Appendix

A Catch composition

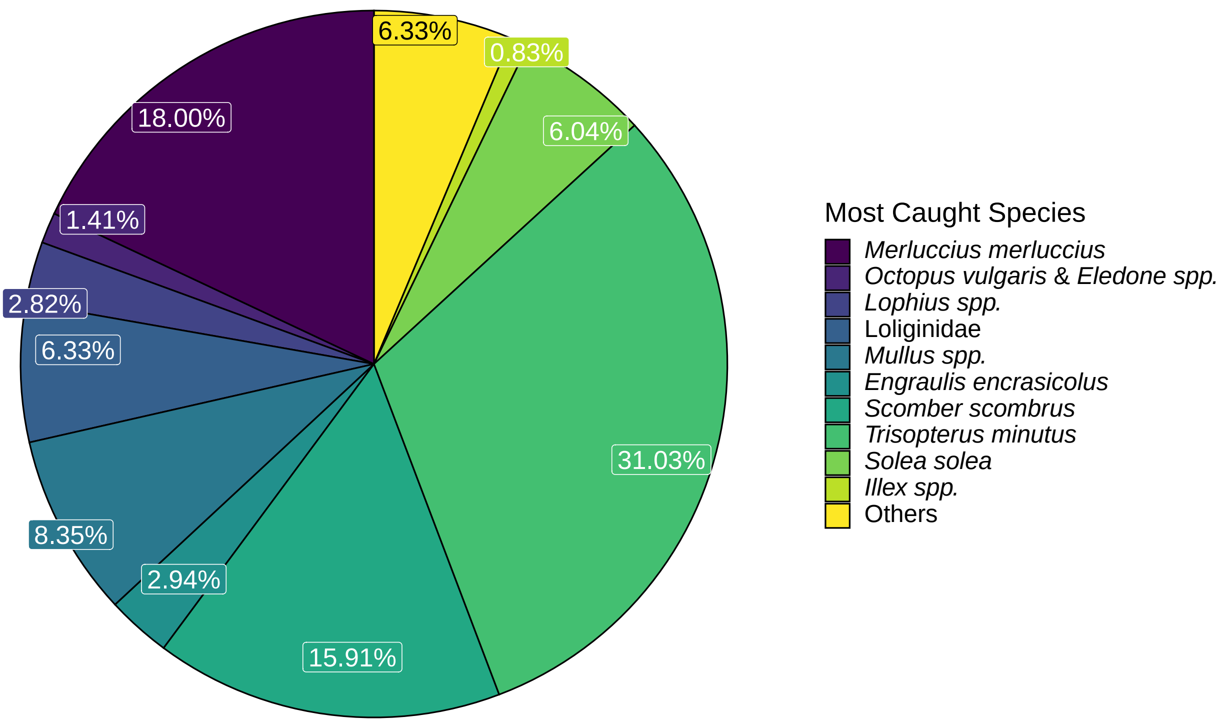

Figure A.1: Composition of the Gulf of Lion demersal fisheries annual landings in 2017 of the top 10 species groups: Anchovy (*Engraulis encrasiolus*), Finned squids (*Illex spp.*), Pencil squids (Loliginidae), European hake (*Merluccius merluccius*), Red mullet and Striped red mullet (*Mullus spp.*), Common octopus, Horned octopus, and Musky octopus (*Octopus vulgaris* and *Eledone spp.*), Mackerel (*Scomber scombrus*), Common sole (*Solea solea*), and Poor cod (*Trisopterus minutus*). Values are shown as catch weight (kg). Species not belonging to these top 10 groups are shown together as "Others".

B Fisheries settings

Table B.1: Fisheries settings: The fleet definitions used in the ISIS-Fish model grouping together the vessel size and harbor are shown. For Spanish vessels, these values were unknown at the time of the study (a common issue for the region) and thus were not further delineated beyond the country level. Strategies grouped vessels with similar fishing area, vessel size, port, catchability, and technique. For Spanish vessels these were not further delineated. French gillnetters, were also not delineated further due to limited information on their exact fishing practices. Métiers included gear, harbor, and vessel size used. For Spanish métiers, main fishing gear and fishing zone were identified by VMS data available on the SIH website (*SIH* 2023). French gillnetters, grouped together fishing grounds due to the data limitation mentioned above.

Fleet	**Strategy**	**Métier**
Spanish Fleet	Spanish Strategy	LLS_ESP
XMA_18-24	XMA_18-24_OTBpur	OTB_ESP
GPV_18-24	GPV_18-24_OTB-OTT	OTB_XMA_18-24
GPV_24-40	GPV_24-40_OTBpur	OTB_GPV_18-24
CMT_18-24	GPV_24-40_OTB-OTM-OTT	OTT_GPV_18-24
CMT_24-40	GPV_24-40_OTB-OTT	OTB_GPV_24-40
CST_18-24	CMT_18-24_OTB-OTM	OTM_GPV_24-40
CST_24-40	CMT_24-40_OTB-OTM	OTT_GPV_24-40
XST_18-24	CST_18-24_OTBpur	OTB_CMT_18-24
XST_24-40	CST_24-40_OTB-OTT	OTB_CMT_24-40
GST_18-24	CST_24-40_OTB-OTM-OTT	OTM_CMT_24-40
GST_24-40	CST_24-40_OTBpur	OTB_CST_18-24
	XST_18-24_OTB-OTT	OTB_CST_24-40
	XST_24-40_OTBpur	OTM_CST_24-40
	XST_24-40_OTB-OTT	OTT_CST_24-40
	XST_24-40_OTB-OTM-OTT	OTT_XST_18-24
	GST_18-24_OTB-OTM	OTB_XST_24-40
	GST_24-40_OTBpur	OTM_XST_24-40
	French Gillnetters	OTT_XST_24-40
		OTB_GST_18-24
		OTM_GST_18-24
		OTB_GST_24-24
		GNS_FRA

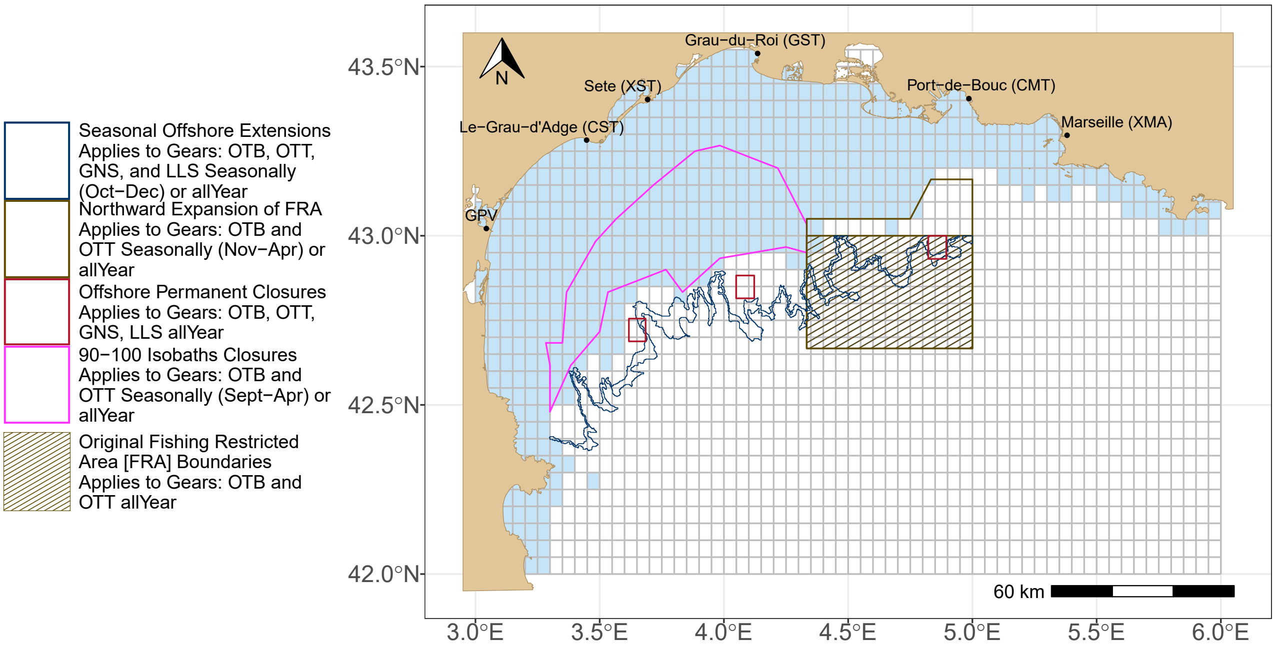

Figure B.1: Fishing zone definitions: Historic fishing grounds for French gillnetters (GNS_FRA) and placement of the assessed spatial temporal closures used in the model.

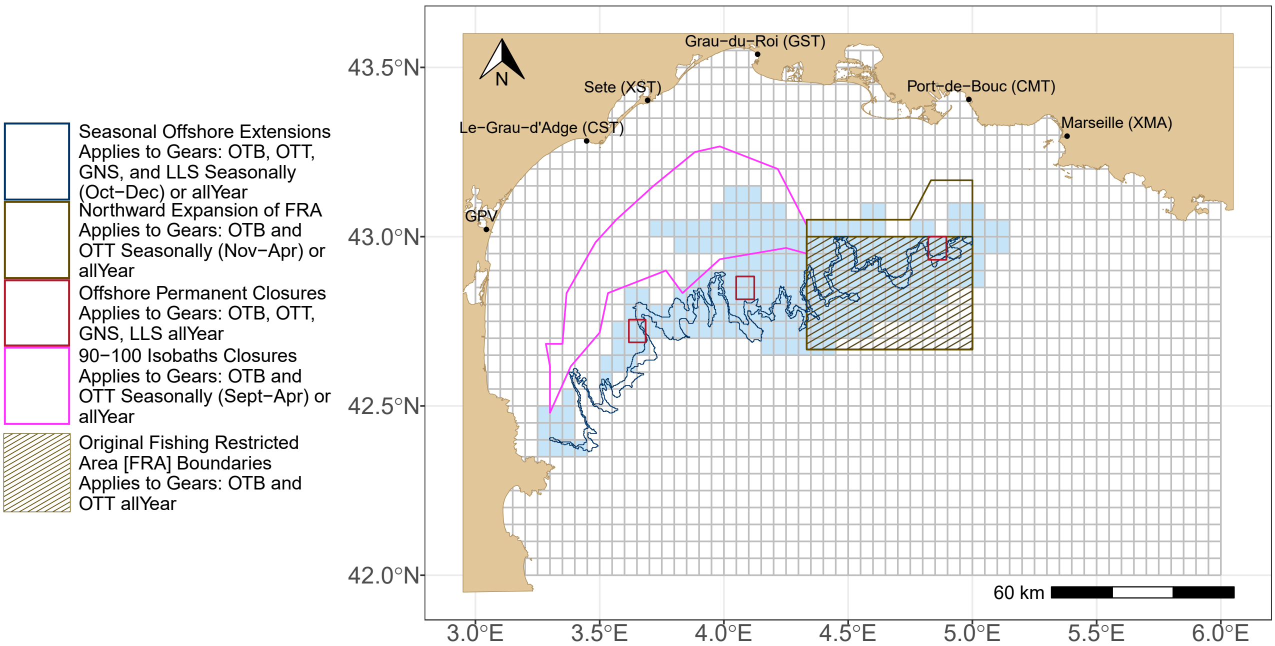

Figure B.2: Fishing zone definitions: Historic fishing grounds for Spanish longliners (LLS_ESP) and placement of the assessed spatial temporal closures used in the model.

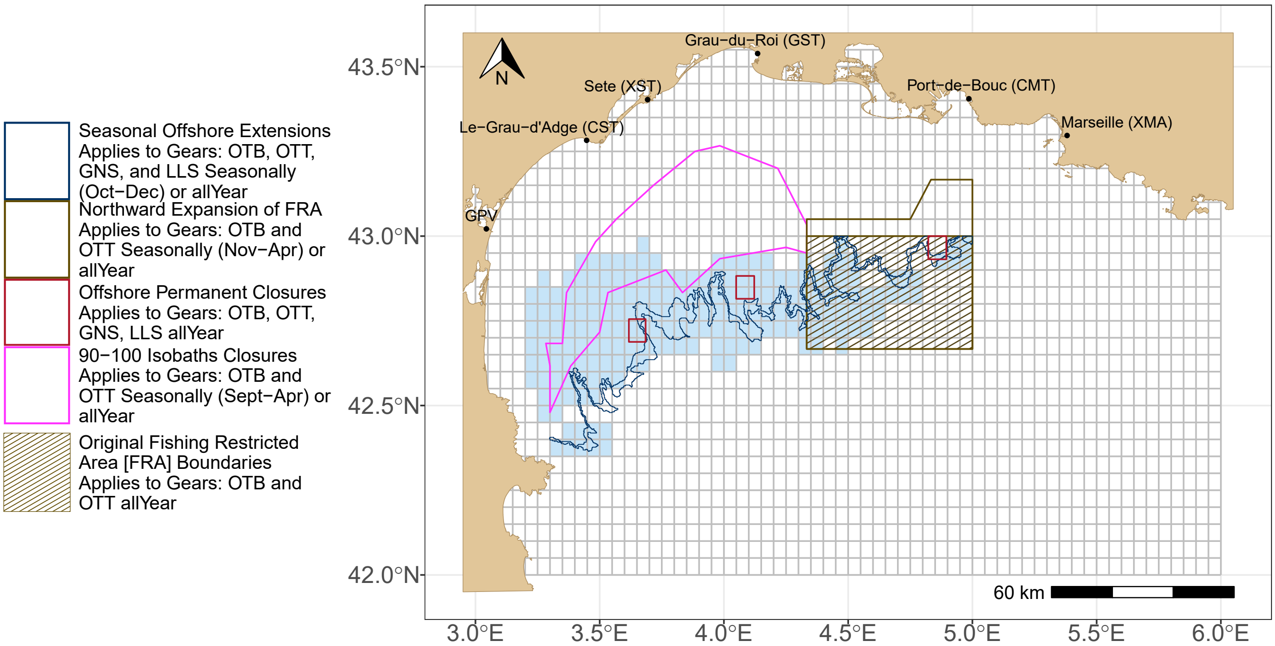

Figure B.3: Fishing zone definitions: Historic fishing grounds for Spanish trawlers (OTB_ESP) and placement of the assessed spatial temporal closures used in the model.

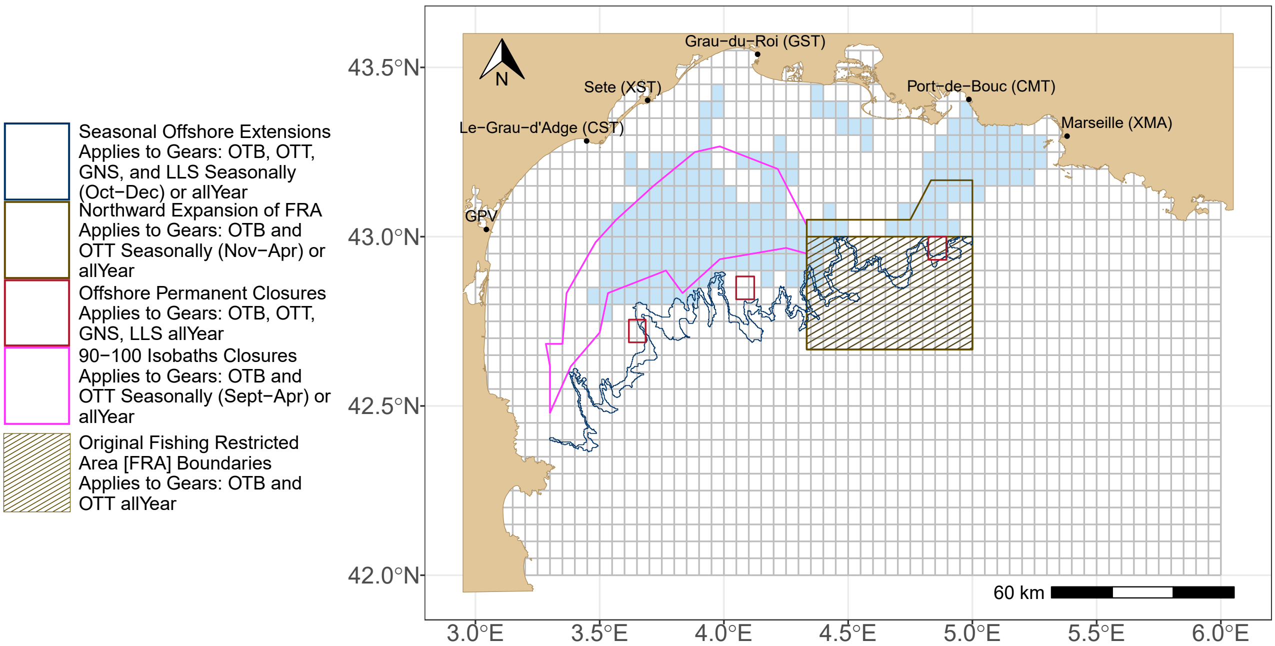

Figure B.4: Fishing zone definitions: Historic fishing grounds for OTM_CMT_24-40 and placement of the assessed spatial temporal closures used in the model.

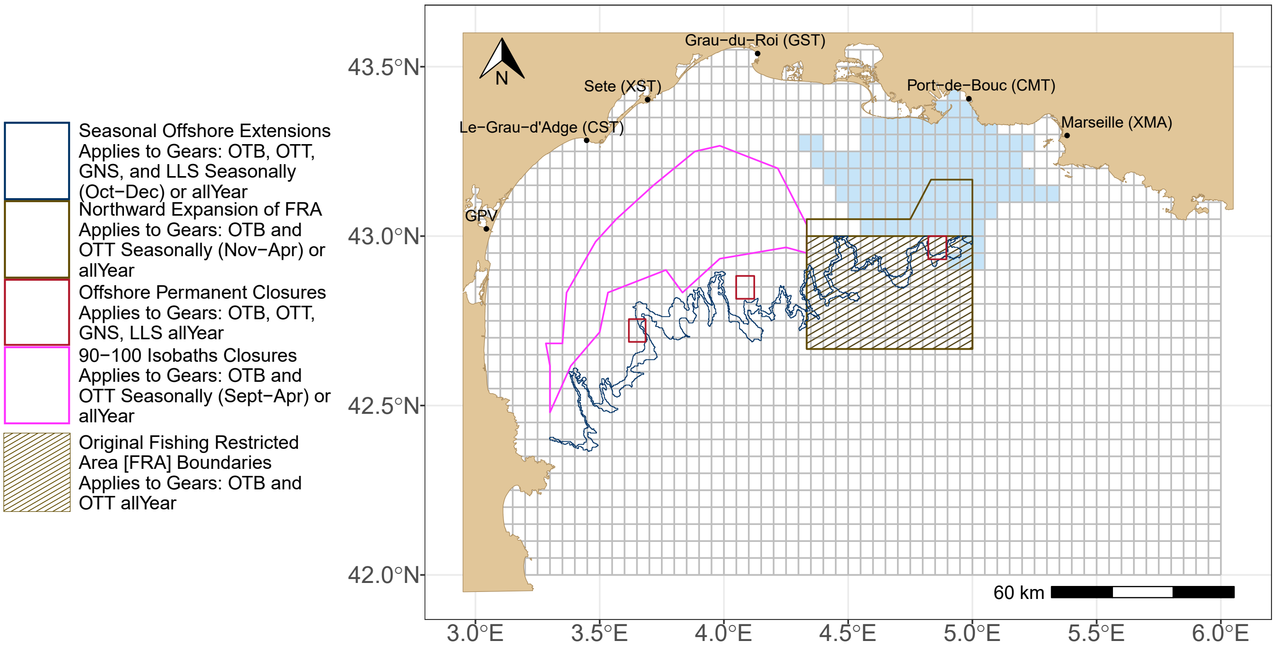

Figure B.5: Fishing zone definitions: Historic fishing grounds for OTB_CMT_18-24 and placement of the assessed spatial temporal closures used in the model.

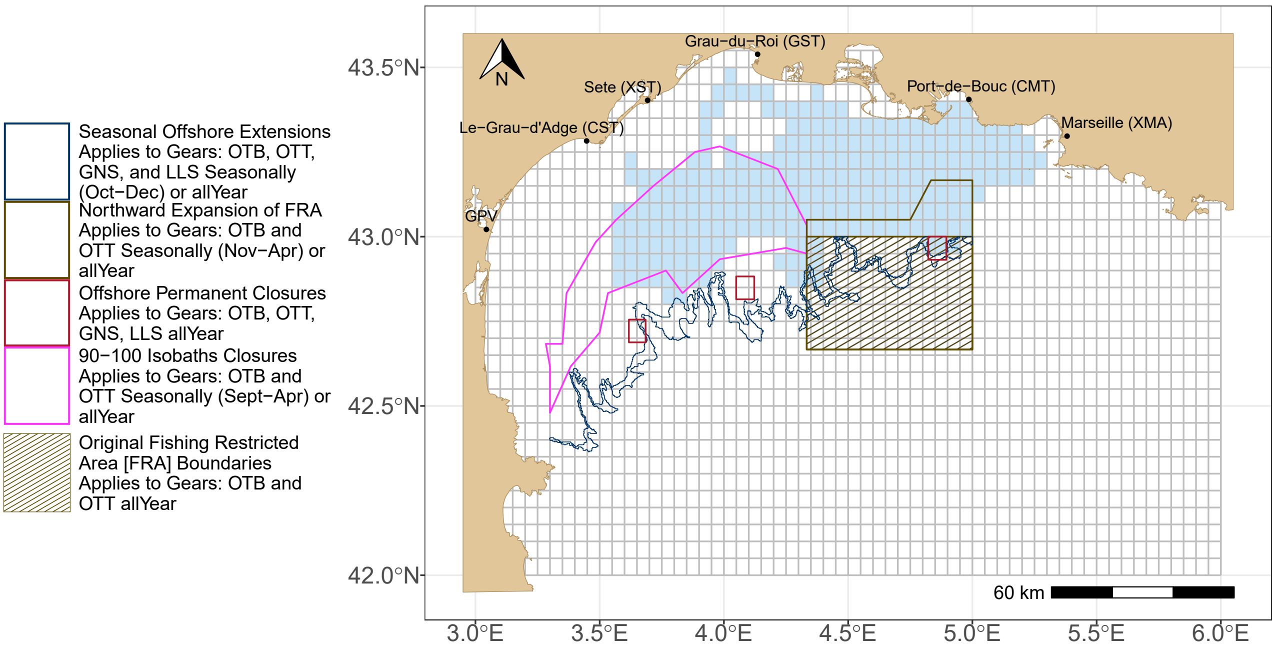

Figure B.6: Fishing zone definitions: Historic fishing grounds for OTB_CMT_24-40 and placement of the assessed spatial temporal closures used in the model.

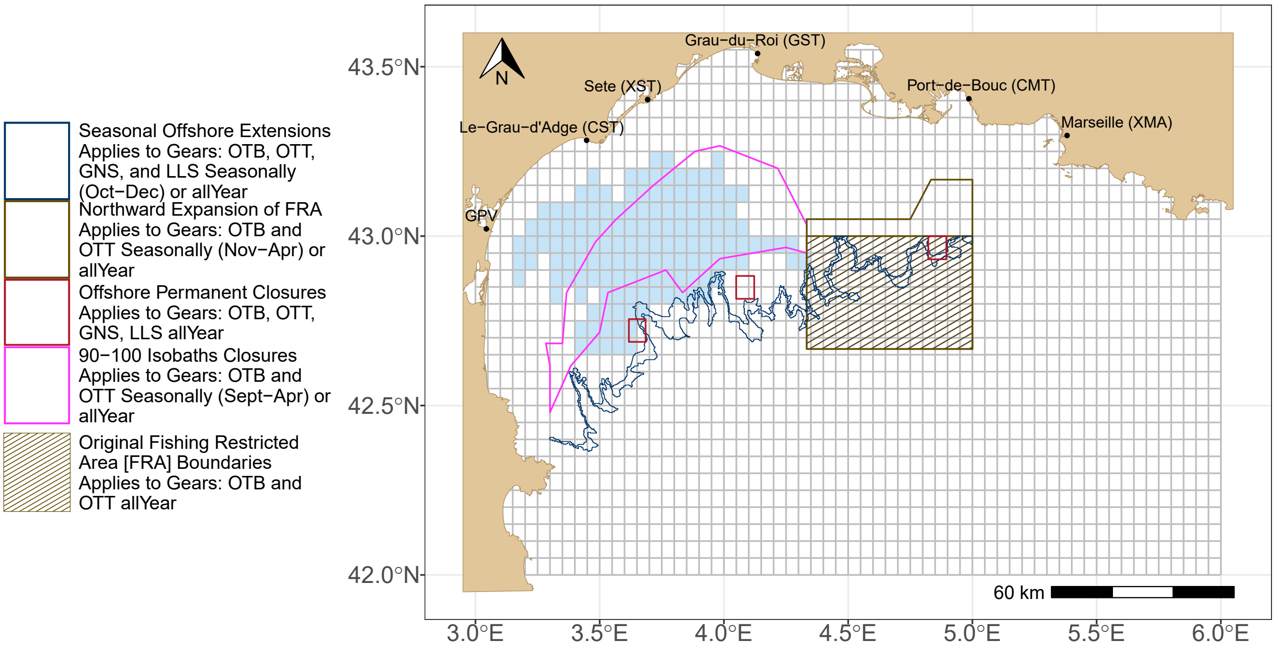

Figure B.7: Fishing zone definitions: Historic fishing grounds for OTM_CST_24-40 and placement of the assessed spatial temporal closures used in the model.

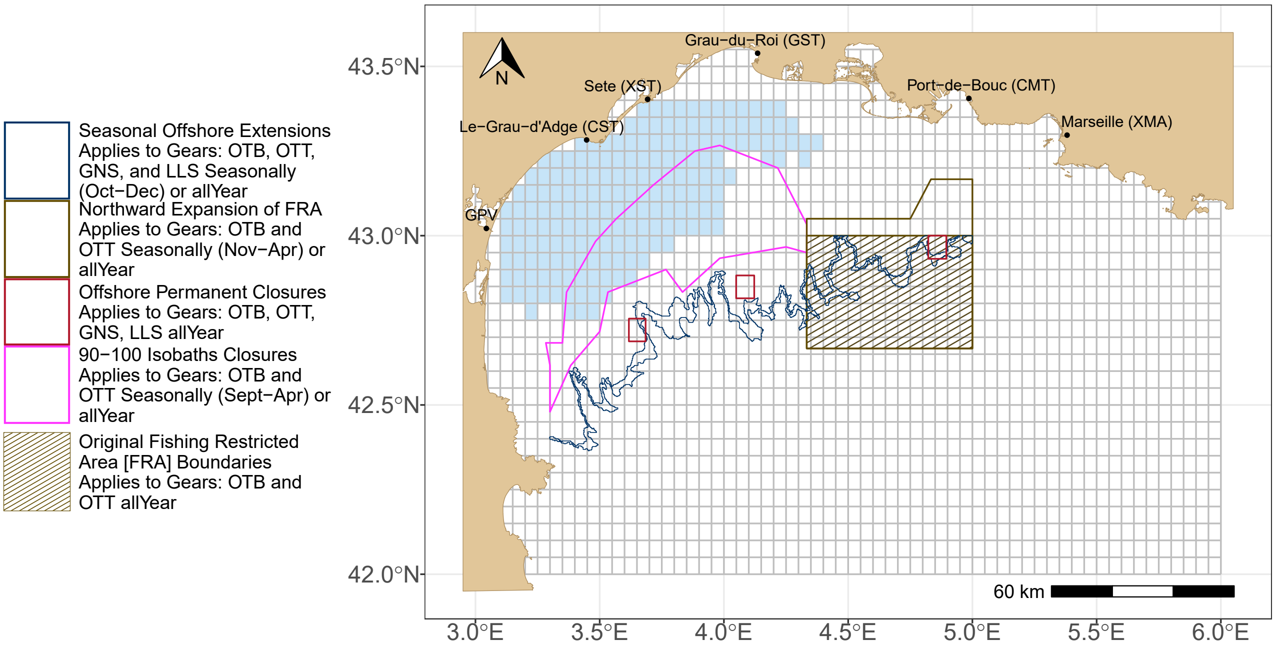

Figure B.8: Fishing zone definitions: Historic fishing grounds for OTB_CST_18-24 and placement of the assessed spatial temporal closures used in the model.

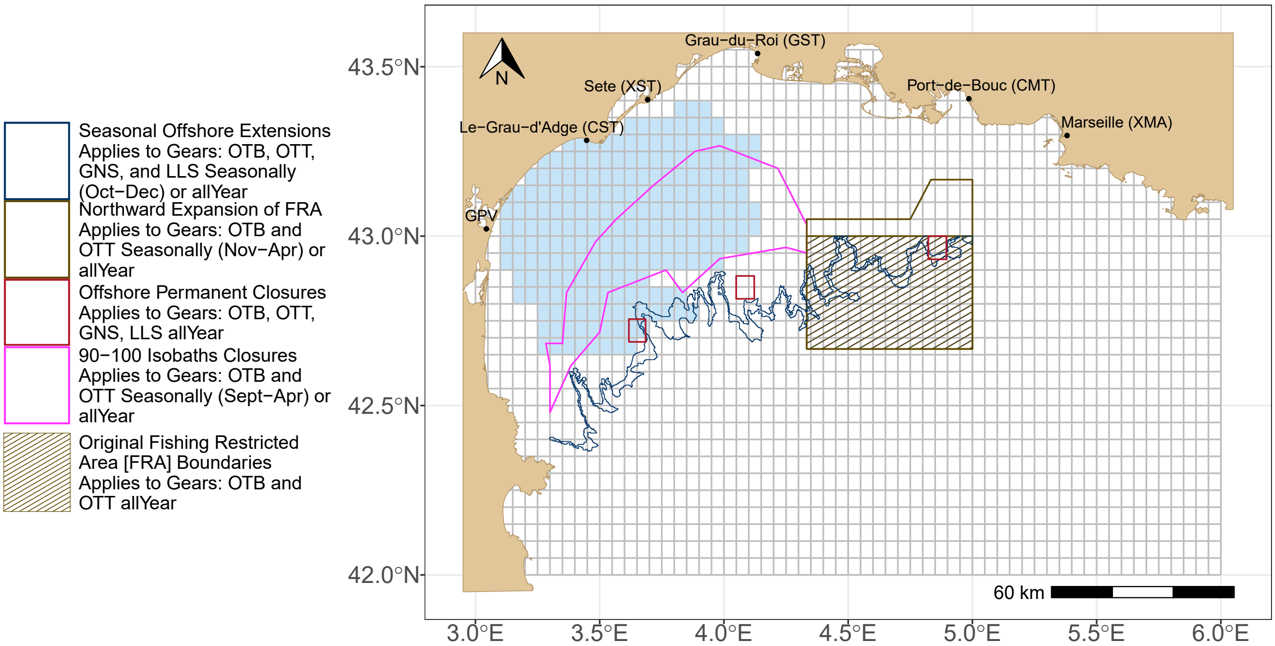

Figure B.9: Fishing zone definitions: Historic fishing grounds for OTB_CST_24-40 and placement of the assessed spatial temporal closures used in the model.

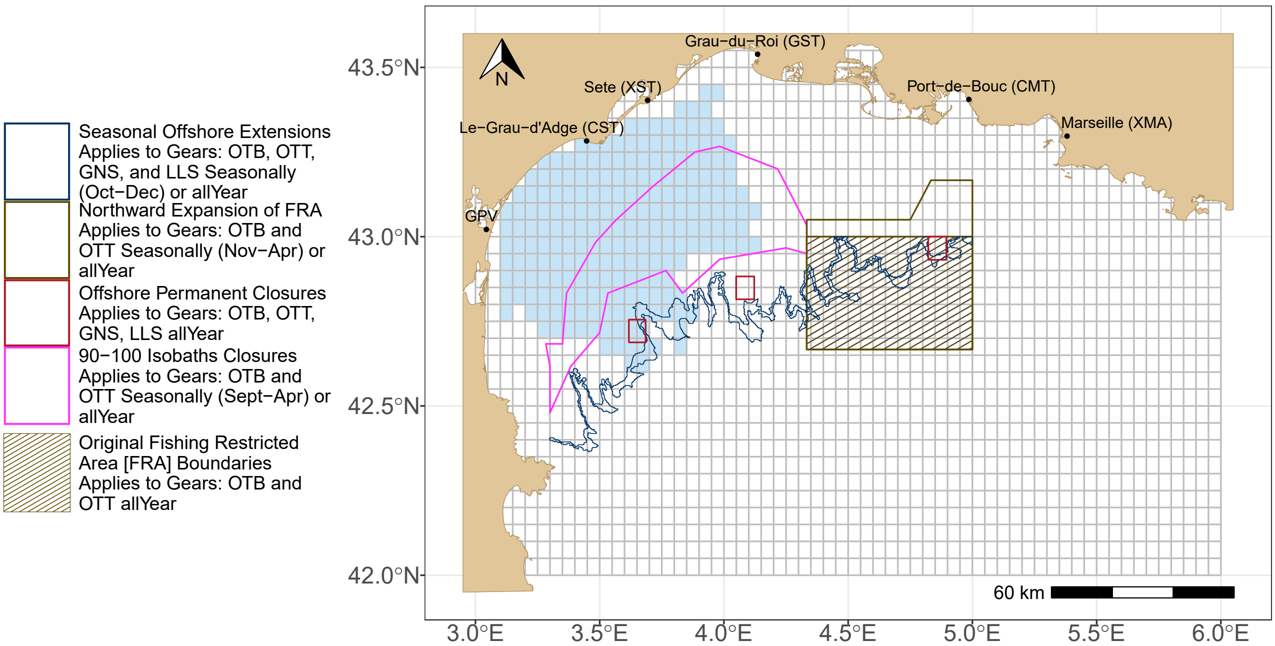

Figure B.10: Fishing zone definitions: Historic fishing grounds for OTT_CST_24-40 and placement of the assessed spatial temporal closures used in the model.

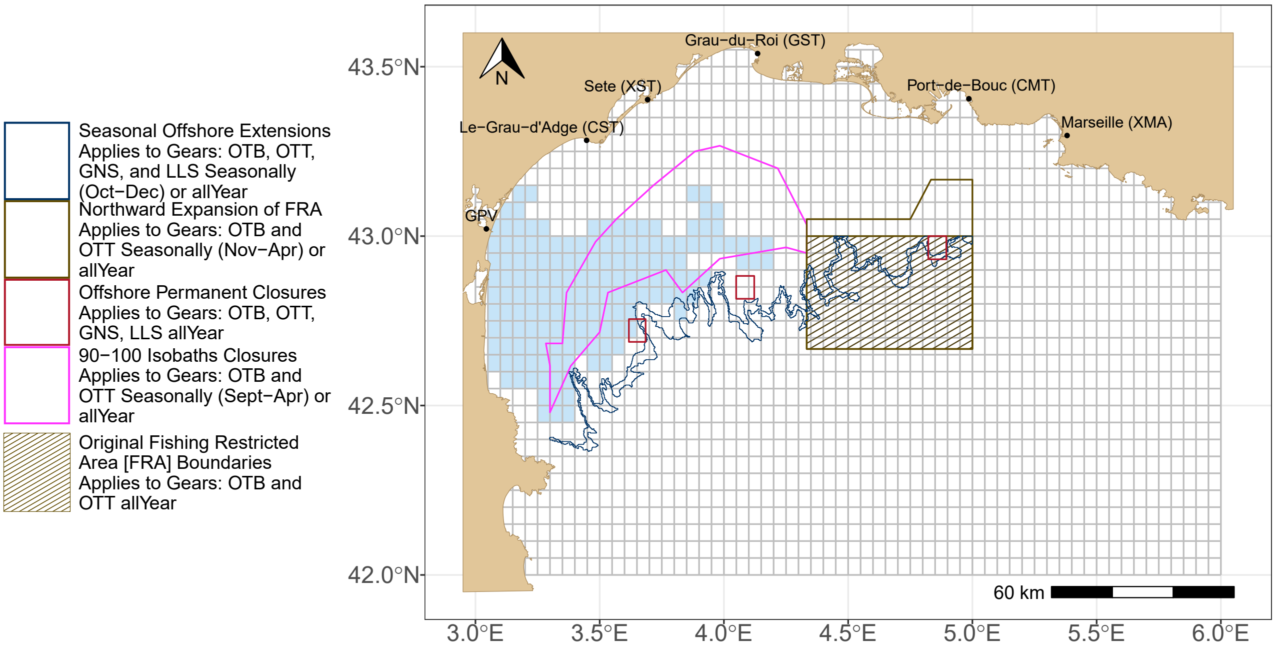

Figure B.11: Fishing zone definitions: Historic fishing grounds for OTM_GPV_24-40 and placement of the assessed spatial temporal closures used in the model.

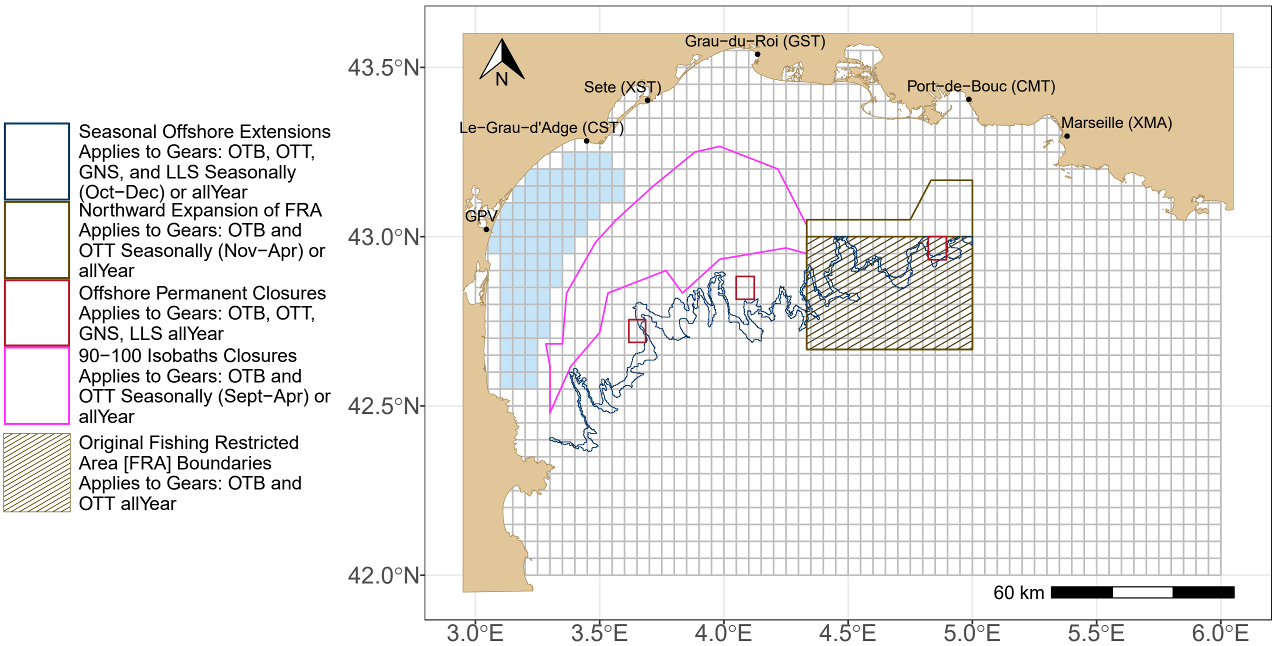

Figure B.12: Fishing zone definitions: Historic fishing grounds for OTB_GPV_18-24 and placement of the assessed spatial temporal closures used in the model.

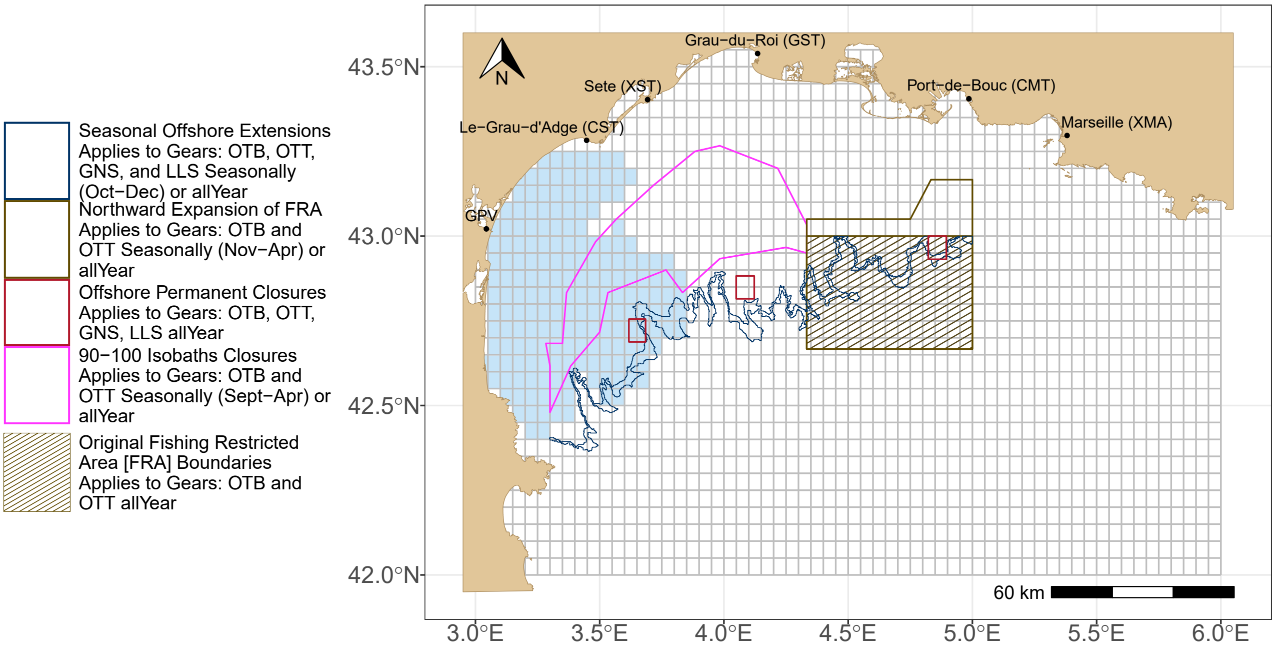

Figure B.13: Fishing zone definitions: Historic fishing grounds for OTB_GPV_24-40 and placement of the assessed spatial temporal closures used in the model.

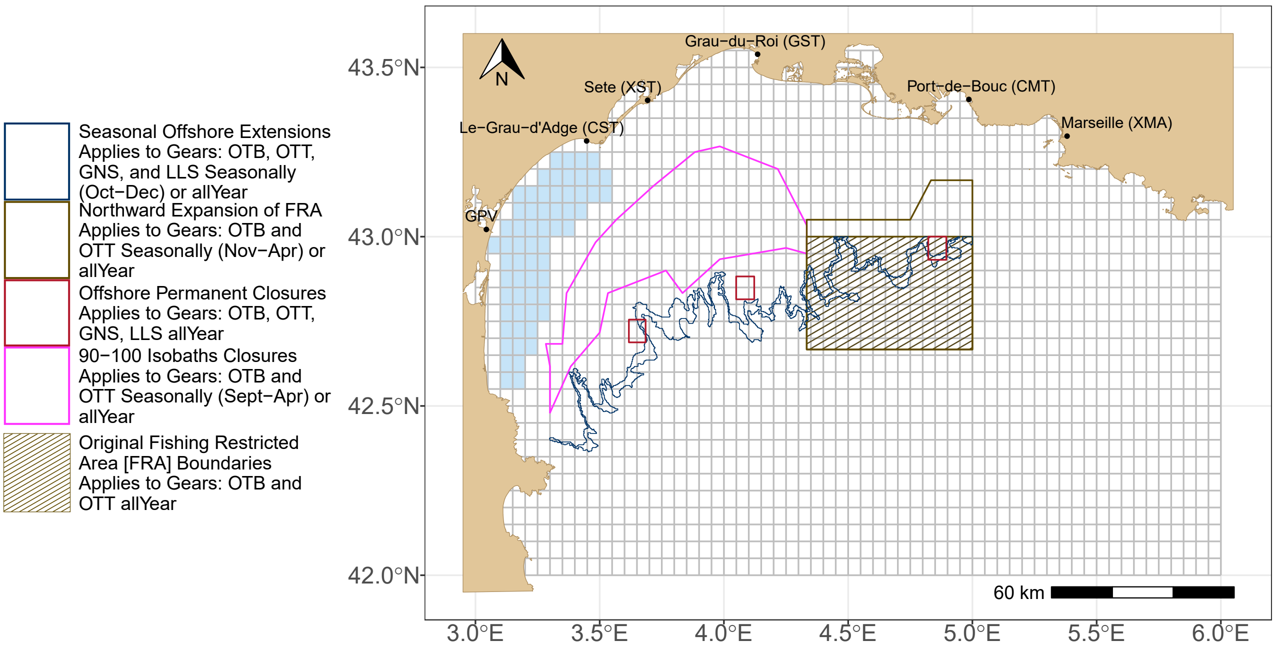

Figure B.14: Fishing zone definitions: Historic fishing grounds for OTT_GPV_18-24 and placement of the assessed spatial temporal closures used in the model.

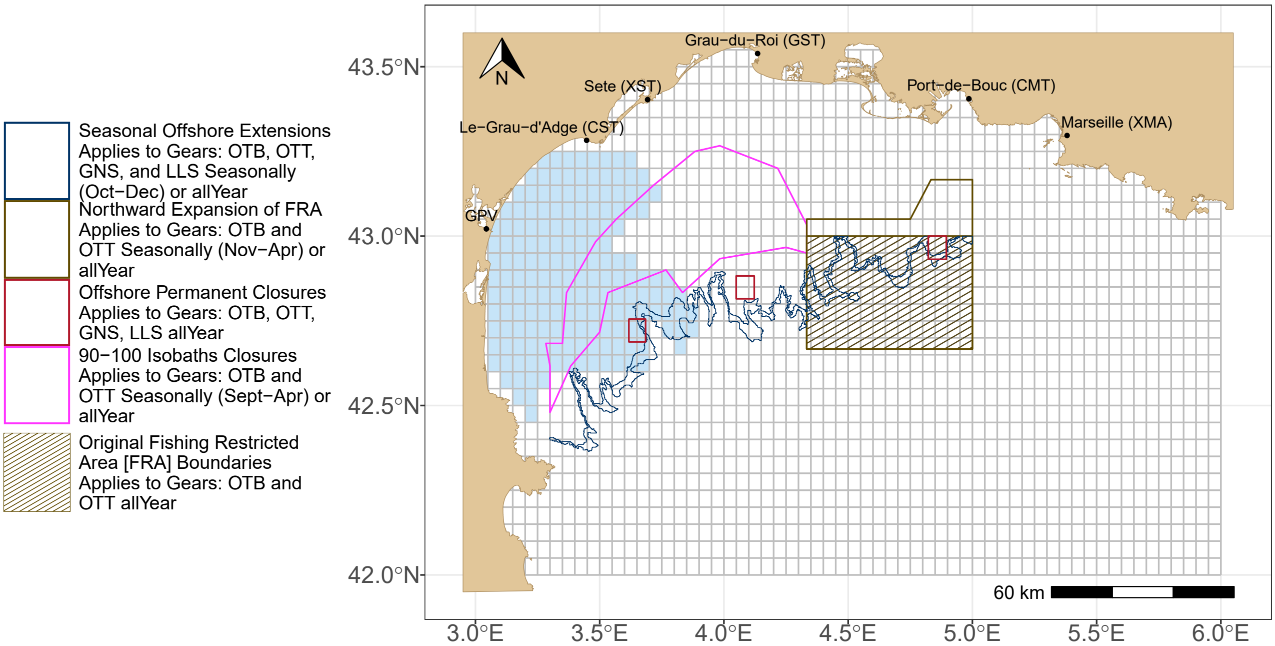

Figure B.15: Fishing zone definitions: Historic fishing grounds for OTT_GPV_24-40 and placement of the assessed spatial temporal closures used in the model.

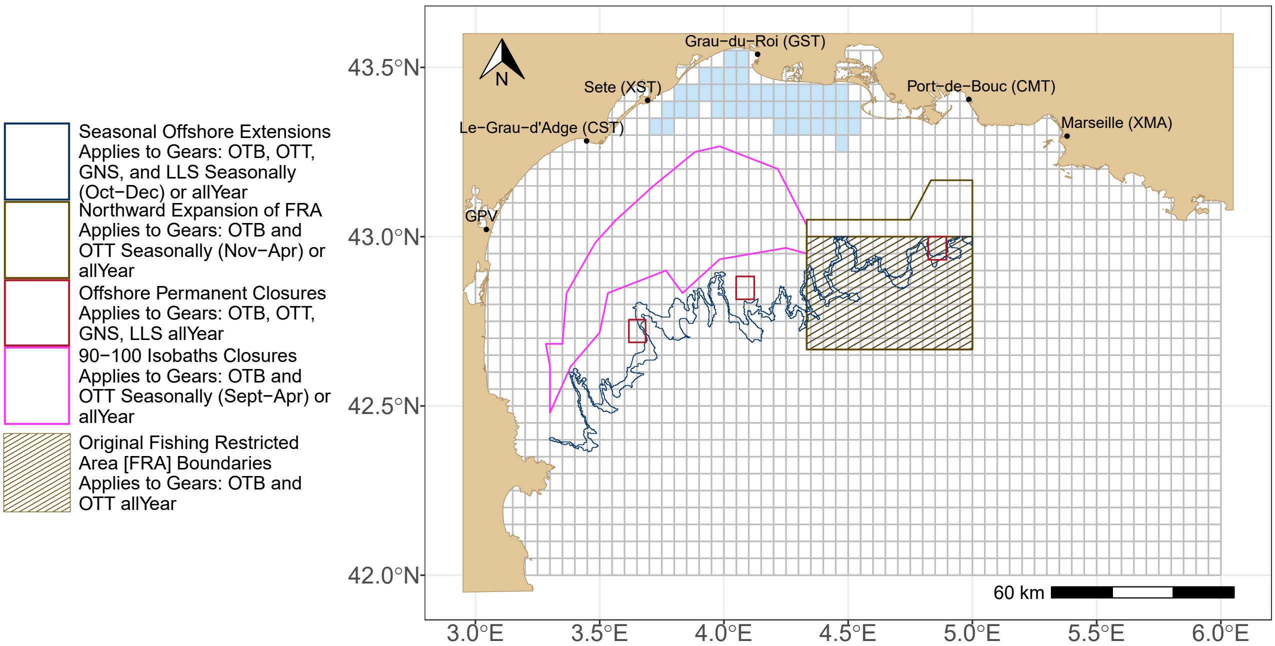

Figure B.16: Fishing zone definitions: Historic fishing grounds for OTM_GST_18-24 and placement of the assessed spatial temporal closures used in the model.

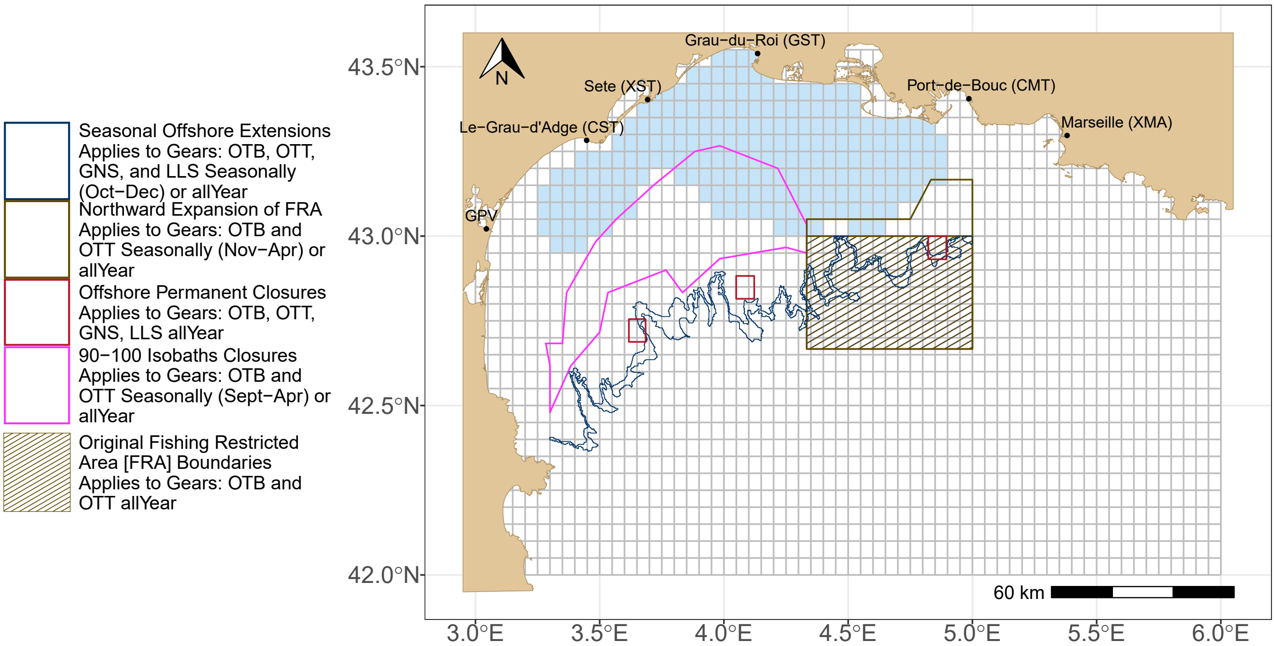

Figure B.17: Fishing zone definitions: Historic fishing grounds for OTB_GST_18-24 and placement of the assessed spatial temporal closures used in the model.

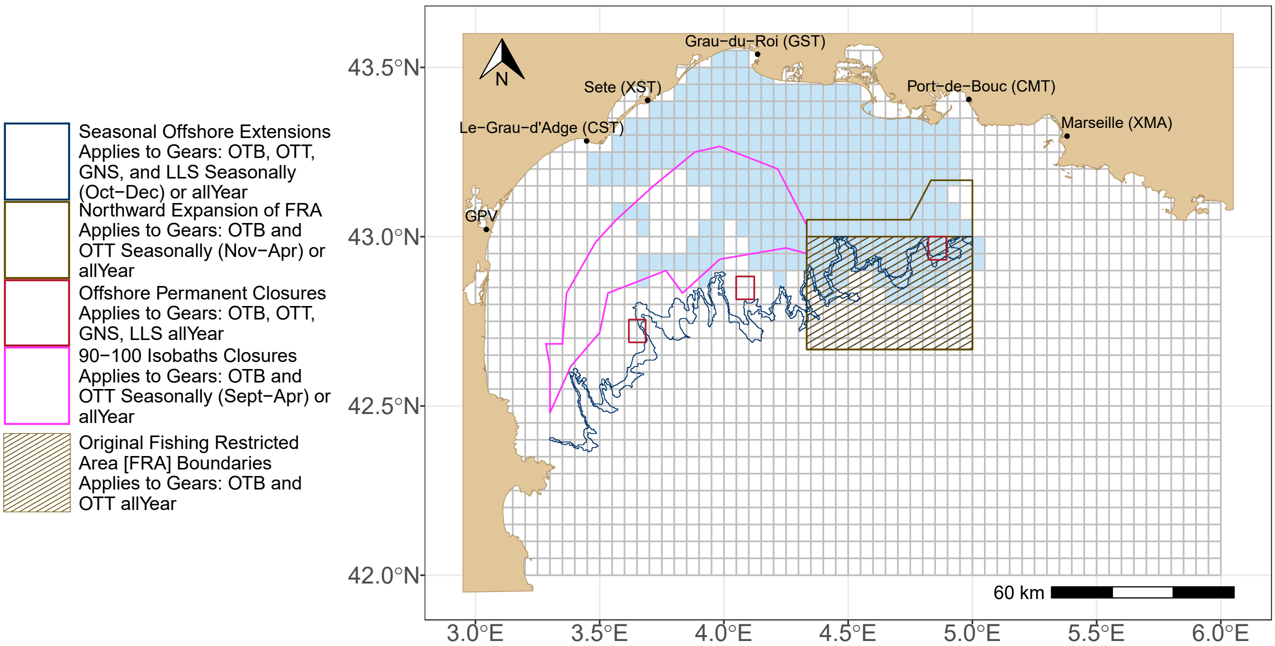

Figure B.18: Fishing zone definitions: Historic fishing grounds for OTB_GST_24-40 and placement of the assessed spatial temporal closures used in the model.

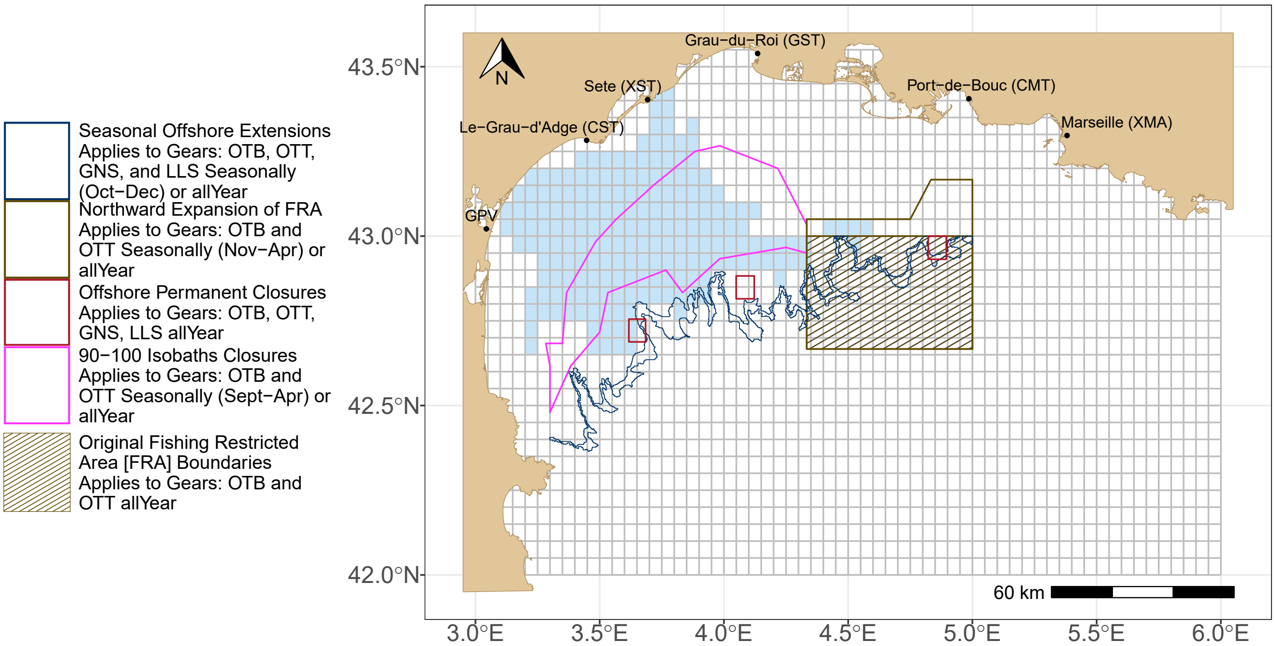

Figure B.19: Fishing zone definitions: Historic fishing grounds for OTM_XST_24-40 and placement of the assessed spatial temporal closures used in the model.

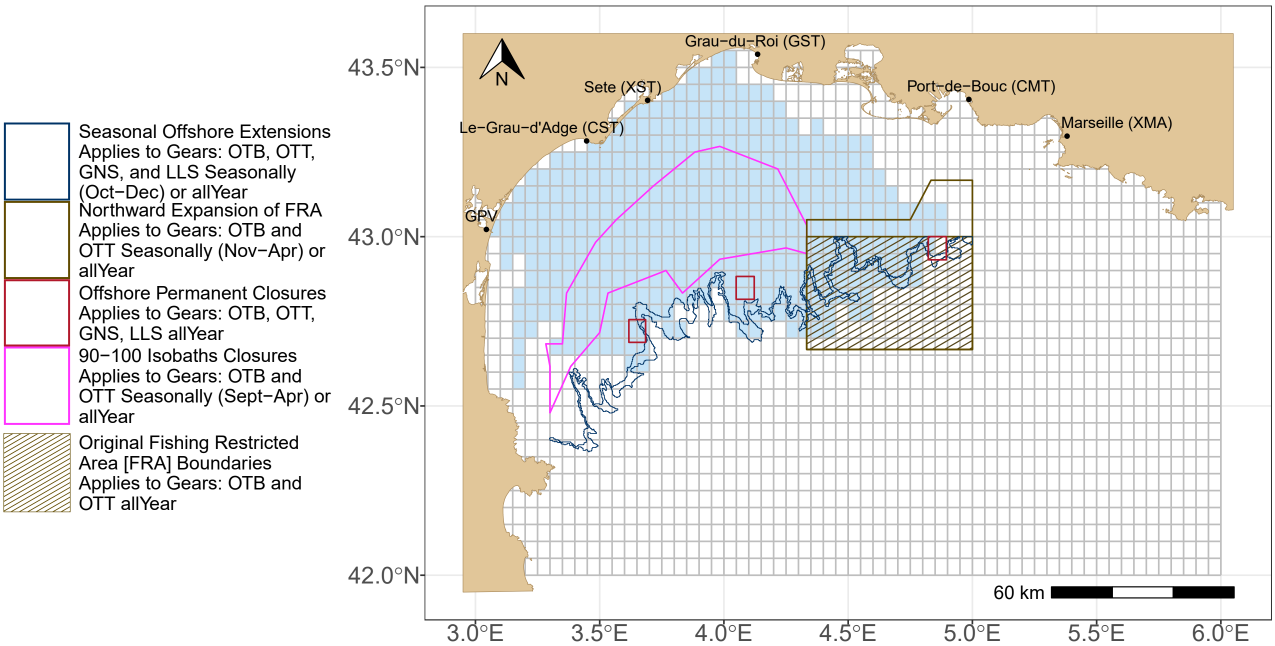

Figure B.20: Fishing zone definitions: Historic fishing grounds for OTB_XST_24-40 and placement of the assessed spatial temporal closures used in the model.

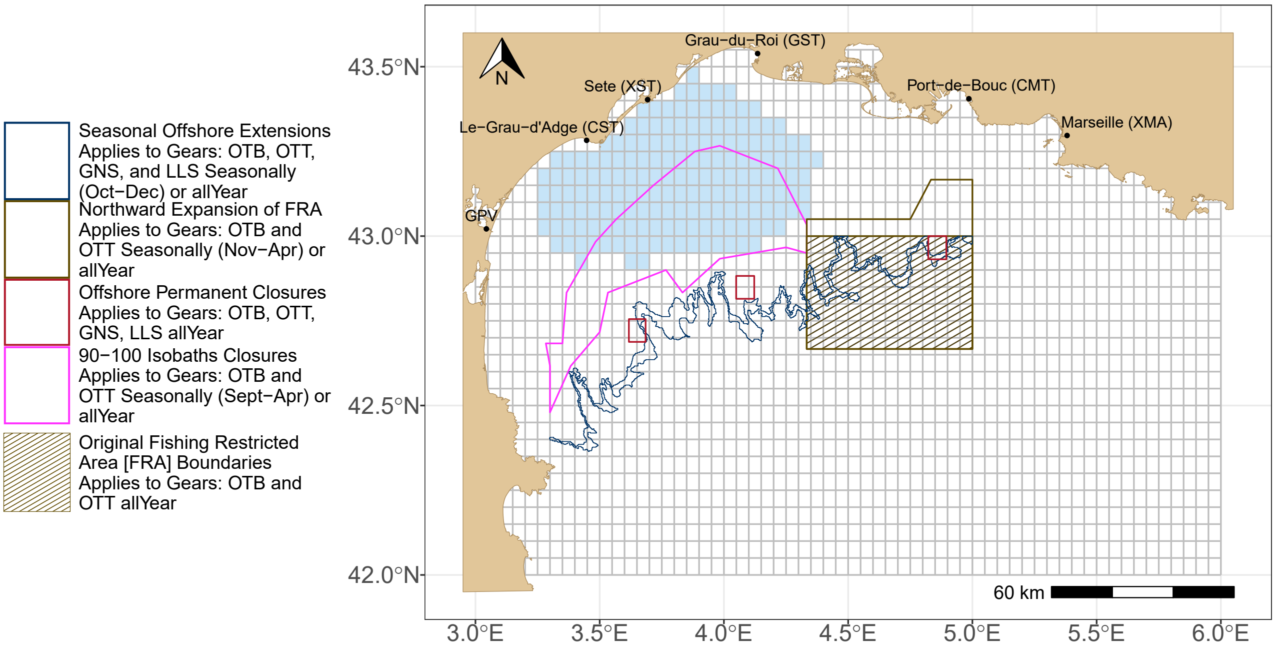

Figure B.21: Fishing zone definitions: Historic fishing grounds for OTT_XST_18-24 and placement of the assessed spatial temporal closures used in the model.

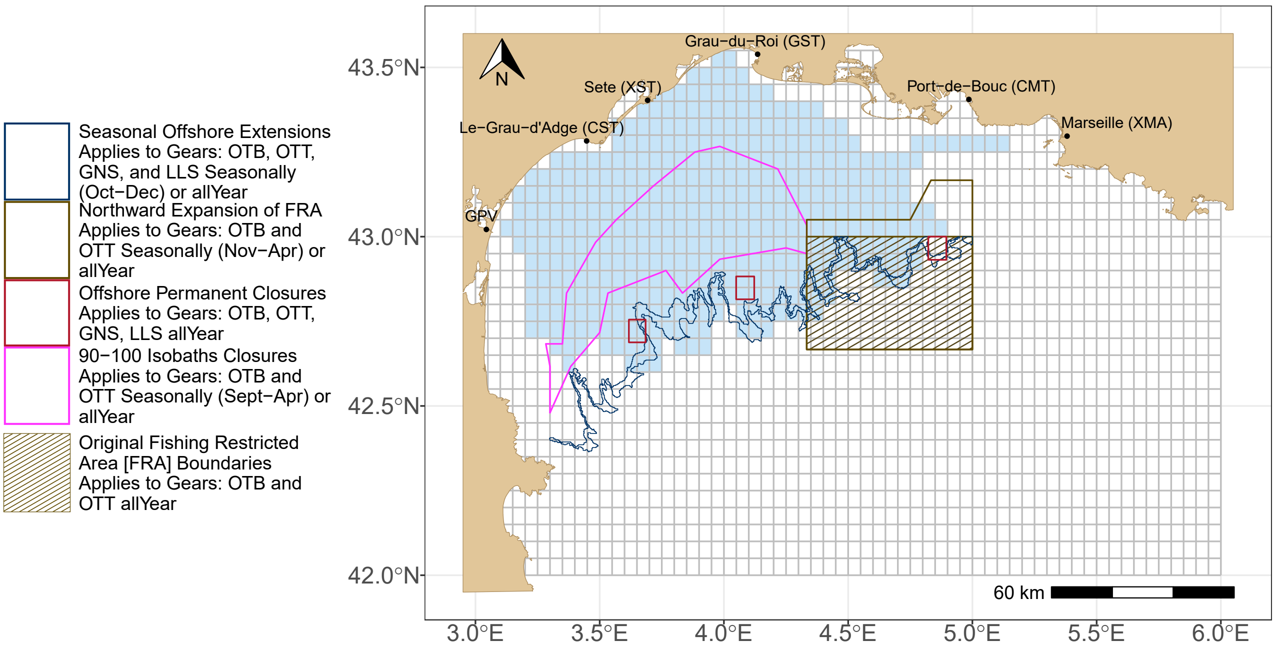

Figure B.22: Fishing zone definitions: Historic fishing grounds for OTT_XST_24-40and placement of the assessed spatial temporal closures used in the model.

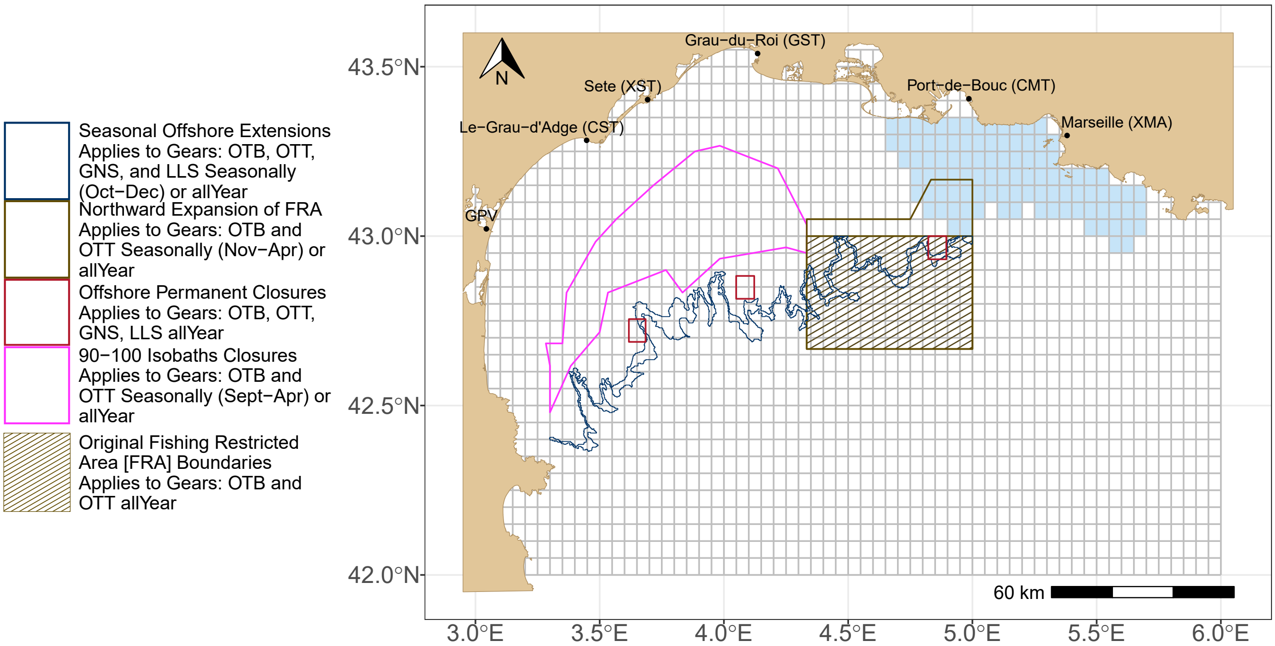

Figure B.23: Fishing zone definitions: Historic fishing grounds for OTB_XMA_18-24 and placement of the assessed spatial temporal closures used in the model.

Table B.2: Catchability: Gear selectivity by age group (q) derived from proportion of catch reported during the reference years 2015 – 2017 in the Gulf of Lion are shown. For Spanish métier and French gillnetters, q was derived from the calibration steps shown in Appendix D.

Age	OTB, OTT, OTM	GNS	LLS
0	1	0	0
1	1	0.41	0.000089
2	1	0.58	0.0045
3	1	0.0053	0.12
4	1	0.0000038	0.29
5+	1	0	0.36

Table B.3: Catchability: Target factor by French trawling métier derived from proportion of catch reported during the reference years 2015 – 2017 in the Gulf of Lion are shown. For Spanish métier and French gillnetters, target factor was derived from the calibration steps shown in Appendix D.

Métier	**Fraction of Catch**
OTB_CMT_18-24	1.00
OTB_CMT_24-40	1.00
OTM_CMT_24-40	0.23
OTB_CST_18-24	0.18
OTB_CST_24-40	0.45
OTM_CST_24-40	0.11
OTT_CMT_24-40	0.21
OTB_GPV_18-24	0.26
OTT_GPV_18-24	0.04
OTB_GPV_24-40	0.59
OTM_GPV_24-40	0.52
OTT_GPV_24-40	0.34
OTB_GST_18-24	0.25
OTM_GST_18-24	0.10
OTB_GST_24-40	0.53
OTM_GST_24-40	0.56
OTB_XMA_18-24	0.77
OTM_XMA_18-24	0.63
OTT_XST_18-24	0.31
OTB_XST_24-40	0.45
OTM_XST_24-40	0.23
OTT_XST_24-40	0.45

C Biological parameters

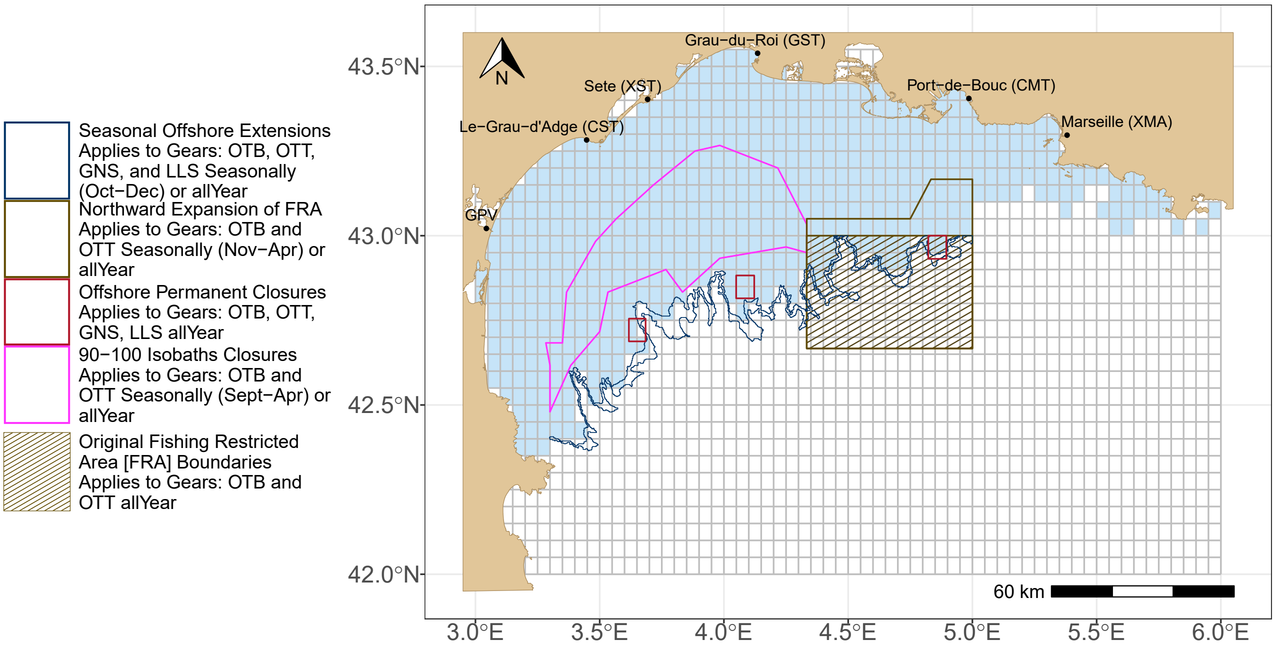

Figure C.1: Population zone definitions: Population zone definitions for continental shelf used in the ISIS-Fish model.

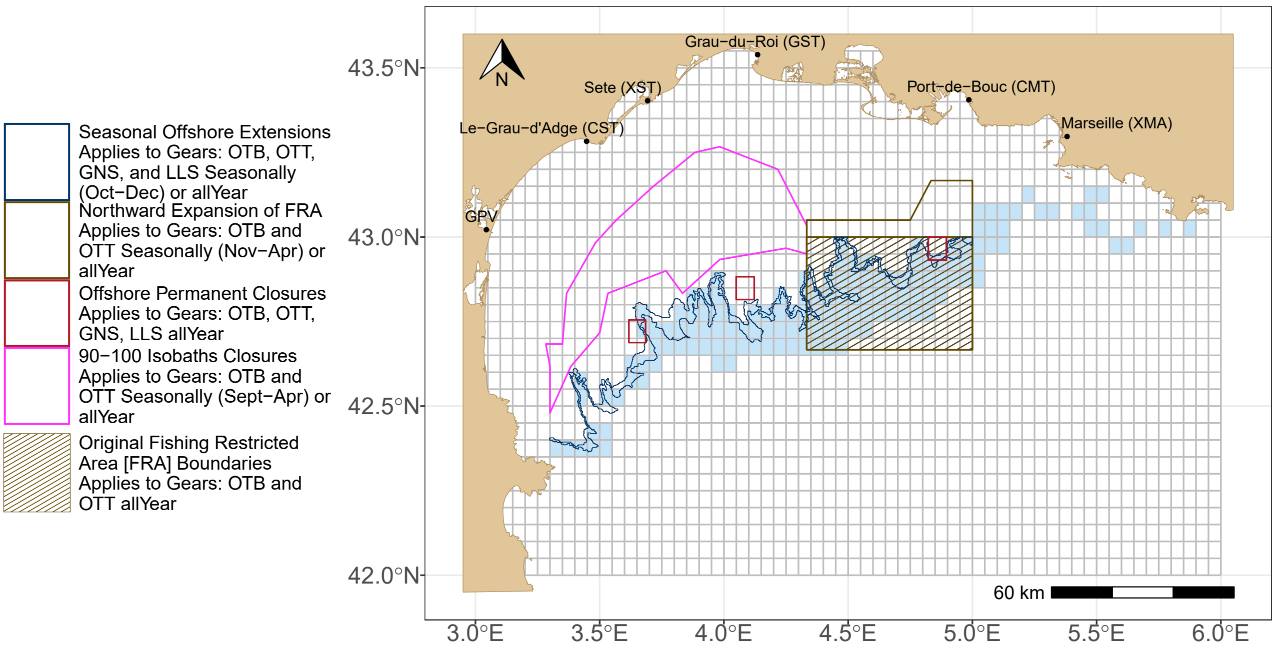

Figure C.2: Population zone definitions: Population zone definitions for the interface of the continental slope and submarine canyon heads used in the ISIS-Fish model.

Table C.1: Life stage parameters: Initial abundance numbers used in the ISIS-Fish model before simulations were run, are shown per age group. For each age, the sum of both abundance values per population zone is the same as 2015 values presented in the stock assessment report for the Gulf of Lion (Certain et al., 2018). The total stock at age used by the assessment model was estimated via Extended Survivor Analysis (XSA) (Certain et al., 2018). The proportion of each age class allocated per population zone is also the same as those estimated by Wendling et al., 2019 in the GALION Project.

Age group	Continental Shelf	Interface of the continental slop and submarine canyon heads
0*	0	0
1	2033027	6673153
2	642042	567548
3	18060	1540
4	1078	92
5+	28	2

Table C.2: Life stage parameters: To obtain more realistic recruitment estimates (Age 0) throughout the model simulation period than what was available from the stock assessment report, recruitment rates were estimated via the calibration steps shown in Appendix C. The results of which are shown below, where recruits are gradually introduced into the system at set quarterly rates across all months. The assessment model currently used by the stock assessment working group is the XSA model, which has recruitment set to once a year (Certain et al., 2018). From the calibrated recruitment rates estimated, recruitment within each population zone (continental shelf and the interface between the continental slope and submarine canyon heads) is later forced based on the connectivity assumptions. For principle hypothesis testing, 83 % of recruits were allocated to the continental shelf, while 17 % were allocated to the interface of the continental slope and submarine canyon heads. For the two alternative hypotheses described in Methods section 2.6 were: 55 % in the continental shelf with 45 % in the interface of the continental slope and submarine canyon heads, and 97 % in the continental shelf with 3 % in the interface of the continental slope and submarine canyon heads.

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
0.0396	0.0396	0.0396	0.1127	0.1127	0.1127	0.1424	0.1424	0.1424	0.0387	0.0387	0.0387

Table C.3: Life stage parameters: Other parameters were used in the biological sub-model of ISIS-Fish. Because recruitment rates were set differently depending on quarter (Appendix Table C.2, individuals entering the system at the end of the year do not suffer the same natural mortality as those arriving at the beginning of the year. Thus, we recalculated natural mortality for age class 0* as shown below. Monthly fishing mortality was computed based on standardized fishing effort and natural mortalities that applies to the population based on the Baranov equation. Fishing time was standardized based on selectivity and catchability. Thus harvest rate is never used, and annual fishing mortality is computed from the annual catch and biomass *a posteriori*.

Measurement	**Values**	**Reference**
von Bertalanffy Relationship	$L_\infty = 110$ K = 0.178 $T_0 = 0$	Mellon-Duval et al., 2010
Length – Weight Relationship	W = $_aL^b$ a = 0.0085 b = 2.97	Certain et al., 2018
Maturity Ogive	Age 0 : 0.032 Age 1 : 0.0389 Age 2 : 0.679 Age 3 : 0.939 Age 4 : 1 Age 5+: 1	Certain et al., 2018
Natural Mortality Rate	Age 0: 2.33* Age 1: 0.58 Age 2: 0.45 Age 3: 0.40 Age 4: 0.37 Age 5+: 0.35	Certain et al., 2018

D Calibration

Table D.1: Calibration steps: ISIS-Fish defines catchability as the product of behavioral catchability (*q*), gear selectivity (*Sel*), and Target Factor (*TF*, *i.e.*, how much is aimed to be caught) (Mahévas, Pelletier, 2004). This improves upon the STECF stock evaluations in that the proportional vessel/gear affects by age class are investigated. For the métier French Gillnetters (*GNS_FRA*), the behavioral aspects of catchability were estimated via calibration along with Target Factor. The delineated space explored ranged between 0 to 2 for behavioral catchability and were chosen based on prior knowledge, while the delineated space explored for Target Factor ranged between 0 to 10, which is common for the industry. Behavioral catchability and Target Factor for the métiers: Spanish bottom otter trawls (*OTB_ESP*) and Spanish longliners (*LLS_ESP*) were also estimated using the same spatial extents. Five data sets were used in these estimations, which corresponded to 5 (Observed data) X 9 (Estimated parameters) dimensions, and the number of sampling points (nodes) used in the LHS corresponded to 5000 simulations.

Step 1: Catch per year for métier GNS									
Estimated parameters	q0	q1	q2	q3	q4	q5	TF OTB	TF LLS	TF GNS
Assessed									X
Delineated space	0-2						0-10		
Number of simulations	5000 simulations								
GOF	$\sum_{i=1}^{10} OF_i = \sum_{j=1}^{J} (ObservedCatch_{i,j} - SimulatedCatch_{i,j})^2$								
Observed data	Catch / country / year / quarter / age								
Solution	0.17	1.06	0.88	0.44	0.73	1.79	0.6	0.19	4.14

Table D.2: Calibration steps: From the previous step, only the French gillnetter Target Factor was corrected for. But based on the results it returned, a new range of values were needed for the Spanish métiers. Therefore for the Target Factor of Spanish bottom otter trawls (*OTB_ESP*), a delineated space of 0-5 was used, while a delineated space of 0-20 was used for the Target Factor estimation of Spanish longliners (*LLS_ESP*). The delineated space explored for behavioral catchability was kept the same however. Five data sets were used in these estimations, which corresponded to 5 (Observed data) X 8 (Estimated parameters) dimensions. The number of sampling points (nodes) used in the LHS corresponded to 5000 simulations.

Step 2: Catch at age per year + Catch/country/year								
Estimated parameters	q0	q1	q2	q3	q4	q5	TF OTB	TF LLS
Assessed							X	X
Fixed parameter	TF_GNS = 1.74							
Delineated space	0-2						0-5	0-20
Number of simulations	5000 simulations							
GOF	$\sum_{i=1}^{10} OF_i = \sum_{j=1}^{J}(ObservedCatch_{i,j} - SimulatedCatch_{i,j})^2$							
Observed data	Catch / country / year / quarter / age							
Solution	0.18	1.42	0.97	1.2	0.79	1.83	0.19	12.68

Table D.3: Calibration steps: Behavioral catchability for the first two age groups (0 and 1 years of age) was re-estimated for each season based on the Galion Project findings (Wendling et al., 2019), which corresponded to 2 sequences of 4 (Observed data) X 8 (Estimated parameters) and 2 (Observed data) X 8 (Estimated parameters) dimensions. The number of sampling points (nodes) used in the LHS corresponded to 8000 simulations.

Step 3: Total catch of Age 0 + Age 0 catches/year/quarter for métier: OTB_FR + Age 1 abundance per year

Estimated parameters	q0	RecT1	RecT2	RecT3	RecT4	Rec15	Rec16	Rec17
Assessed	X							
Delineated space	0-1	$0-1(\sum Rec \quad Ti = 1)$				0.5-1.5		
Number of simulations	8000 simulations							
GOF	$\sum_{i=1}^{2} OF_i = \sum_{j=1}^{J} (ObservedCatch_{i,j} - SimulatedCatch_{i,j})^2 + \sum_{j=1}^{J} (EvaluatedAbundance_{i,j} SimulatedAbundance_{i,j})^2$							
Observed data	Catch of Age 0 caught by French trawlers / year / quarter / gear & Age 1 Abundance per year							
Solution	0.18	0.17	0.41	0.32	0.09	0.95	0.89	0.56

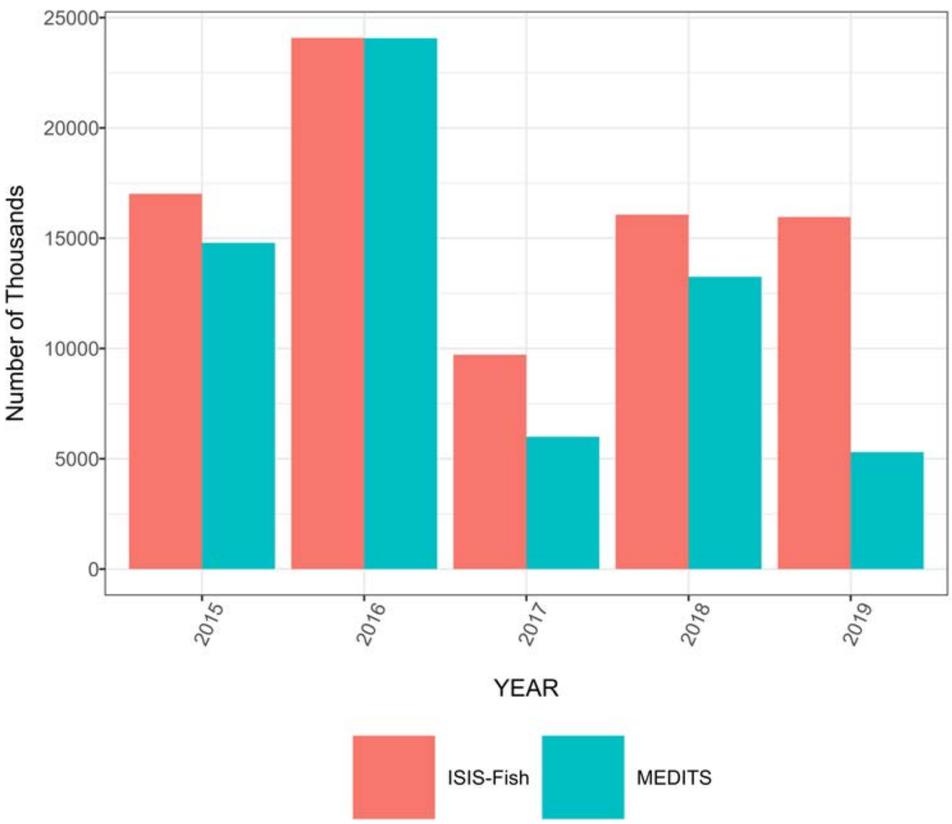

Figure D.1: Comparison between ISIS-Fish simulated January abundance values for age class 0 (shown in red) and MEDITS abundance indices (shown in blue) during the years 2015 to 2019. Abundance values are shown as numbers of individuals in the thousands.

Table D.4: Calibration steps: Behavioral catchability for age class "0-1" was resolved from the previous step. However, recruitment values per quarter by year were recalibrated to account for the inter-annual variation for each of the reference years 2015, 2016, and 2017 separately. The mean of these patterns were then used for training and projection years (2018 on-wards). The data sets used in these estimations corresponded to 2 sequences of 4 (Observed data) X 15 (Estimated parameters) and 2 (Observed data) X 15 (Estimated parameters) dimensions. The number of sampling points (nodes) used in the LHS corresponded to 8000 simulations.

Step 4: Age 0 catches/year/quarter for métier OTB_FR + Age 1 abundance per year															
Estimated parameters	2015 RecT1	2015 RecT2	2015 RecT3	2015 RecT4	2016 RecT1	2016 RecT2	2016 RecT3	2016 RecT4	2017 RecT1	2017 RecT2	2017 RecT3	2017 RecT4	Rec15	Rec16	Rec17
Assessed	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fixed parameter	q0 = 0.18														
Delineated space	$0-1(\sum Rec \quad Ti = 1)$				$0-1(\sum Rec \quad Ti = 1)$				$0-1(\sum Rec \quad Ti = 1)$				0.5-1.5		
Number of simulations	10000 simulations														
GOF	$\sum_{i=1}^{2} OF_i = \sum_{j=1}^{J} (ObservedCatch_{i,j} - SimulatedCatch_{i,j})^2$ & $\sum (EvaluatedAbundanceSimulatedAbundance)^2$														
Observed data	Catch of Age 0 caught by French trawlers / year / quarter / gear & Age 1 Abundance per year														
Solution	0.22	0.44	0.04	0.03	0.17	0.61	0.21	0.01	0.43	0.014	0.095	0.46	0.8	1.07	0.59

Table D.5: Calibration steps: Having found from the previous step satisfactory recruitment levels and catchability for age class “0 - 1”, Target Factors for the Spanish fleet and catchabilities for the remaining age classes, and métiers were reattempted. The explored delineated space ranged from 0-5 for Spanish trawlers (*OTB_ESP*) and 0-20 for Spanish longliners (*LLS_ESP*), while estimates of catchability by age class used the same range of values as in Step 2: 0-2. Five data sets were used in these estimations. These corresponded to 5 (Observed data) X 7 (Estimated parameters) dimensions, while the number of sampling points (nodes) used in the LHS corresponded to 4000 simulations.

Step 5: Catch at age per year + Catch/country/year							
Estimated parameters	q1	q2	q3	q4	q5	TF OTB	TF LLS
Assessed	X	X	X	X	X	X	X
Fixed parameter	q0 = 0.18; TF_GNS = 1.74						
Delineated space	0-2					0-5	0-20
Number of simulations	4000 simulations						
GOF	$\sum_{i=1}^{10} OF_i \sum_{j=1}^{J} (ObservedCatch_{i,j} - SimulatedCatch_{i,j})^2$						
Observed data	Catch / country / year / quarter / age						
Solution	0.5	0.48	1.1	0.13	1.29	0.38	6.54

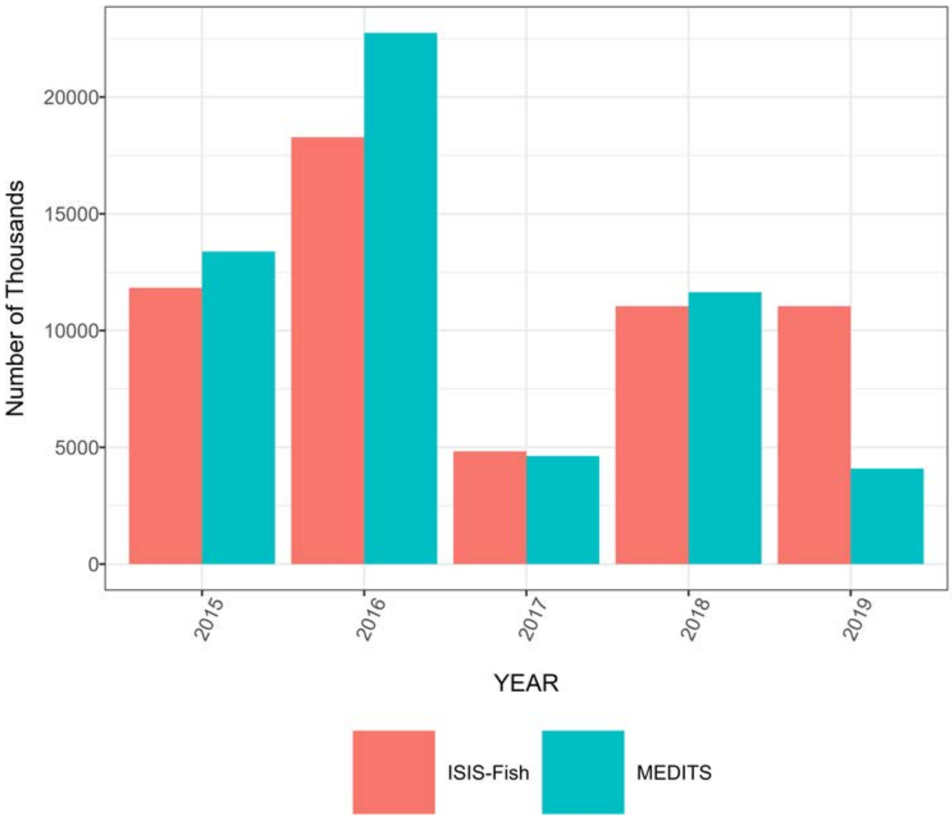

Figure D.2: Comparison between the mean of April-July ISIS-Fish simulated abundance numbers for all age classes added together (shown in red) and MEDITS abundance indices (shown in blue) during the years 2015 to 2019. Abundance values are shown as numbers of individuals in the thousands.

E Parameterization of revenues

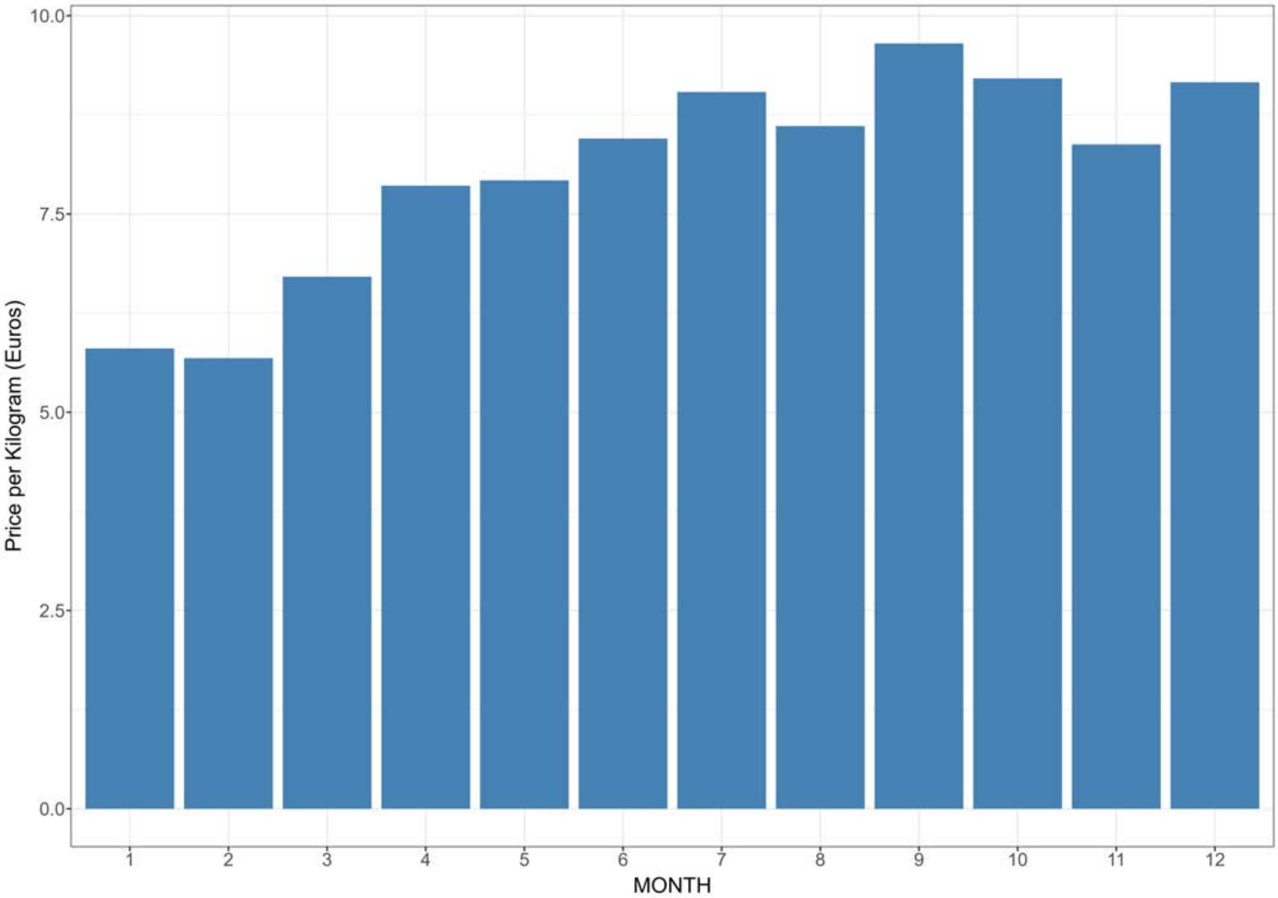

Figure E.1: Mean price per kilogram (kg) of hake in 2017 shown by month that were used in the hake revenues computations. For a given month, the catch weight of hake was multiplied by price.

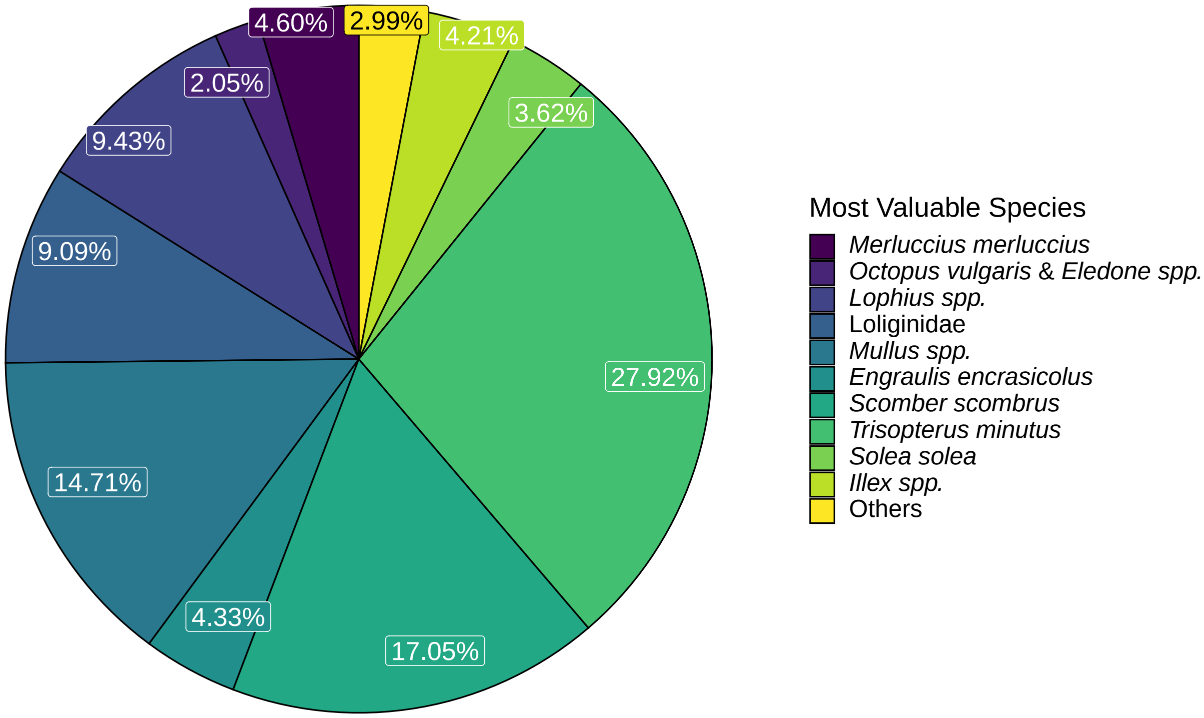

Figure E.2: Percentage of the total annual revenues derived from each of the top 10 species groups in the Gulf of Lion in 2017: Anchovy (*Engraulis encrasiolus*), Finned squids (*Illex spp.*, Pencil squids (Lolginidae), European hake (*Merluccius merluccius*), Red mullet and Striped red mullet (*Mullus spp.*), Common octopus, Horned octopus, and Musky octopus (*Octopus vulgaris* and *Eledone spp.*), Mackerel (*Scomber scombrus*), Common sole (*Solea solea*), and Poor cod (*Trisopterus minutus*). Values are shown as gross revenues before operation costs and fees (euros). Species not belonging to these top 10 groups are shown together as "Others".

$$VPUE_{(met)} = 1/n \sum_{n=1}^{ncells_{(str,met,trp)}} \left(\frac{Revenues_{(vsl,trp,tax)}}{TimeFished_{(vsl,trp,tax)}}\right) \tag{3}$$

where $ncells_{(str,met,trp)}$ is the number of cells fished by a vessel of a given métier and strategy per trip in a given year and month, $Revenues_{(vsl,trp,tax)}$ is the total amount earned in euros by a single vessel during a single fishing trip at a given cell for a single species, $TimeFished_{(vsl,trp,tax)}$ is the total time spent fishing by a single vessel in hours during a single fishing trip at a given cell for a single species, $Revenues_{(vsl,trp,tax,sce)}$ is the total amount of revenues lost in euros by a single vessel during a single fishing trip at a given cell for a single species when a spatial closure is applied to that cell, and $TimeFished_{(vsl,trp,tax,sce)}$ is the total time spent fishing by a single vessel in hours during a single fishing trip at a given cell for a single species when a spatial closure is applied to that cell.

$$Revenues_{Otherspecies} = VPUE_{(met)} * E_{(met,month)}) \tag{4}$$

where $VPUE_{(met)}$ is described by equation 3 and $E_{(met,month)}$ is the fishing time of practice of the métier *met* in at the current $month$.

F Explanatory Patterns

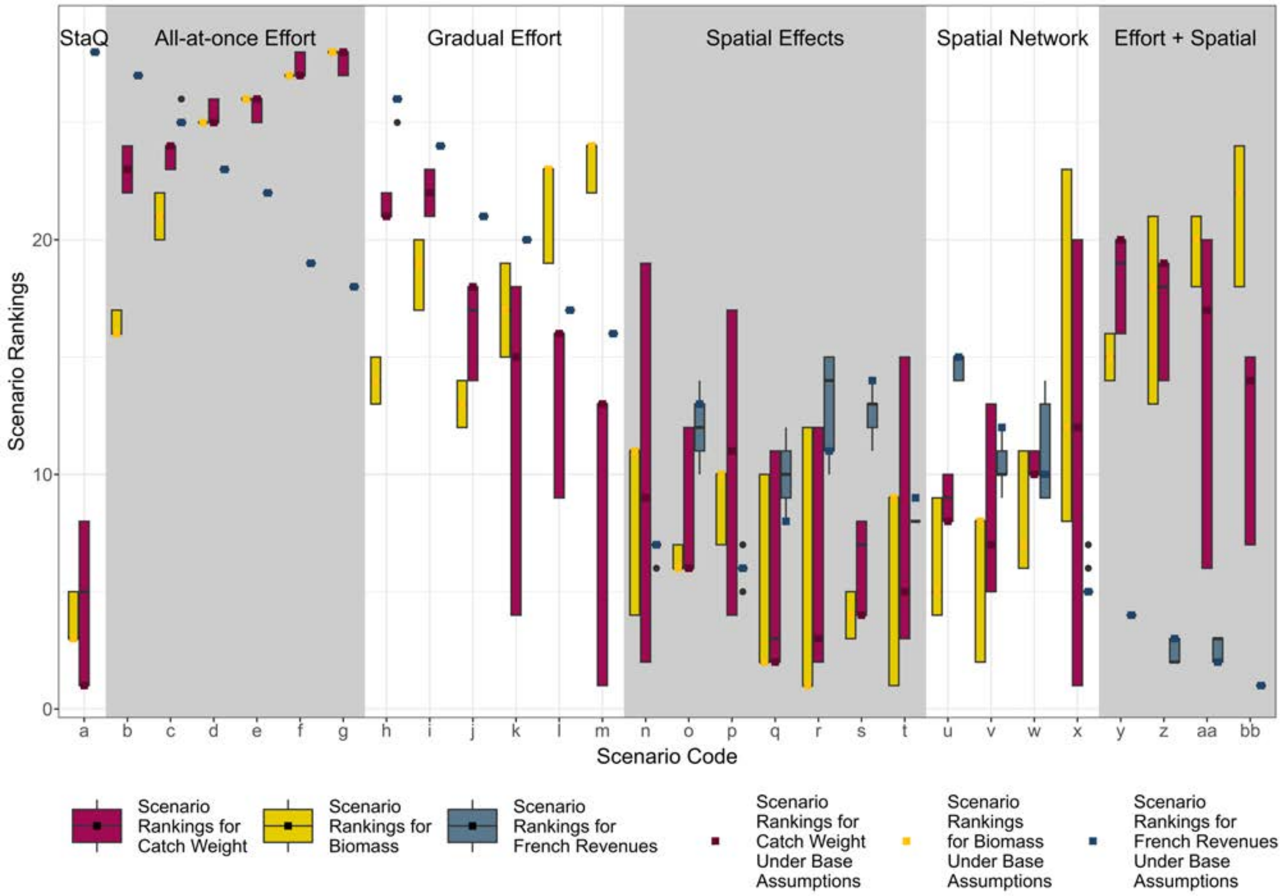

Figure F.1: Modeled robustness of the 28 scenarios to uncertainties in recruitment, connectivity between population zones, and initial abundance. Hake catch weight (in red) and population biomass (in yellow) are shown after five years of enforcement. French revenues for both hake and other species under 2017 dynamics are shown (in blue). Catch weight values include both the Spanish and French fleets together. The scenario ranks under the model's base assumptions (reference values): spatial distribution, recruitment, and the initial abundance are shown as bullets. For each of the 28 scenarios, the box shows the range of the scenario ranks accounting for the 18 combinations of uncertainty values. *StaQ* includes the Status Quo scenario, while *All-at-once Effort* includes all-at-once effort reduction measures. *Gradual Effort* includes gradual effort reduction measures and *Spatial Effects* all spatial closure single effect scenarios. Lastly, *Spatial Network* includes combined spatial closure effects, while *Effort + Spatial* includes the assessed effort reduction scenarios combined with the spatio-temporal closures. The position of the model's base assumptions (bullet) and the height of the box are used to assess the robustness of the scenario. Scenarios with higher rankings are positioned at the top and the most robust scenarios are considered to have shorter boxes. The median rank over the 18 values is the horizontal black line of each box.

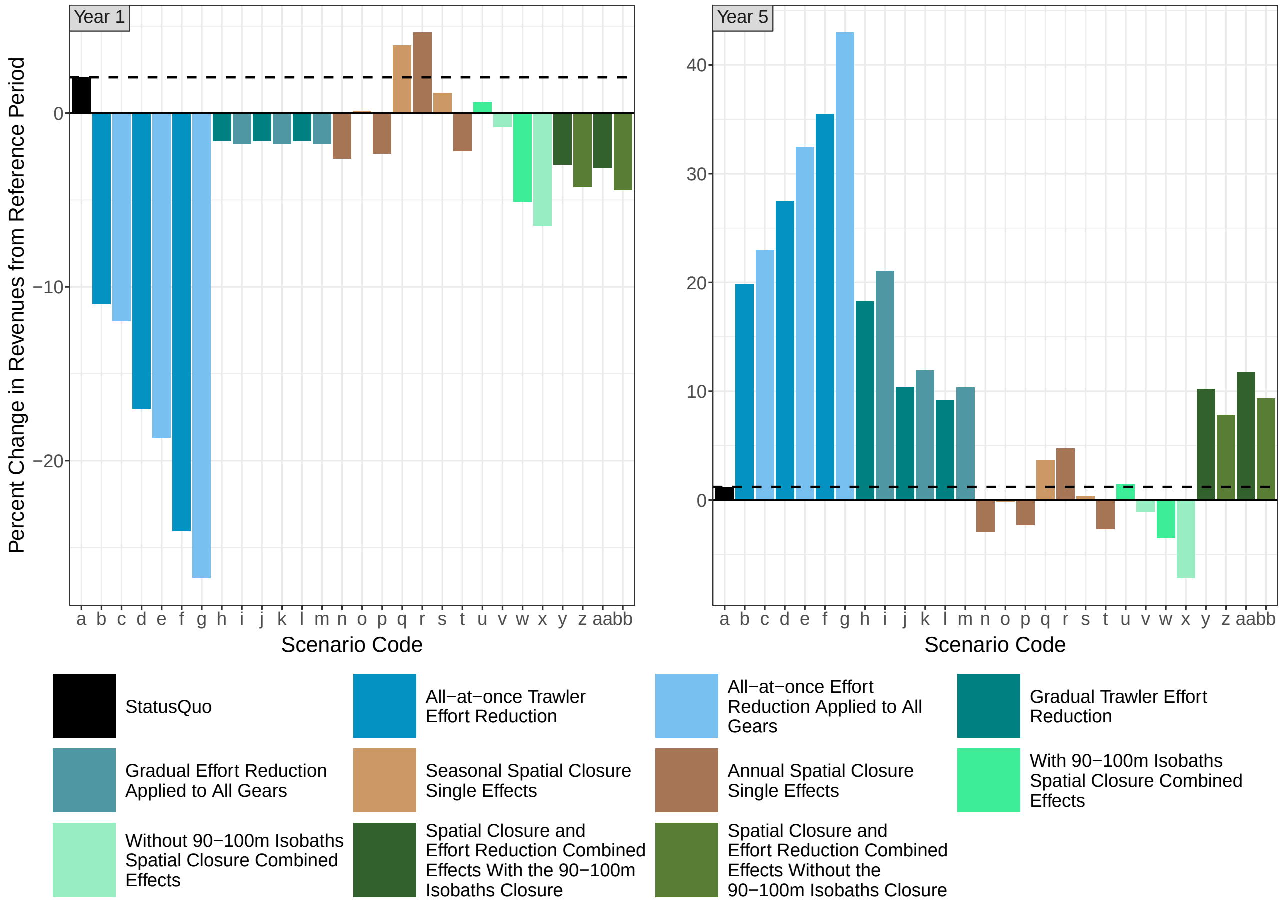

Figure F.2: Relative difference in projected hake derived revenues from the mean of the reference period 2017 for each management scenario described in Table 1 (x-axis) after one year and five years of enforcement. The Status Quo forecast is shown in black with a horizontal dashed line contrasting the projected revenues under each scenario to its values. A bar above zero (respectively below) shows an increase (resp. decrease) in projected relative to the reference period (2015-2017). A bar above the dashed line shows better performance than the Status Quo scenario. The color of the bar refers to the subgroup scenario detailed in Table 1.

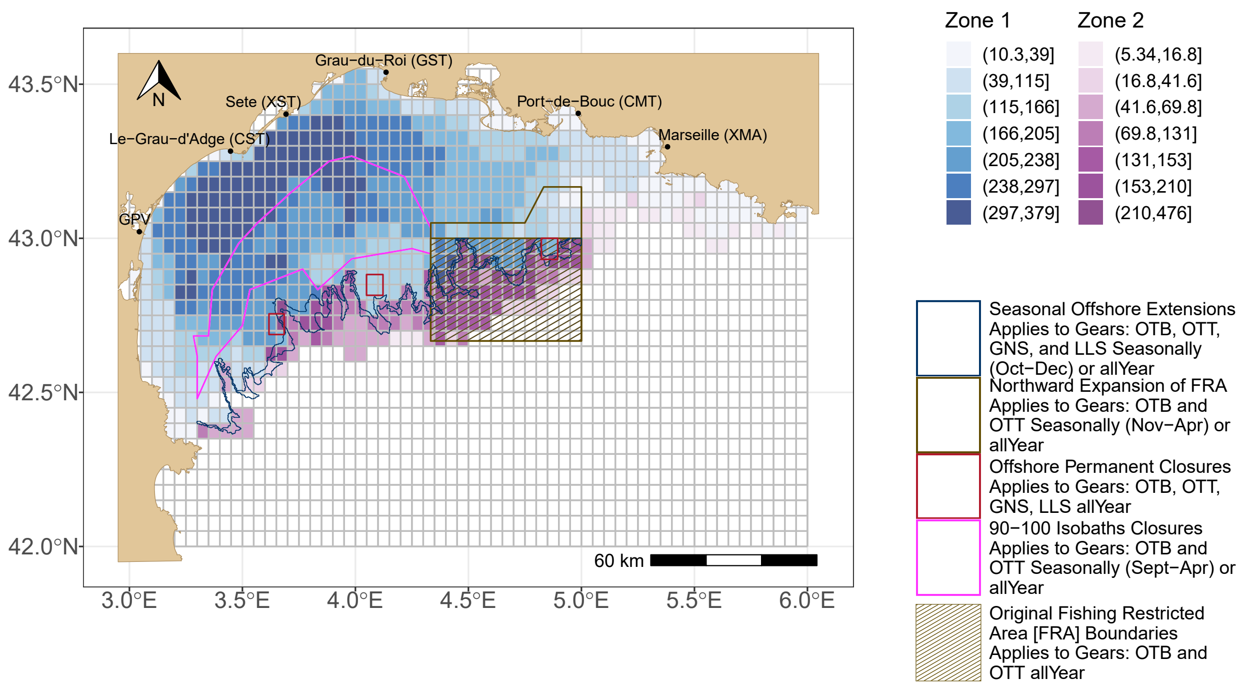

Figure F.3: Total annual fishing effort under the Status Quo scenario (*scenario a*) during year five (2024). Here no effort is redistributed. Spatial temporal closures are included for comparison against other scenario measures (Appendix Figs. F.4,F.5, F.6, F.7), but are not applied here. Instead fishers fish in their historic fishing zones. Effort exerted by all métiers together is shown as the sum of days fished. The continental shelf (Zone 1) are shown in blue while the interface between the continental slope and submarine canyon heads (Zone 2) is shown in purple.

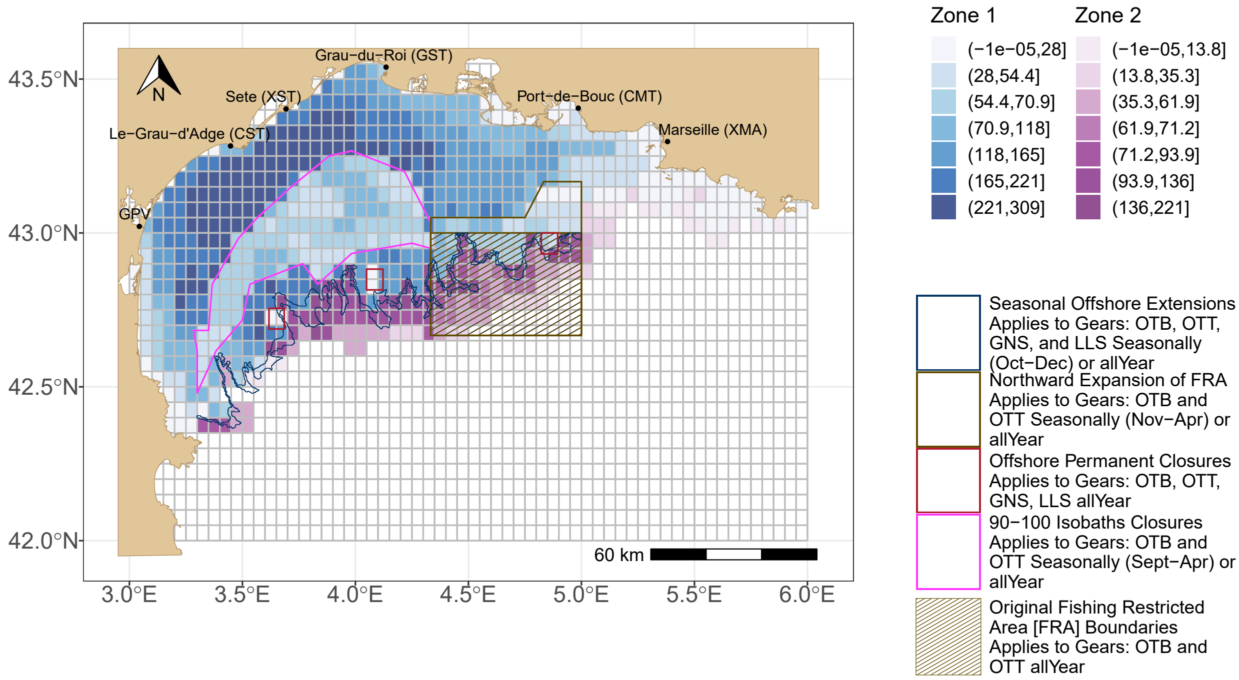

Figure F.4: Total annual fishing effort under *scenario y*, which combined gradual effort reduction to trawlers up to 40 % on an incremental basis (10, 17.5, 25, 32.5, 40) and spatial temporal closures with the 90 to 100 m isobaths included during year 5 (2024). Effort is evenly redistributed within remaining métier zone cells when a spatial closure is intersected. Therefore, effort exerted by all métiers is spatialized. Effort exerted by all métiers together is shown as the sum of days fished. The continental shelf (Zone 1) is shown in blue while the interface between the continental slope and submarine canyon heads (Zone 2) is shown in purple.

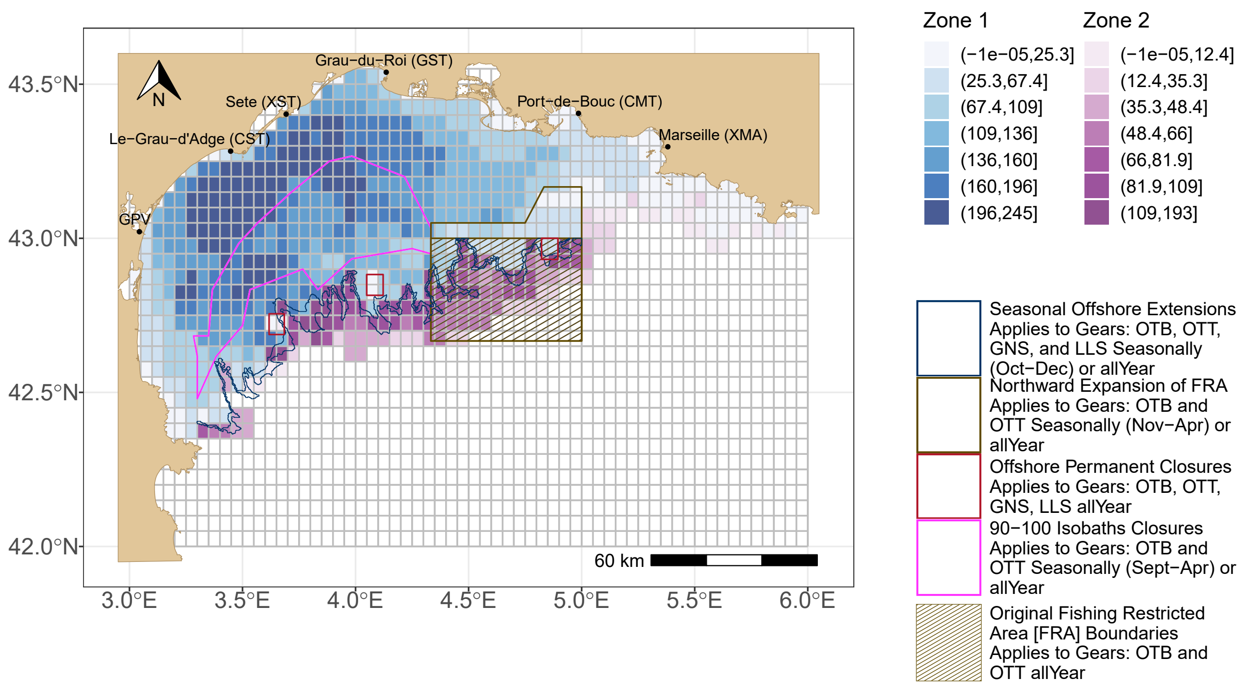

Figure F.5: Total annual fishing effort under *scenario z*, which combined gradual effort reduction to trawlers up to 40 % on an incremental basis (10, 17.5, 25, 32.5, 40) and spatial temporal closures without the 90 to 100 m isobaths included during year 5 (2024). Effort is evenly redistributed within remaining métier zone cells when a spatial closure is overlaid. Therefore, effort exerted by all métiers is spatialized. Effort exerted by all métiers together is shown as the sum of days fished. The continental shelf (Zone 1) is shown in blue while the interface between the continental slope and submarine canyon heads (Zone 2) is shown in purple.

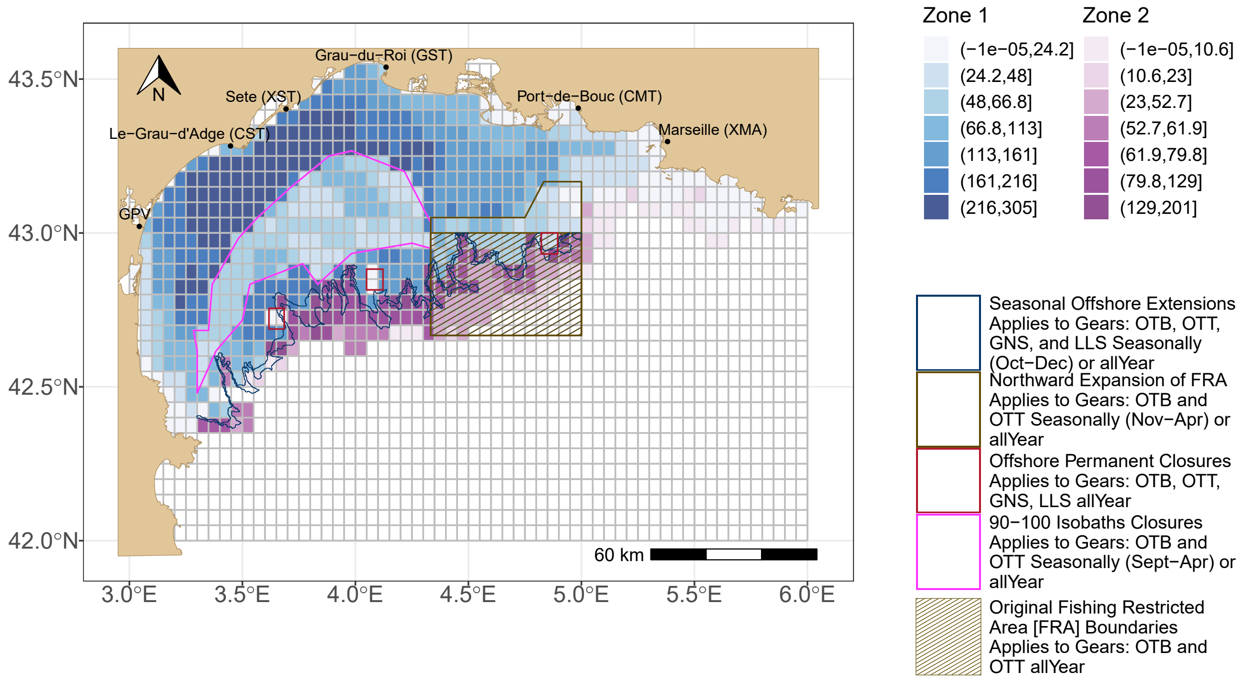

Figure F.6: Total annual fishing effort under *scenario aa*, which combined gradual effort reduction to all gears up to 40 % on an incremental basis (10, 17.5, 25, 32.5, 40) and spatial temporal closures with the 90 to 100 m isobaths included during year 5 (2024). Effort is evenly redistributed within remaining métier zone cells when a spatial closure is intersected. Therefore, effort exerted by all métiers is spatialized. Effort exerted by all métiers together is shown as the sum of days fished. The continental shelf (Zone 1) is shown in blue while the interface between the continental slope and submarine canyon heads (Zone 2) is shown in purple.

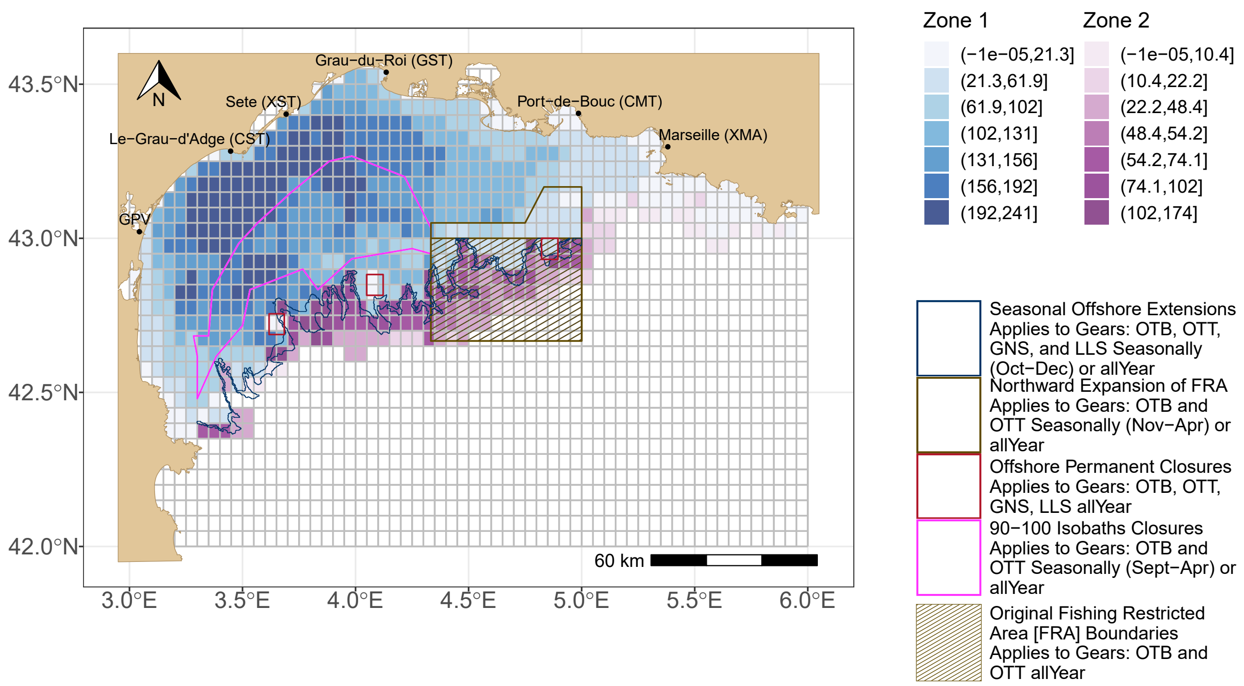

Figure F.7: Total annual fishing effort under *scenario bb*, which combined gradual effort reduction to all gears up to 40 % on an incremental basis (10, 17.5, 25, 32.5, 40) and spatial temporal closures without the 90 to 100 m isobaths included during year 5 (2024). Effort is evenly redistributed within remaining métier zone cells when a spatial closure is intersected. Therefore, effort exerted by all métiers is spatialized. Effort exerted by all métiers together is shown as the sum of days fished. The continental shelf (Zone 1) is shown in blue while the interface between the continental slope and submarine canyon heads (Zone 2) is shown in purple.

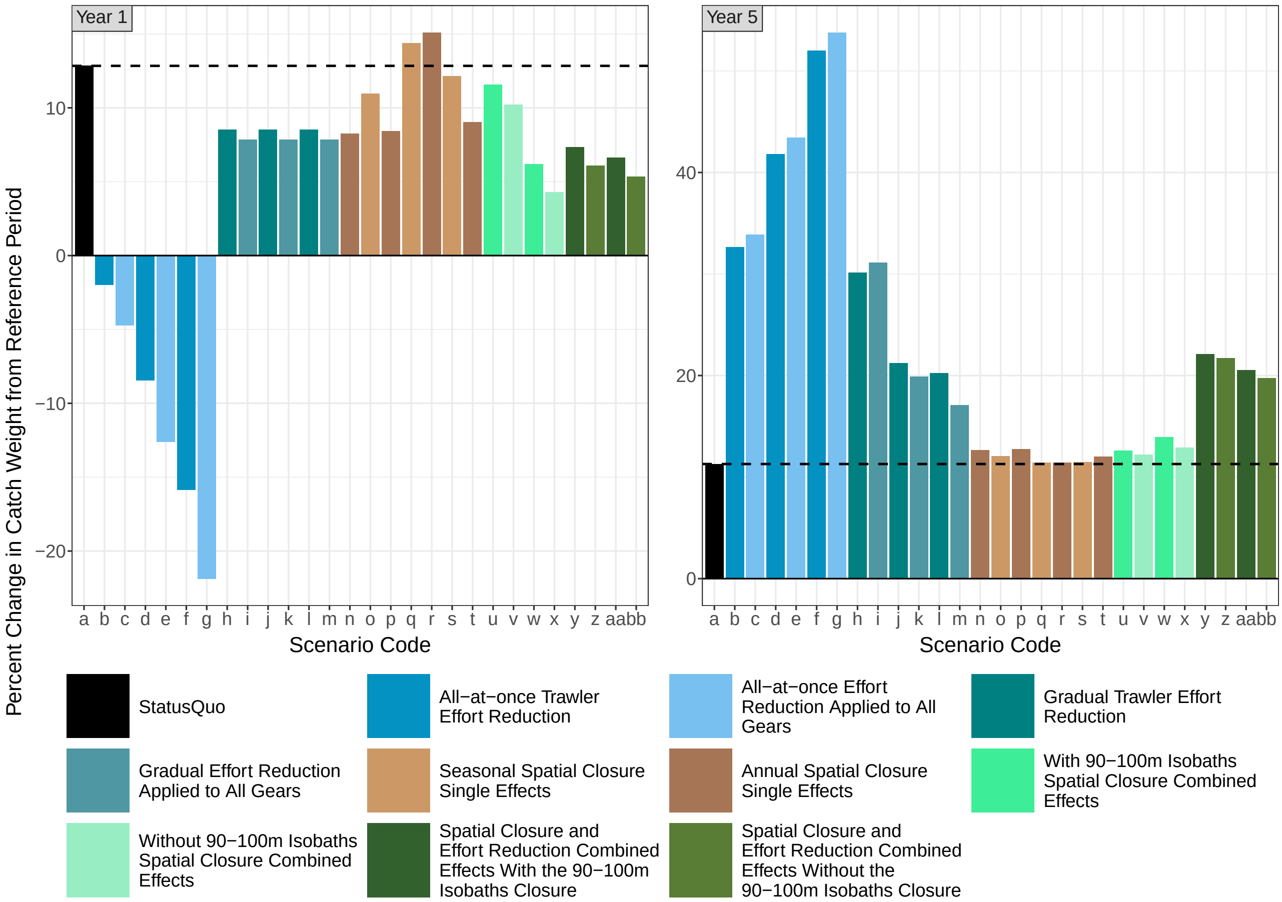

Figure F.8: Relative difference in hake total catch weight from the mean of the reference period 2015 to 2017 for each management scenario described in Table 1 (x-axis) after one year and five years of enforcement. The Status Quo forecast is shown in black with a horizontal dashed line contrasting the total catch weight under each scenario to its values. A bar above zero (respectively below) shows an increase (resp. decrease) in catch weight relative to the reference period (2015 – 2017). A bar above the dashed line shows better performance than the Status Quo scenario. The color of the bar refers to the subgroup scenario detailed in Table 1.

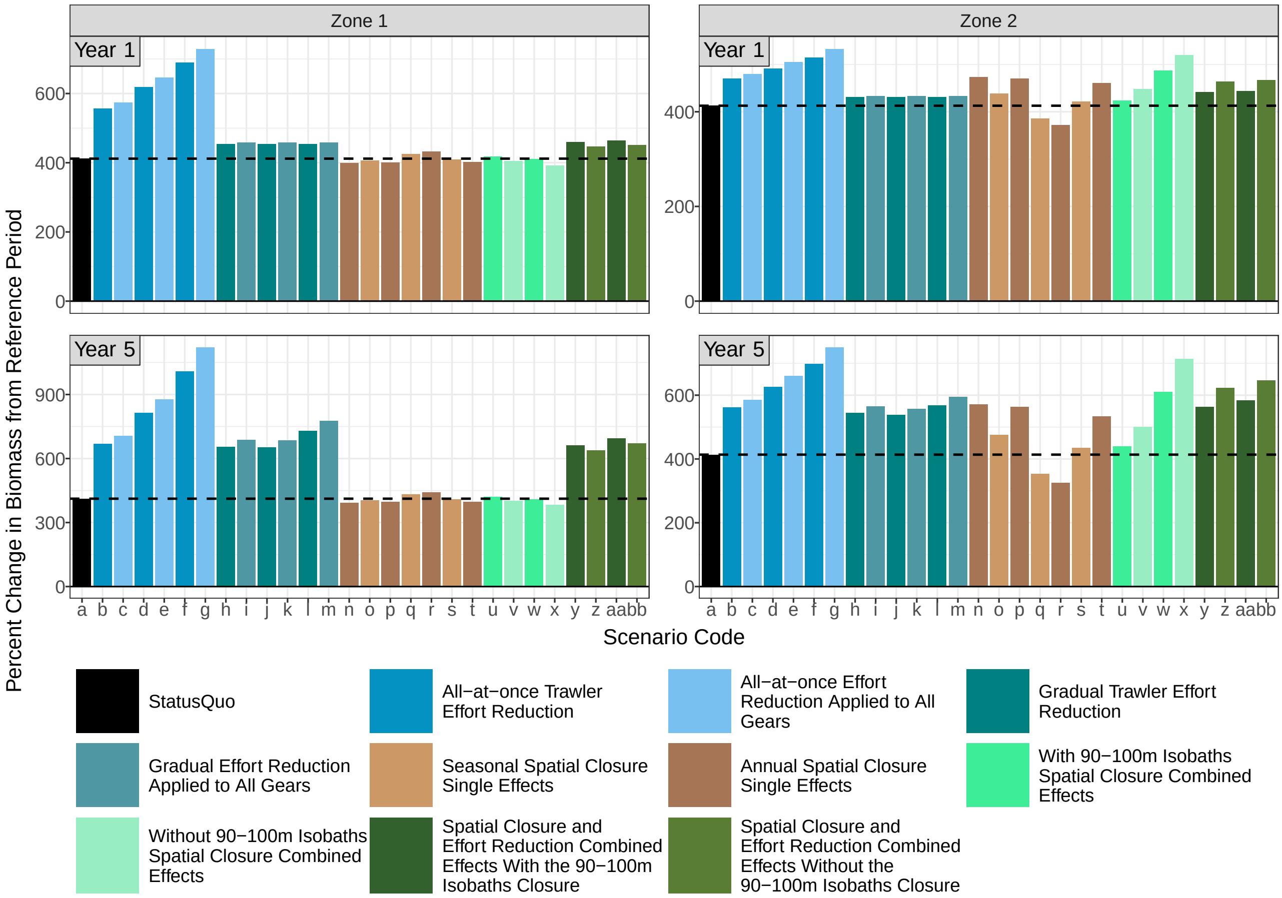

Figure F.9: Relative difference in annual biomass by population zone from the mean of the reference period 2015 to 2017 for each management scenario described in Table 1 (x-axis) after one year and five years of enforcement. The Status Quo forecast is shown in black with a horizontal dashed line contrasting the annual biomass under each scenario to its values. A bar above zero (respectively below) shows an increase (resp. decrease) in annual biomass relative to the reference period (2015-2017). A bar above the dashed line shows better performance than the Status Quo scenario.