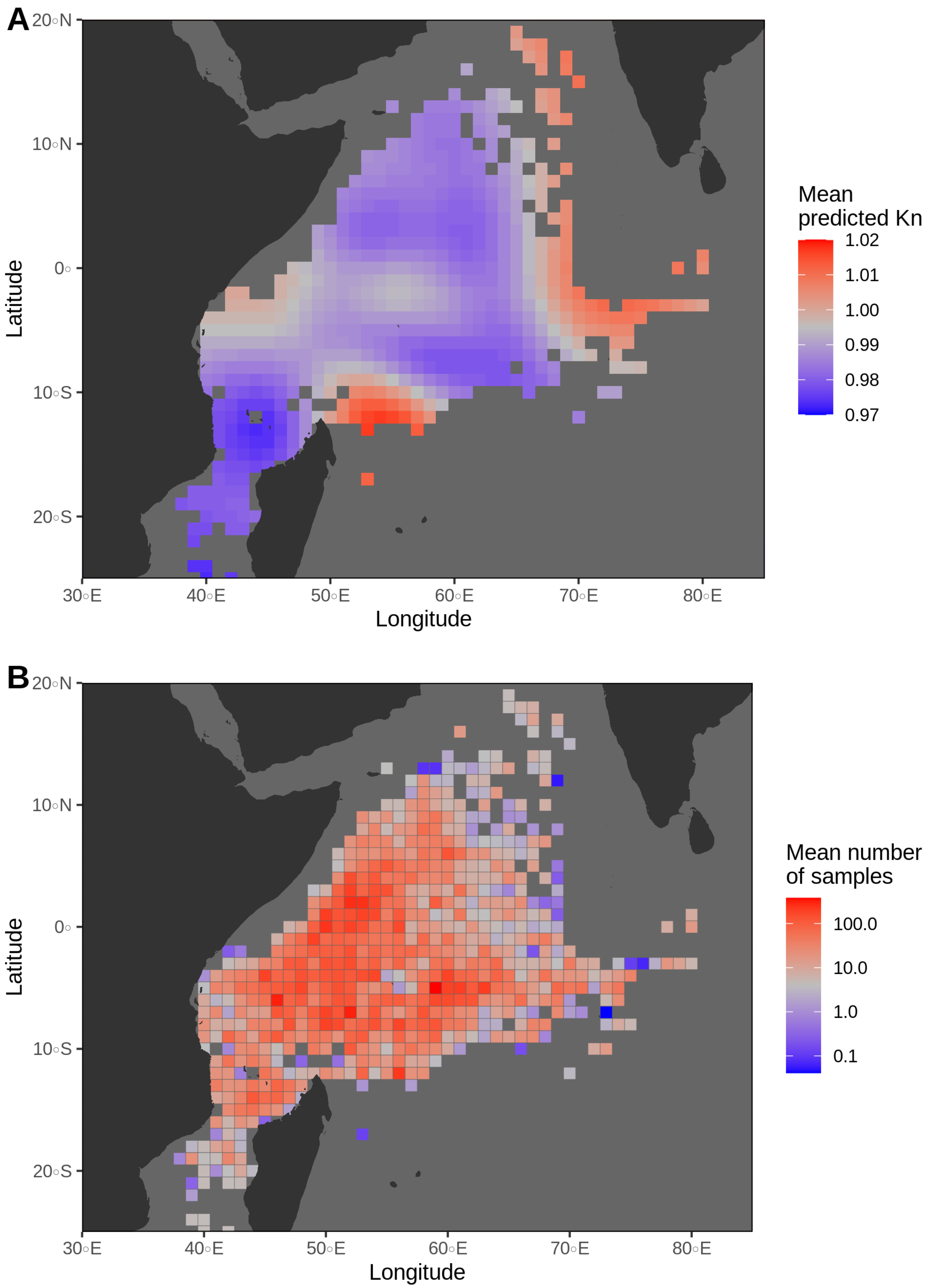


Figure S6: Spatial prediction of the Generalized Additive Models. (A) Mean predicted value of K_n. (B) Mean number of samples in the data used as input in the model. Dark grey cells represent cells in which no tuna was sampled. Considered categories of reference for the prediction: Y: 2019; Q: Q1; size class: <75 cm.

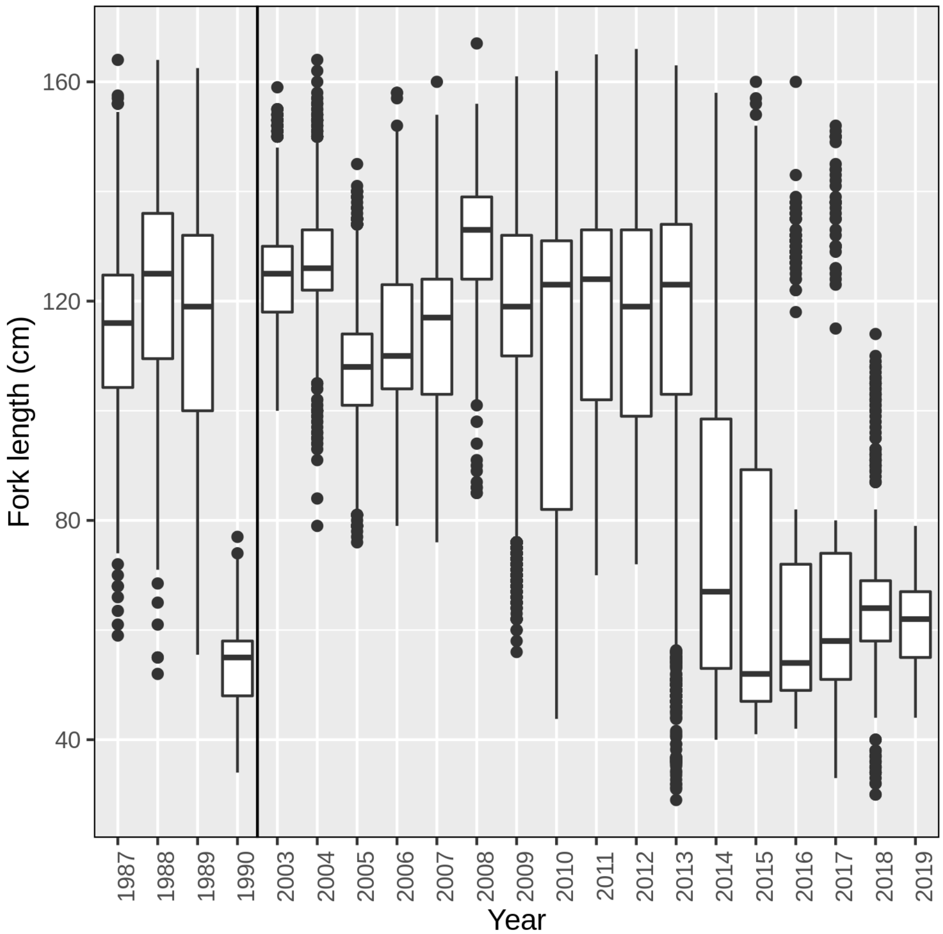


Figure S7: Boxplot of the fork length of sampled tuna per year. The uneven distribution of the sampling is mainly due to the fact that data comes from different research projects, which do not always aim at studying the same size class.

Section S2.

The power-law function $W = a\ FL^b$ was used to fit the fish weight as a function of the fork length data recorded throughout the study period (Figure S8), using a linear regression procedure of the log-transformed data (using the *lm* function of the package *stats* in R). The parameters presented in Table S3 were obtained.

Table S3: Values of the parameters fitted for the relation between Weight and Fork Length: $W = a\ FL^b$

	Value	Standard deviation	p-value
ln(a)	-10.658	$7.5\ 10^{-3}$	$<10^{-16}$
a	**$2.35\ 10^{-5}$**		
b	**2.976**	$1.6\ 10^{-3}$	$<10^{-16}$

Hence, $W_{th} = 2.35\ 10^{-5} FL^{2.976}$, $R^2 = 0.992$; where W_{th} is the predicted weight, in kilograms, and FL is the fork length, in centimeters.

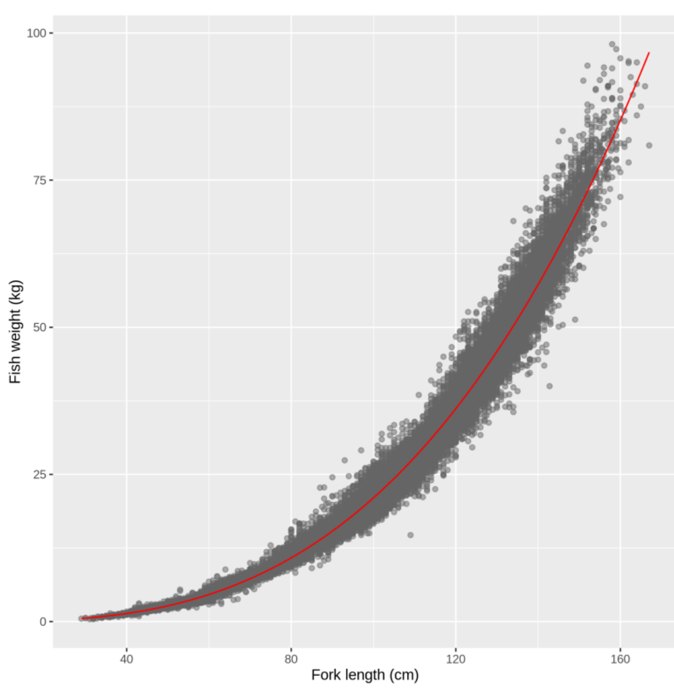


Figure S8: Relationship between fish weight and fork length.

Section S3.

The transformed $T[K_n(i)]$ was obtained as follows:

$$T[K_n(i)] = \frac{\overline{W_{th}} K_n(i) - \overline{W}}{\sqrt{\sigma_{th}^2 K_n(i)^2 - 2\rho\sigma\sigma_{th} K_n(i) + \sigma^2}}$$

where $K_n(i)$ is the relative condition factor of individual *(i)*; $\overline{W}$ is the mean measured weight, and σ its standard deviation; $\overline{W_{th}}$ is the mean theoretical weight, and σ_{th} its standard deviation. Geary (1930) demonstrated that $T[K_n(i)]$ is normally distributed with mean zero and standard deviation unity.

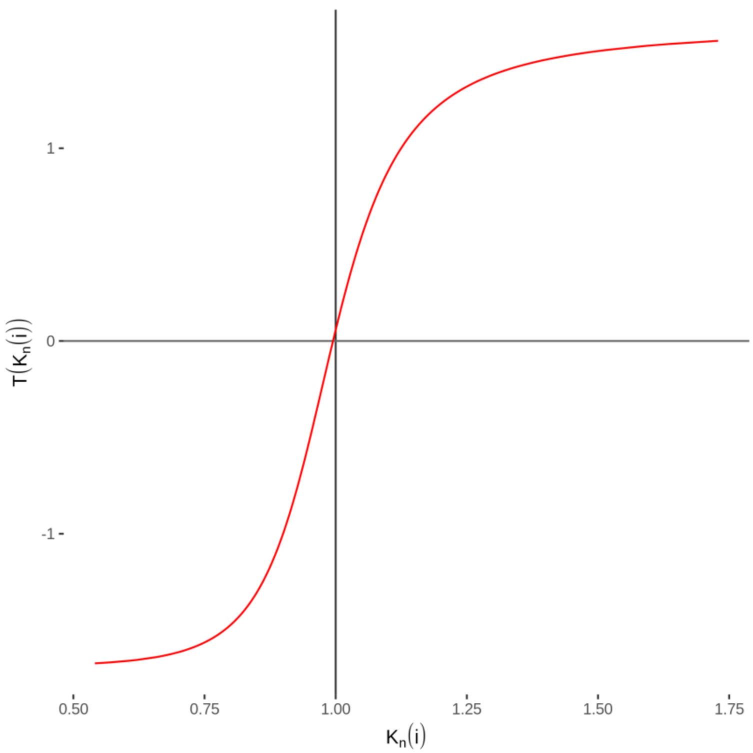


Figure S9: Result of the Geary-Hinkley transformation performed on $K_n(i)$.

Section S4.

The number of DFADs used in the Indian Ocean has increased during the study period (1987-2019) but no exact trend of floating objects (FOBs) number exist covering the whole period. The total number of FOBs for 2013-2019 was estimated in Baidai (2020), using the number of buoys used by the french purse seine fleets and raising factors from Katara et al. (2018) and Dupaix et al. (2021).

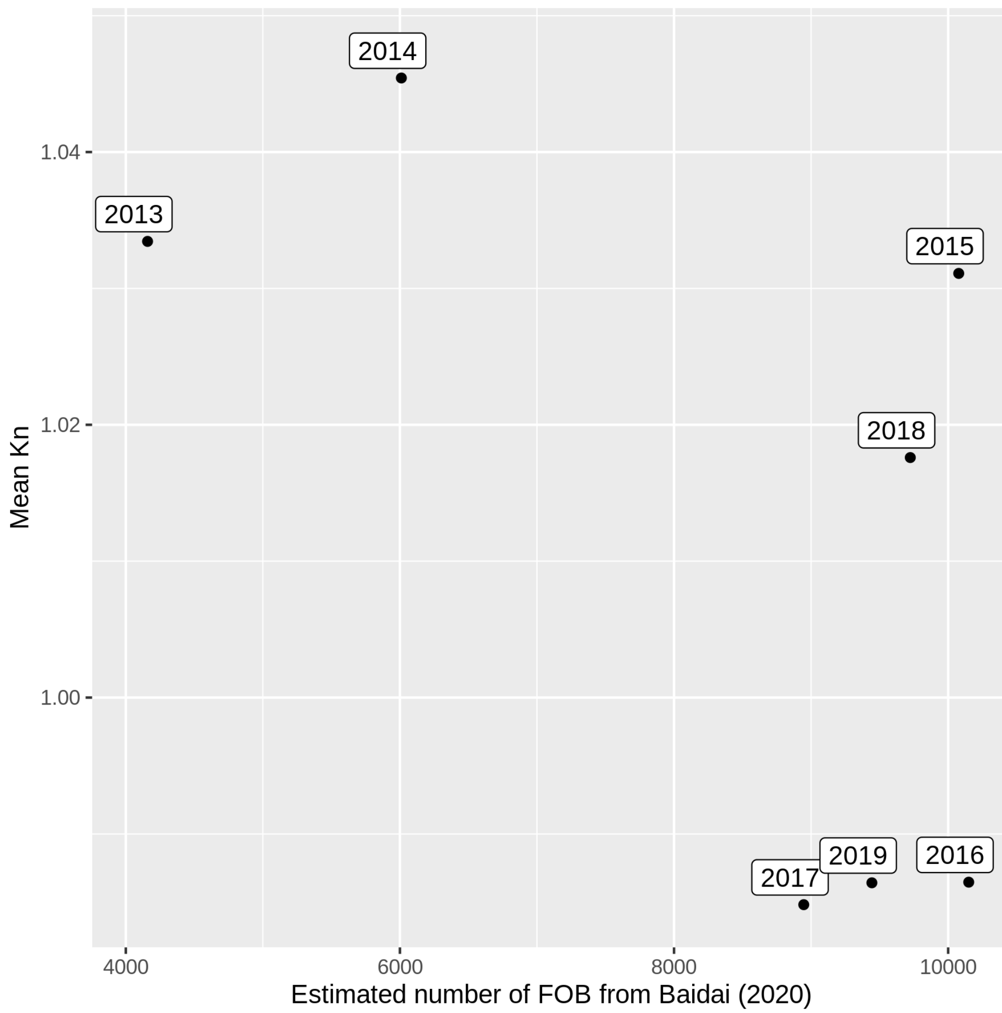


Figure S10: Relationship between the mean relative condition factor (K_n) and the mean number of floating objects (FOBs) in 2013-2019.

Using Baidai's (2020) estimation, we tested if a correlation could be observed between the mean relative condition factor (K_n) and the mean total number of FOBs in the Indian Ocean in 2013-2019 (Figure S10), using a Spearman's rank correlation test. No correlation was observed: $\rho = -0.357$; p.value = 0.44.

References

Baidai Y (2020) Derivation of direct abundance index for tropical tunas based on their associative behavior with floating objects. PhD, Université de Montpellier, Montpellier, France

Dupaix A, Capello M, Lett C, Andrello M, Barrier N, Viennois G, Dagorn L (2021) Surface habitat modification through industrial tuna fishery practices. ICES Journal of Marine Science 78:3075–3088. https://doi.org/10.1093/icesjms/fsab175

Katara I, Gaertner D, Marsac F, Grande M, Kaplan D, Guéry L, Depetris M, Duparc A, Floch L, Lopez J, Abascal F (2018) Standardisation of yellowfin tuna CPUE for the EU purse seine fleet operating in the Indian Ocean. IOTC-2018-WPTT20-36:23.