Supplementary Material

1 Supplementary Figures and Tables

1.1 Supplementary Figures

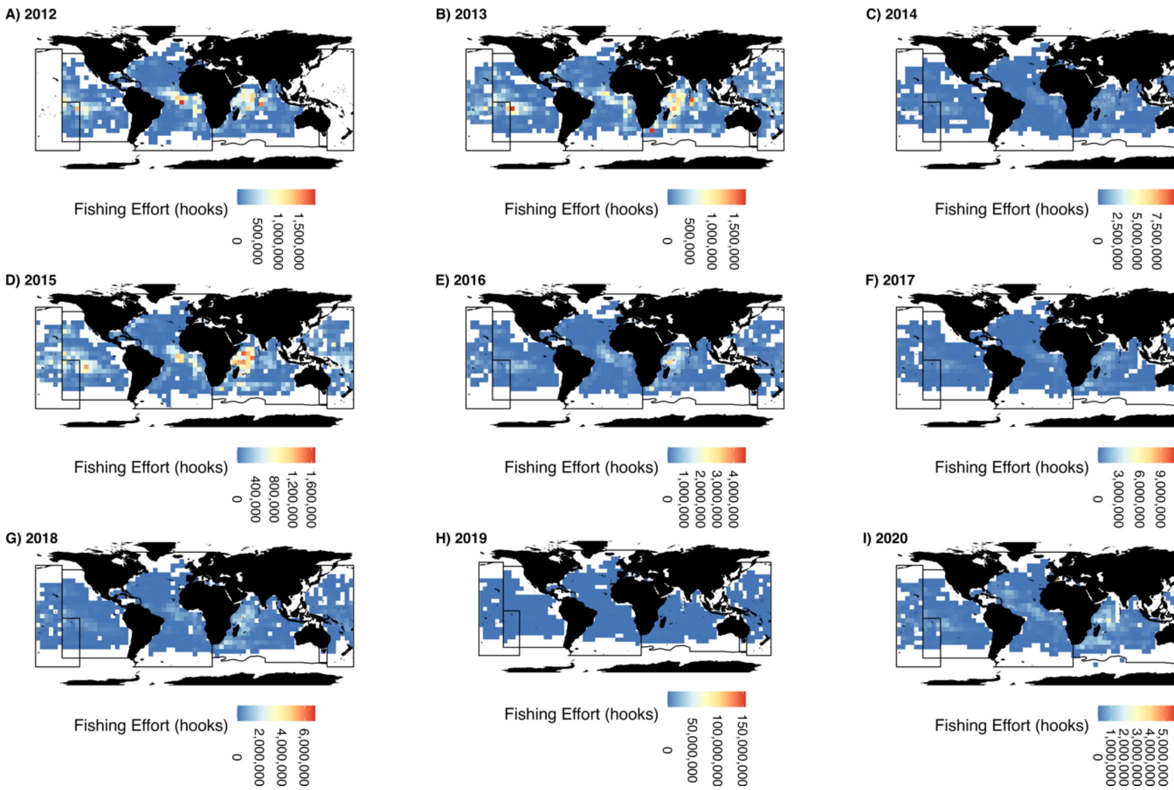

Figure S1. Effort reported with target catch by tRFMOs (hooks) from longline vessels from 2012 to 2020.

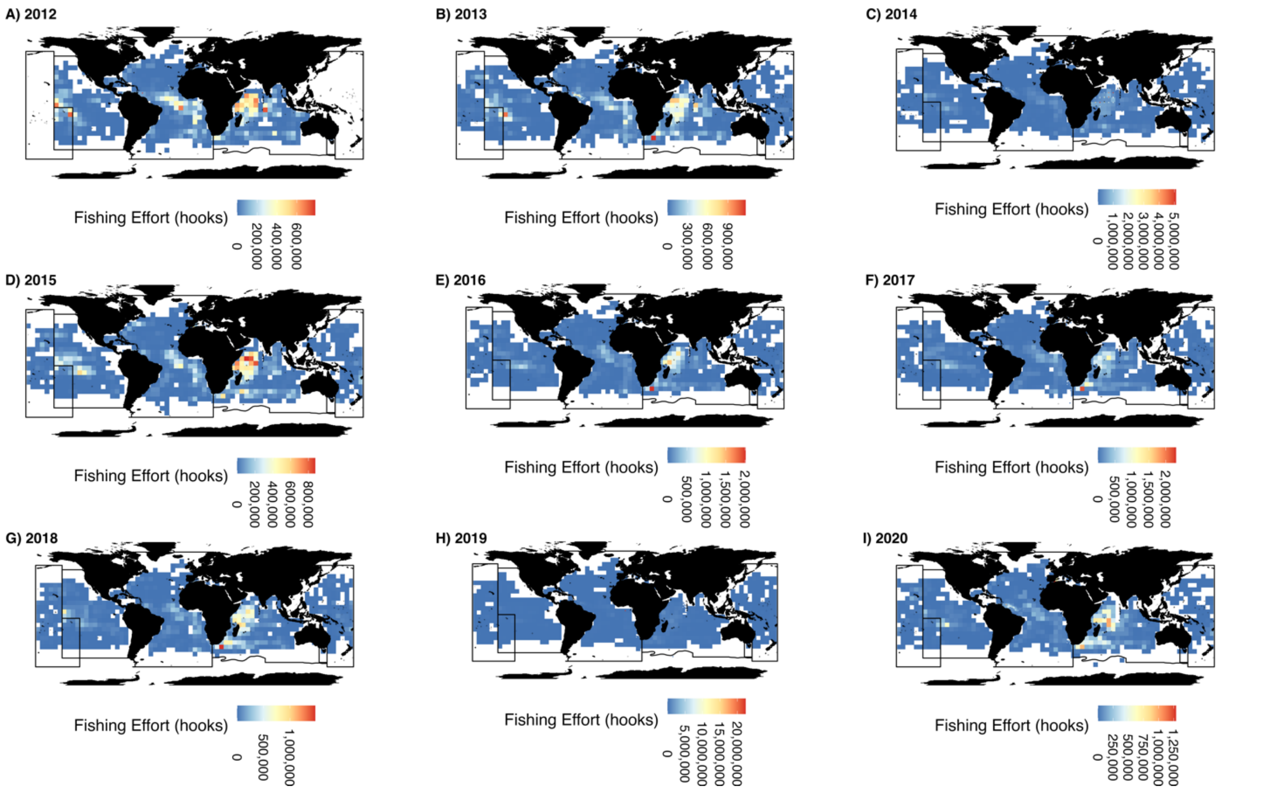

Figure S2. Effort reported with shark catch by tRFMOs (hooks) from longline vessels from 2012 to 2020.

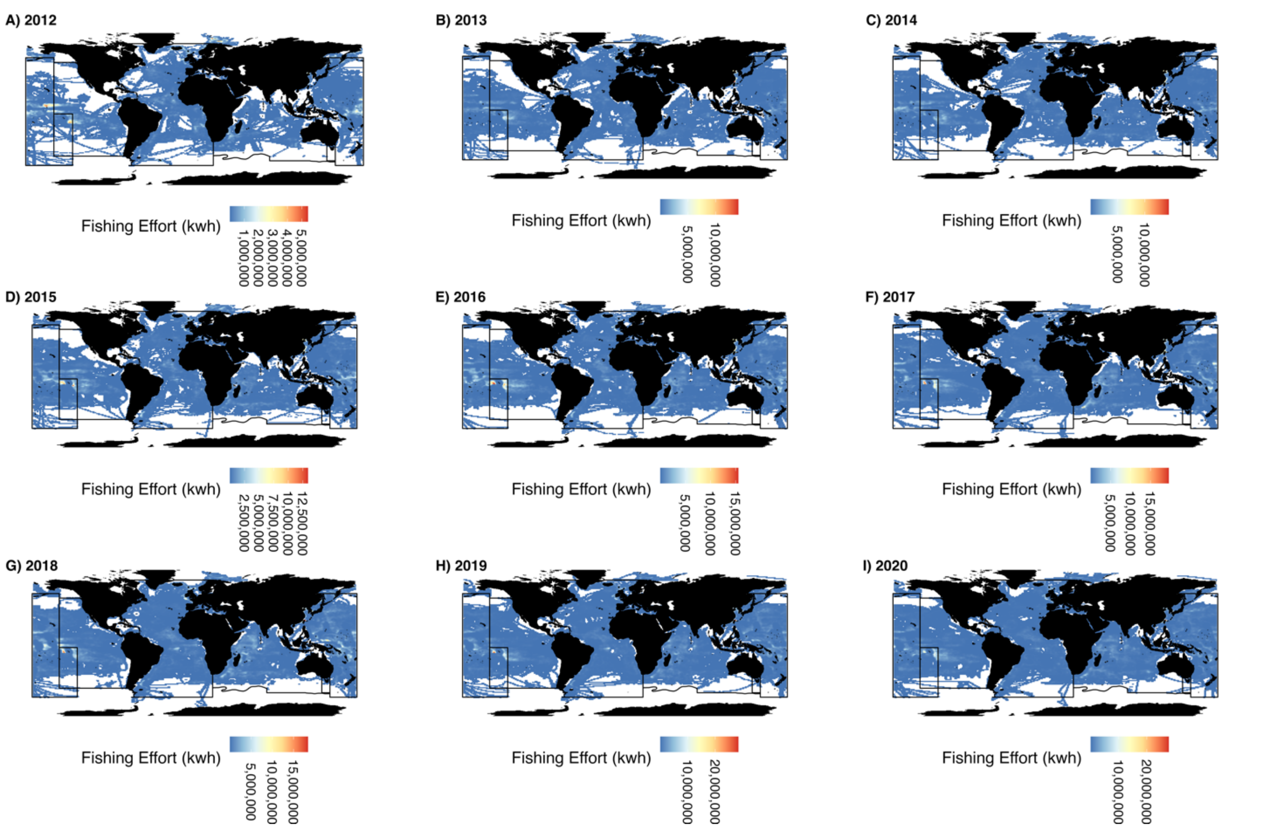

Figure S3. Global Fishing Watch effort (kwh) from longline vessels from 2012 to 2020.

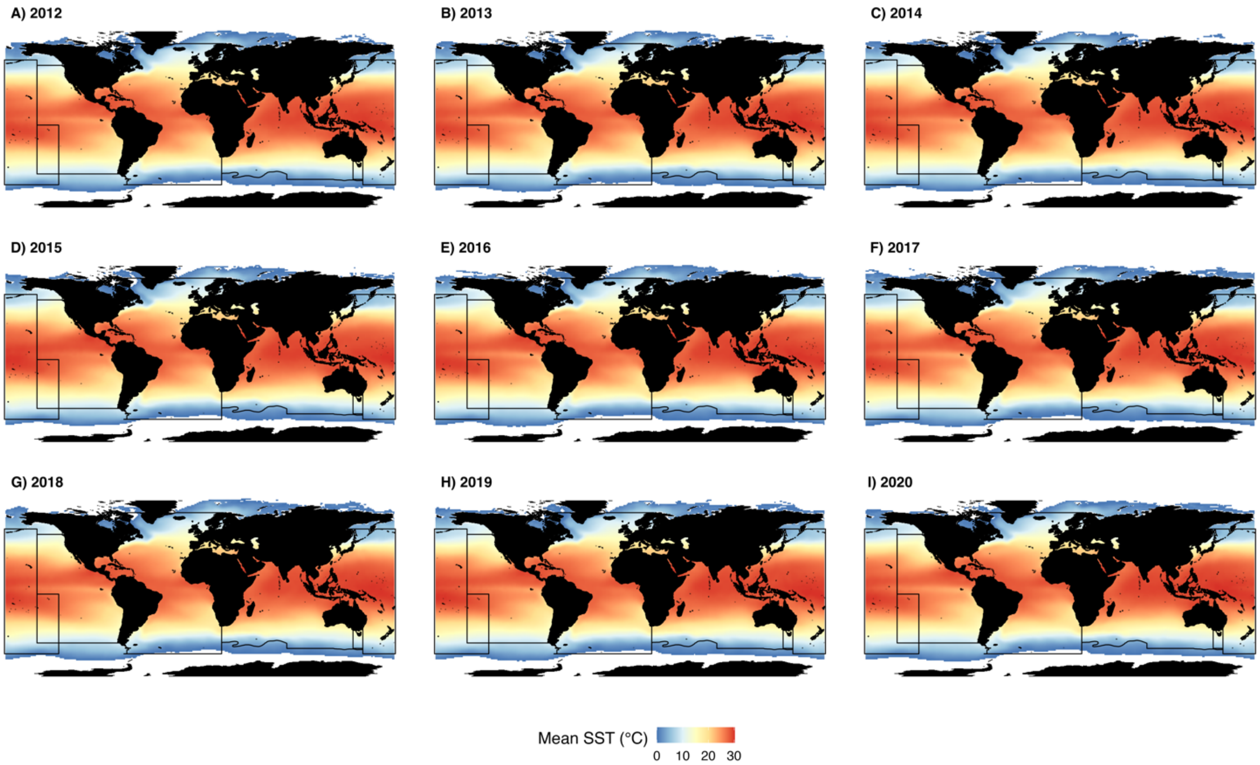

Figure S4. Mean annual sea surface temperature (SST, °C) from 2012 to 2020.

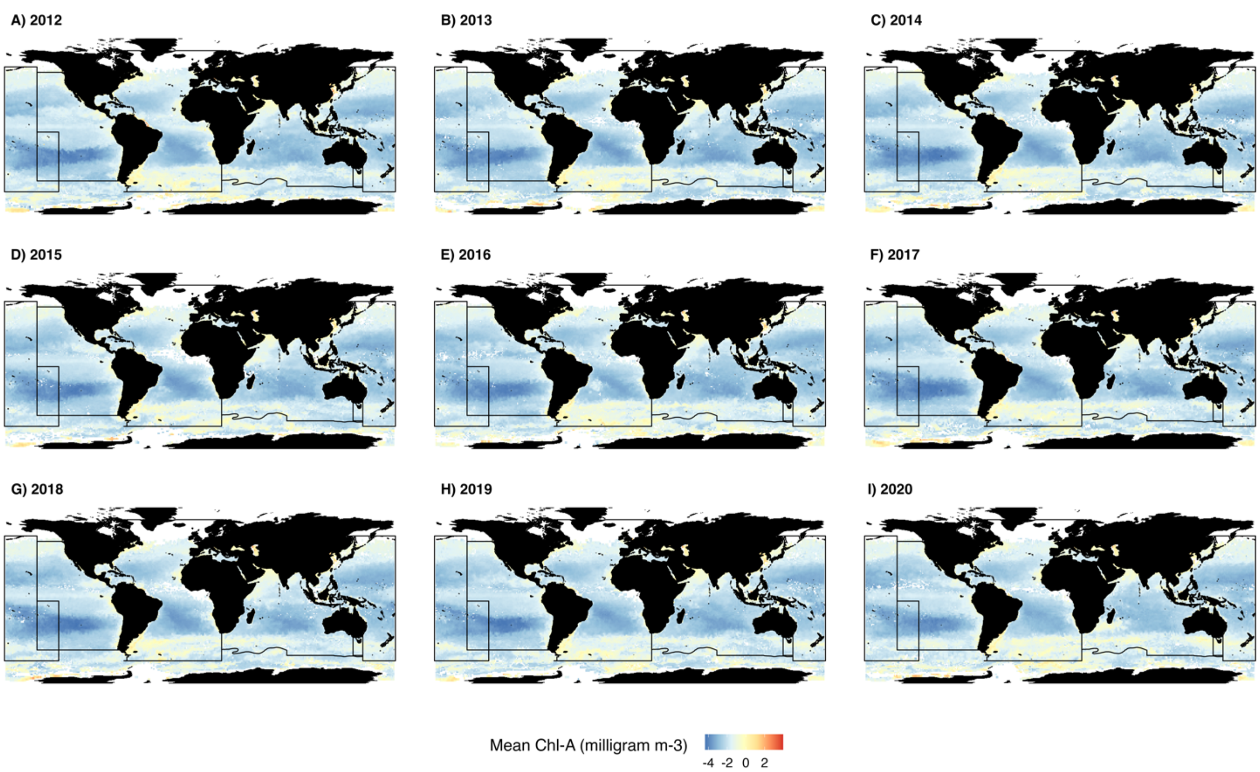

Figure S5. Mean annual chlorophyll-A (chl-A, milligram m-3) from 2012 to 2020. Values are log scaled for visualization.

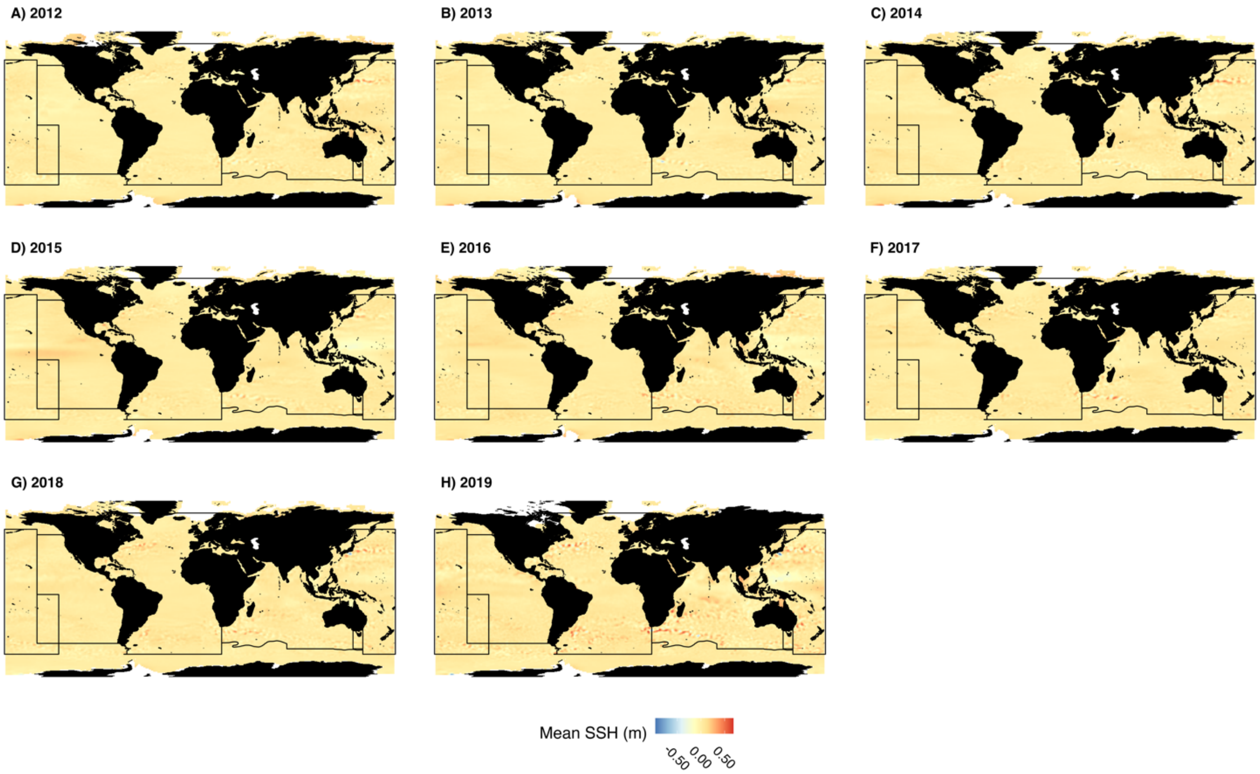

Figure S6. Mean annual sea surface height (SSH, m) from 2012 to 2019. Sea surface height data were not available for 2020 and were interpolated in the random forest model using k nearest neighbors..

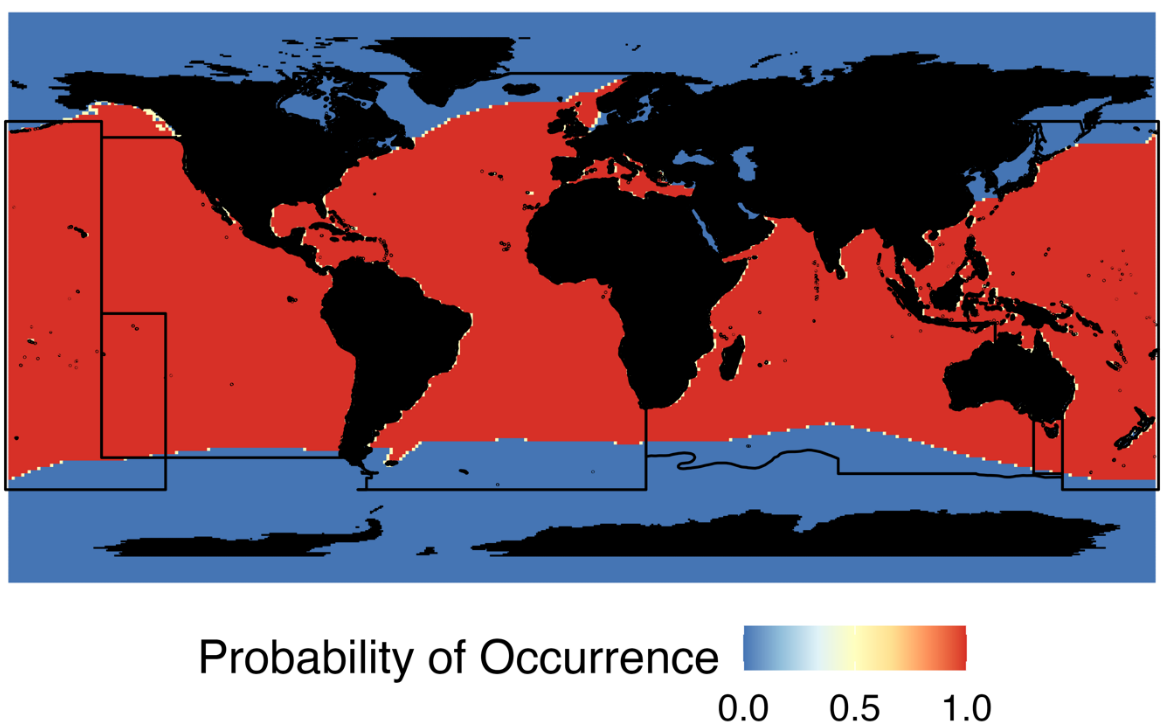

Figure S7. Probability of occurrence for blue sharks (*Prionace glauca*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

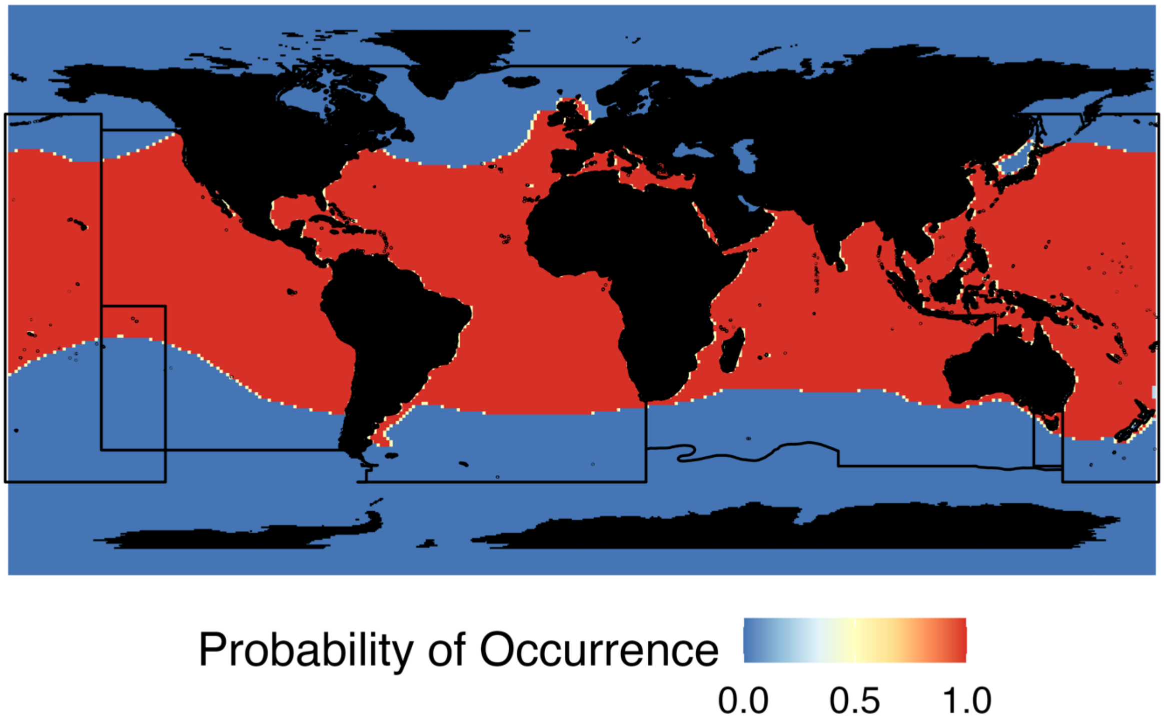

Figure S8. Probability of occurrence for shortfin mako sharks (*Isurus oxyrinchus*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

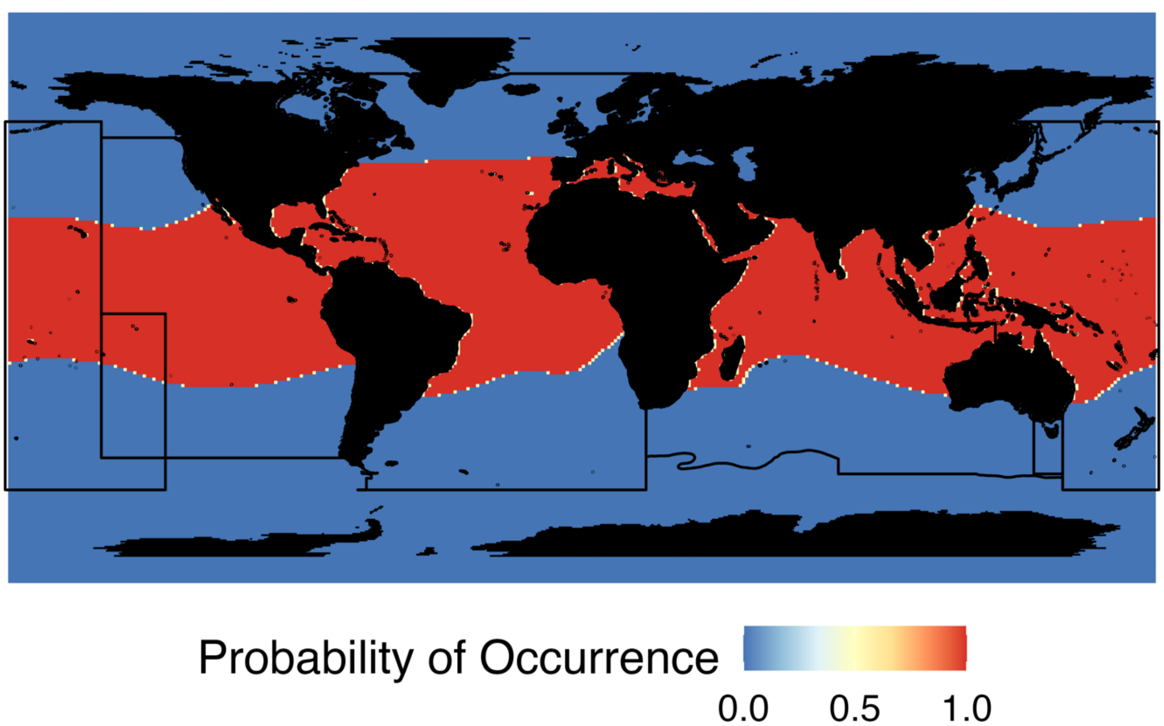

Figure S9. Probability of occurrence for silky sharks (*Carcharhinus falciformis*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

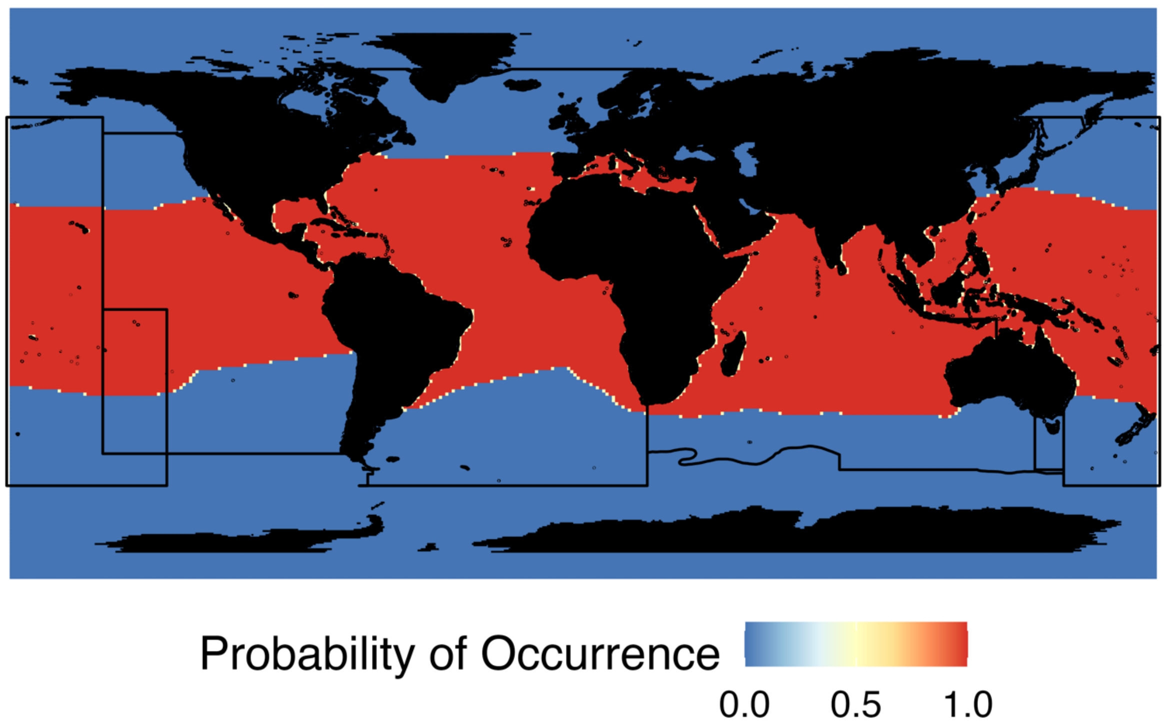

Figure S10. Probability of occurrence for oceanic whitetip sharks (*Carcharhinus longimanus*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

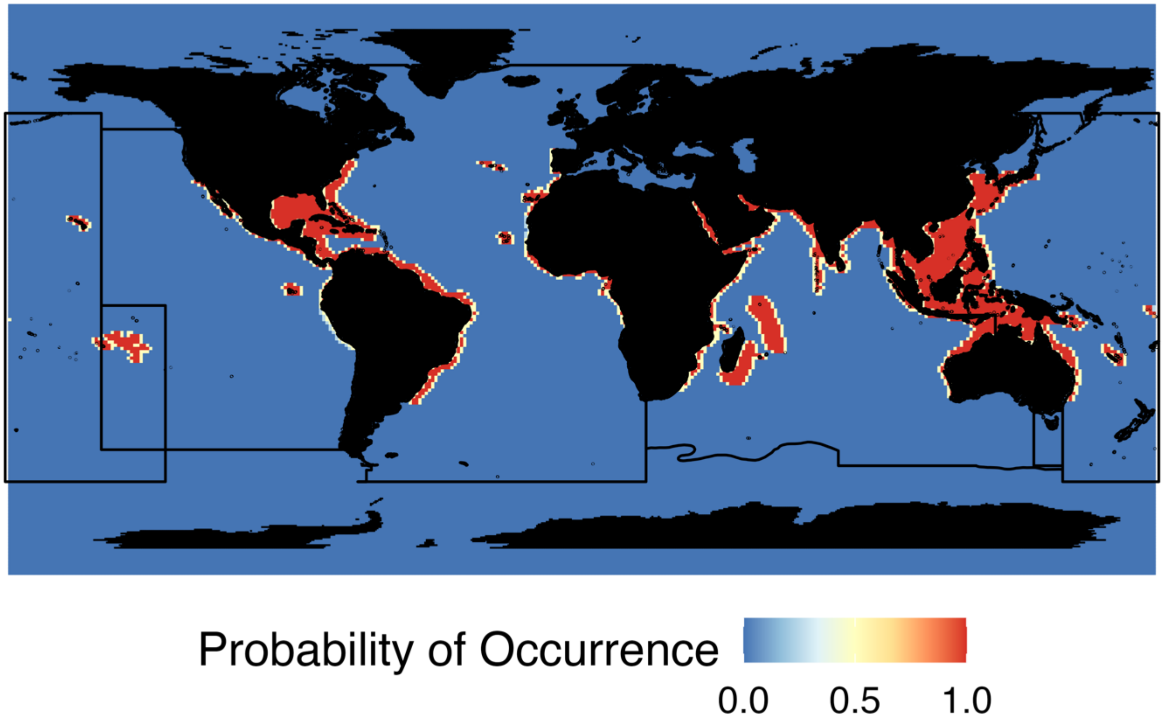

Figure S11. Probability of occurrence for scalloped hammerhead sharks (*Sphyrna lewini*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

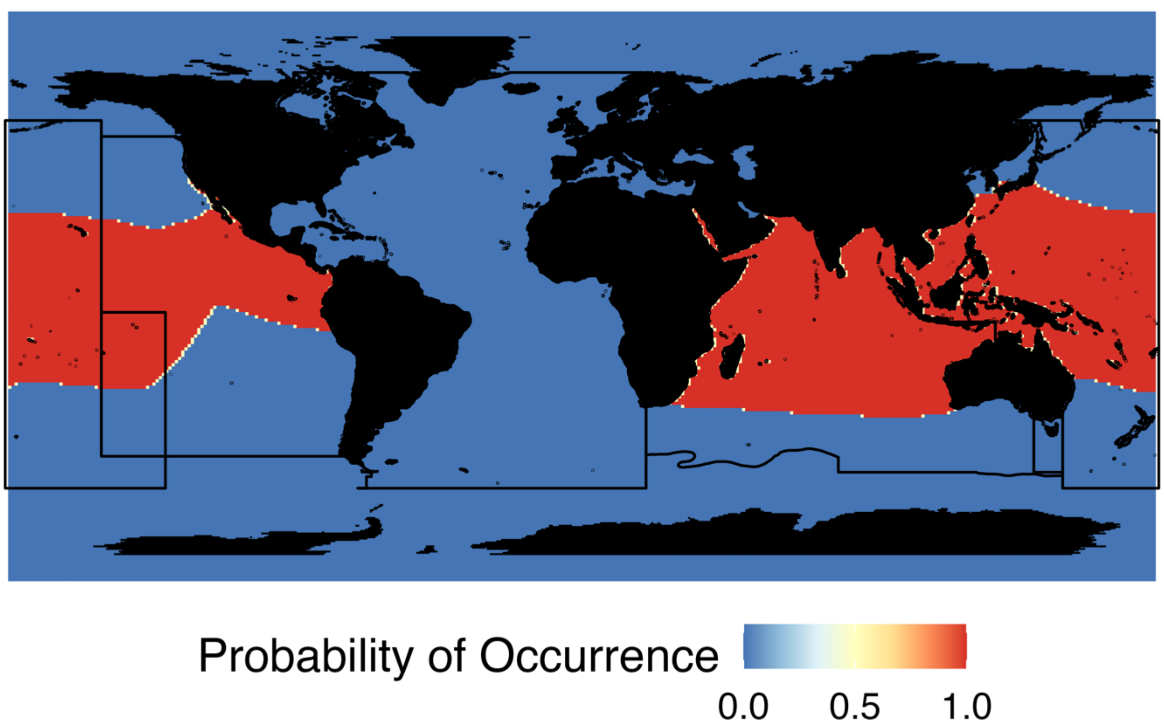

Figure S12. Probability of occurrence for pelagic thresher sharks (*Alopias pelagicus*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

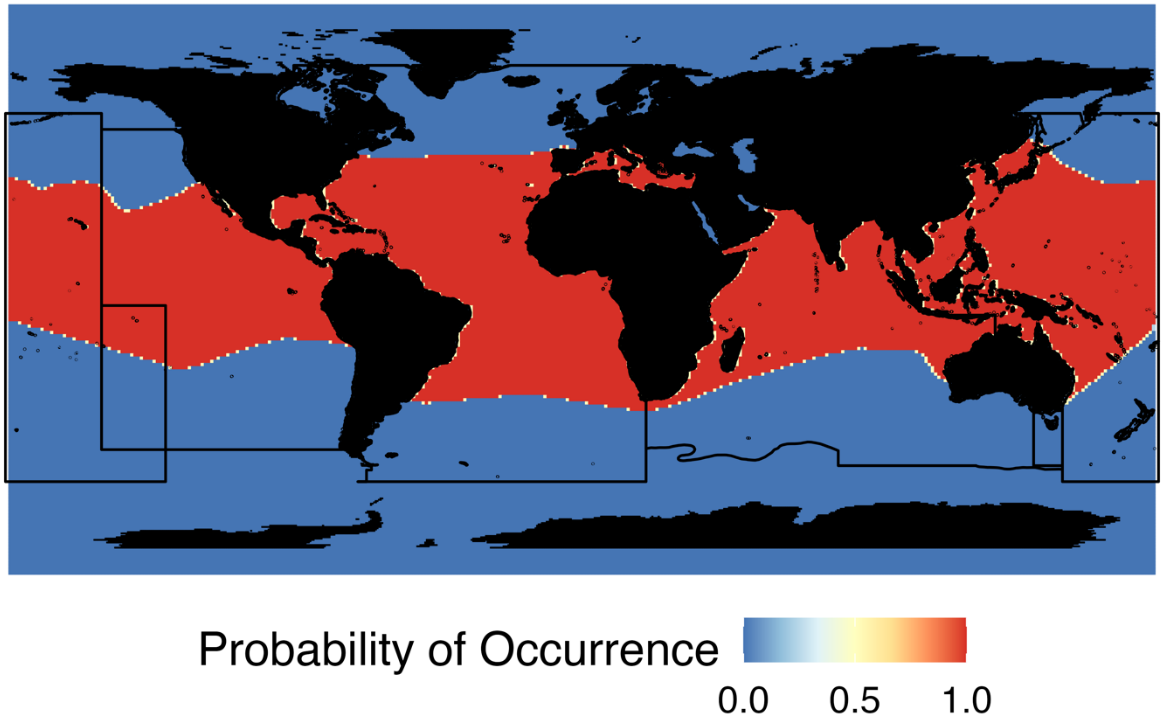

Figure S13. Probability of occurrence for longfin mako sharks (*Isurus paucus*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

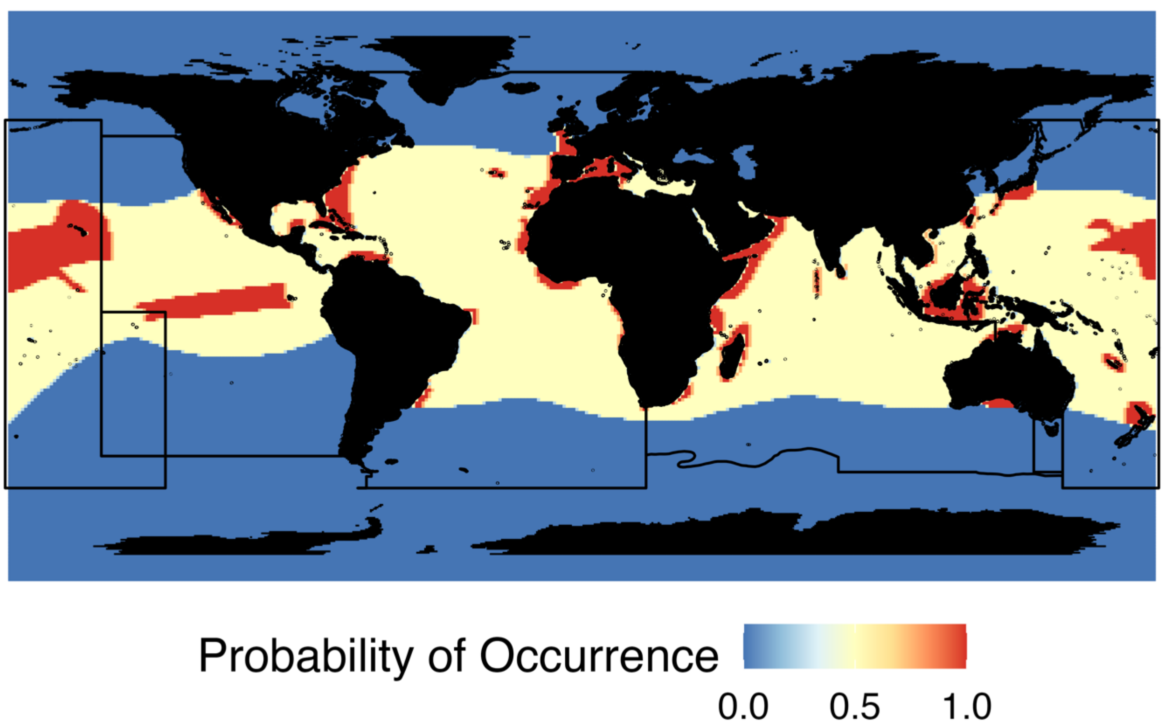

Figure S14. Probability of occurrence for bigeye thresher sharks (*Alopias superciliosus*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

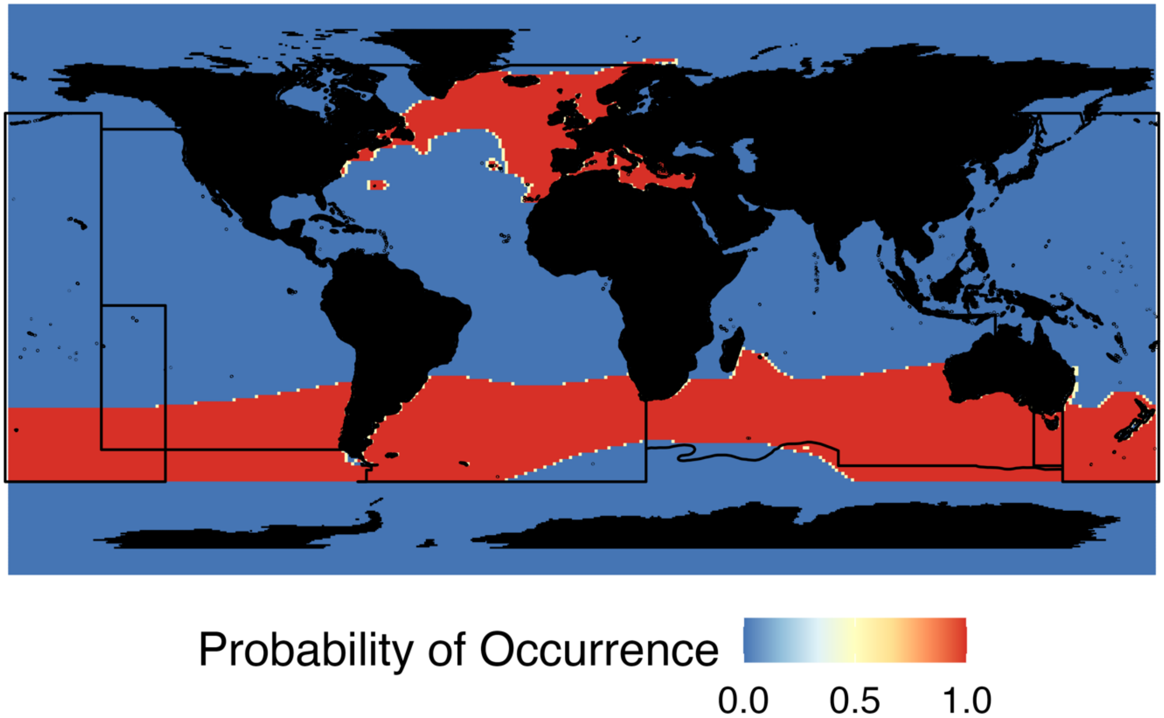

Figure S15. Probability of occurrence for porbeagle sharks (*Lamna nasus*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

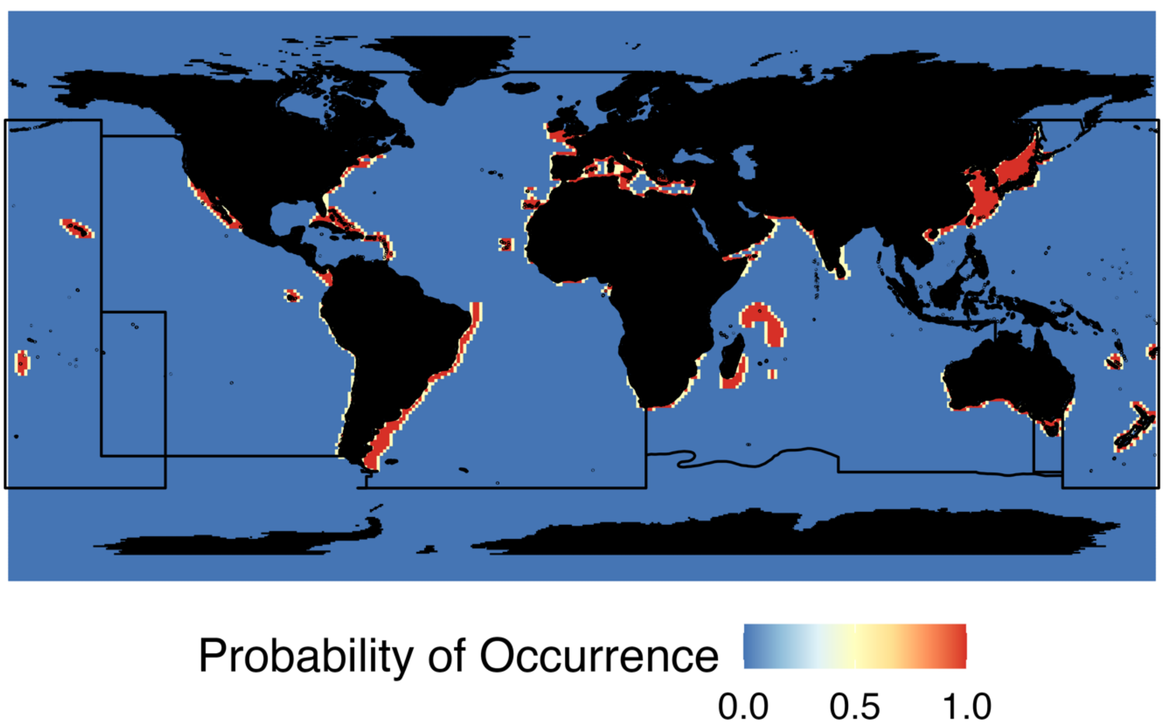

Figure S16. Probability of occurrence for smooth hammerhead sharks (*Sphyrna zygaena*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

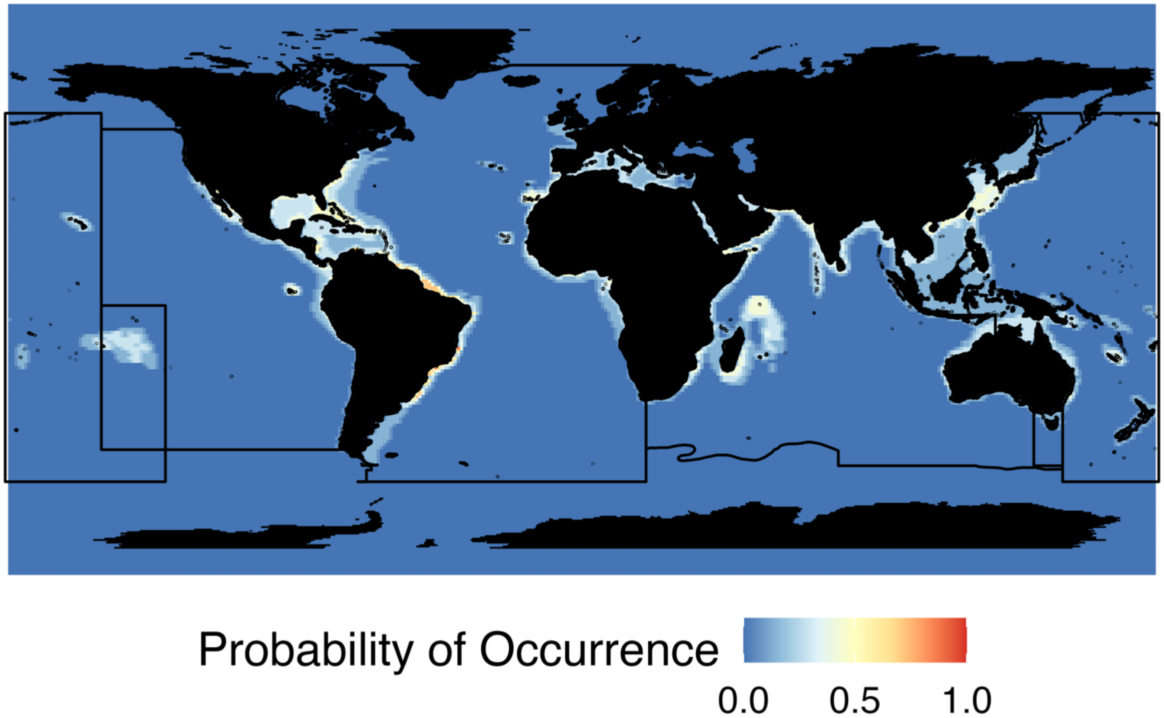

Figure S17. Probability of occurrence for hammerhead sharks (*Sphyrna*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

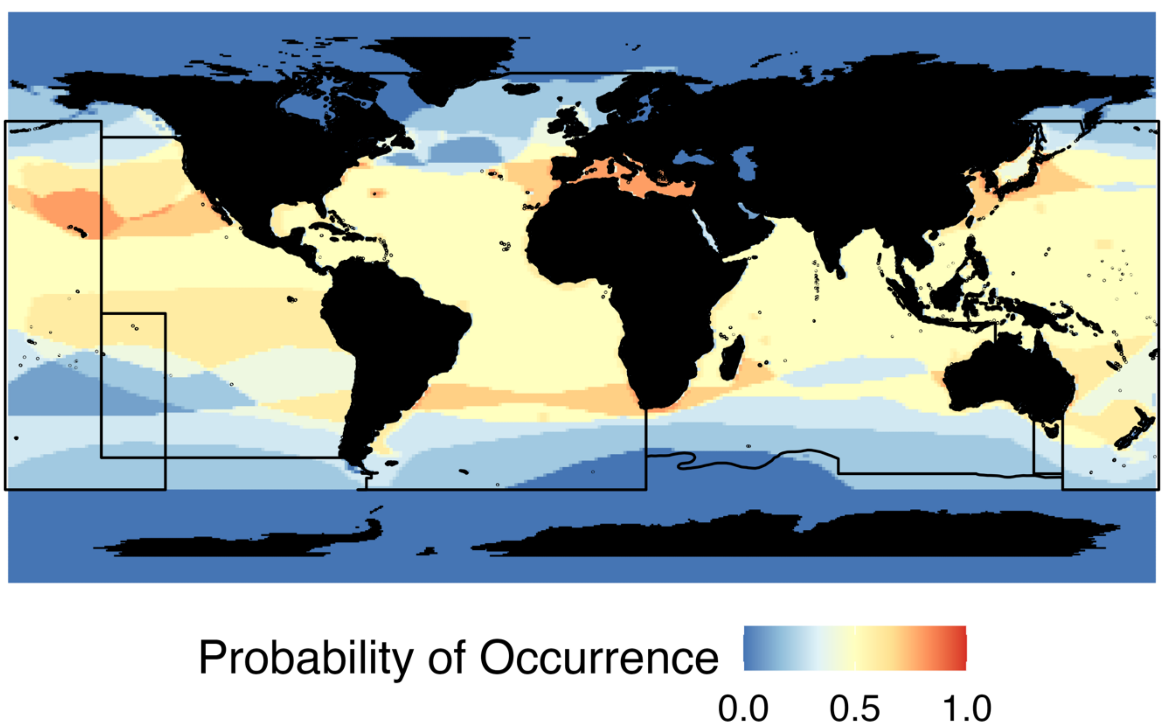

Figure S18. Probability of occurrence for mackerel and porbeagle sharks (*Lamnidae*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

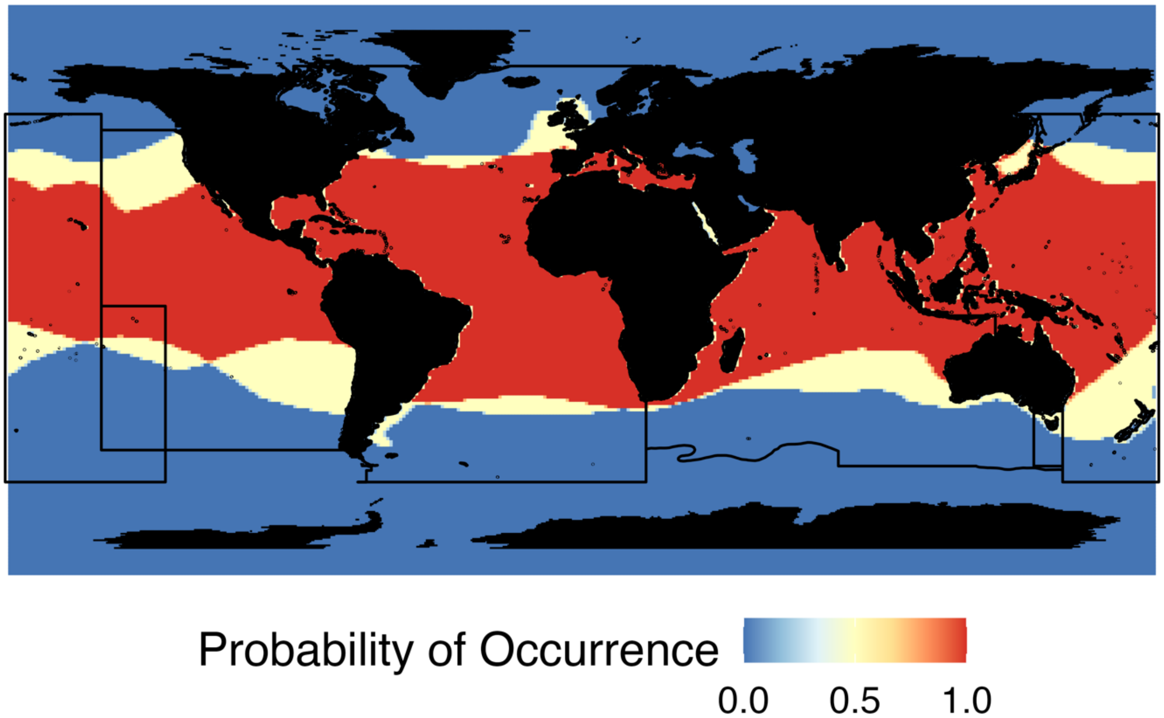

Figure S19. Probability of occurrence for mako sharks (*Isurus*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

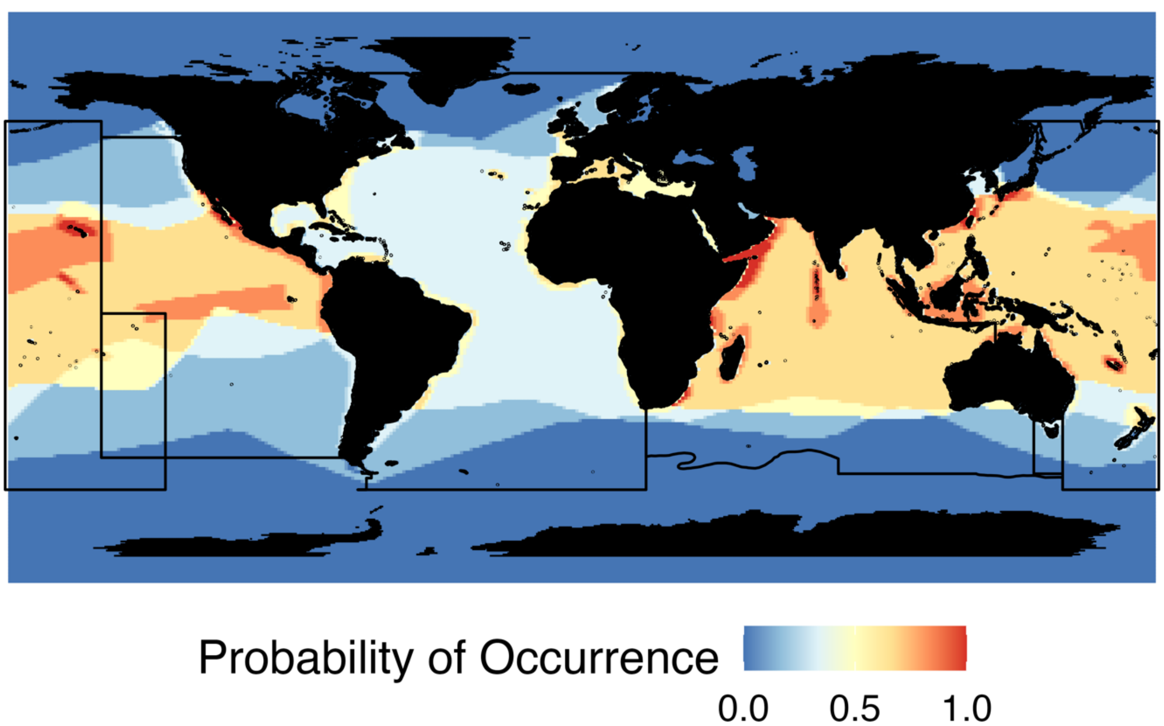

Figure S20. Probability of occurrence for thresher sharks (*Alopias*). Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

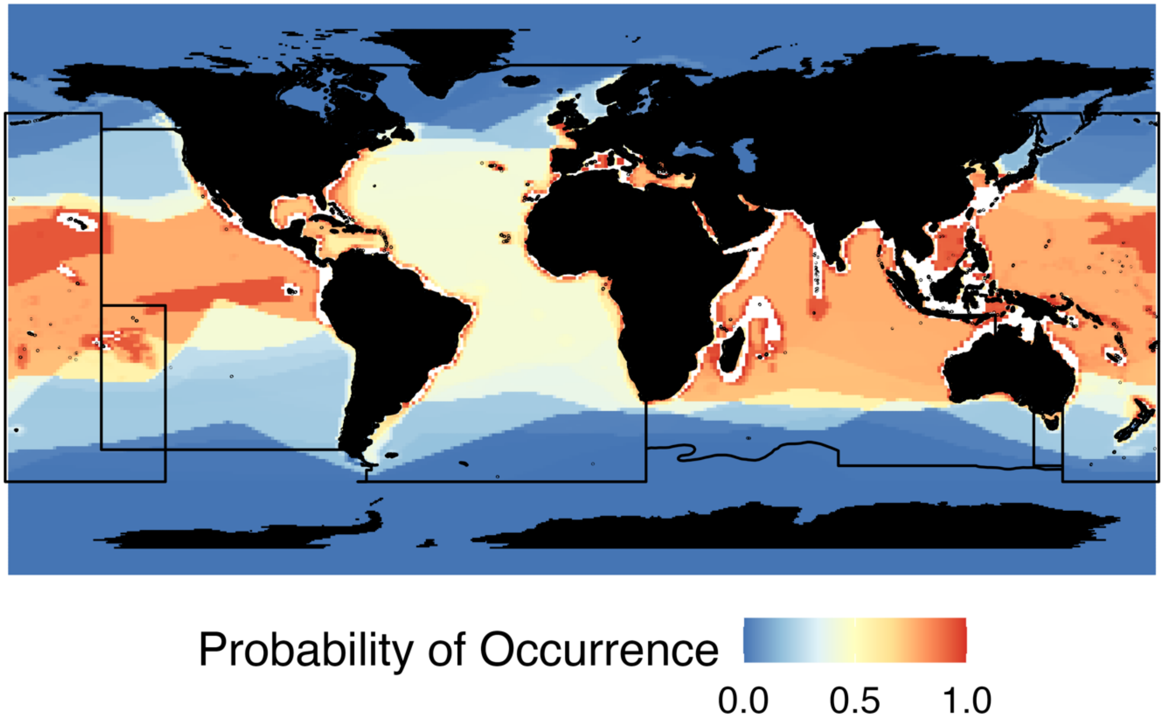

Figure S21. Probability of occurrence for unidentified sharks. Data were collected from the IUCN. Blue values (0) represent low probability of occurrence, while red values (1) represent high probability of occurrence.

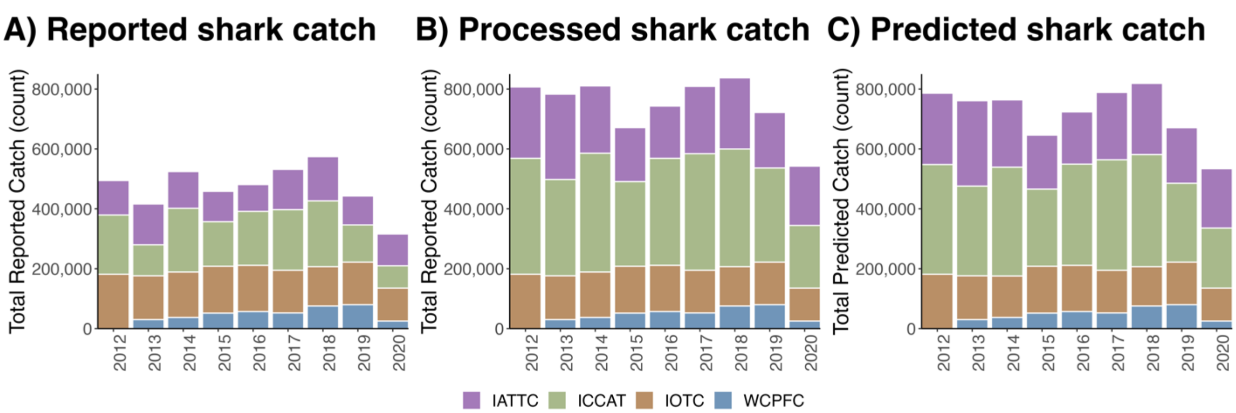

Figure S22. The total shark catch by tRFMO reported as count by each tRFMO (A), the total shark catch by tRFMO after entries for IATTC and ICCAT that were reported in metric tonnes were converted and summed to count (only for these tRFMOs since the best performing models included these data transformation, see Table 3) (B), and the total predicted shark catch by tRFMO (C).

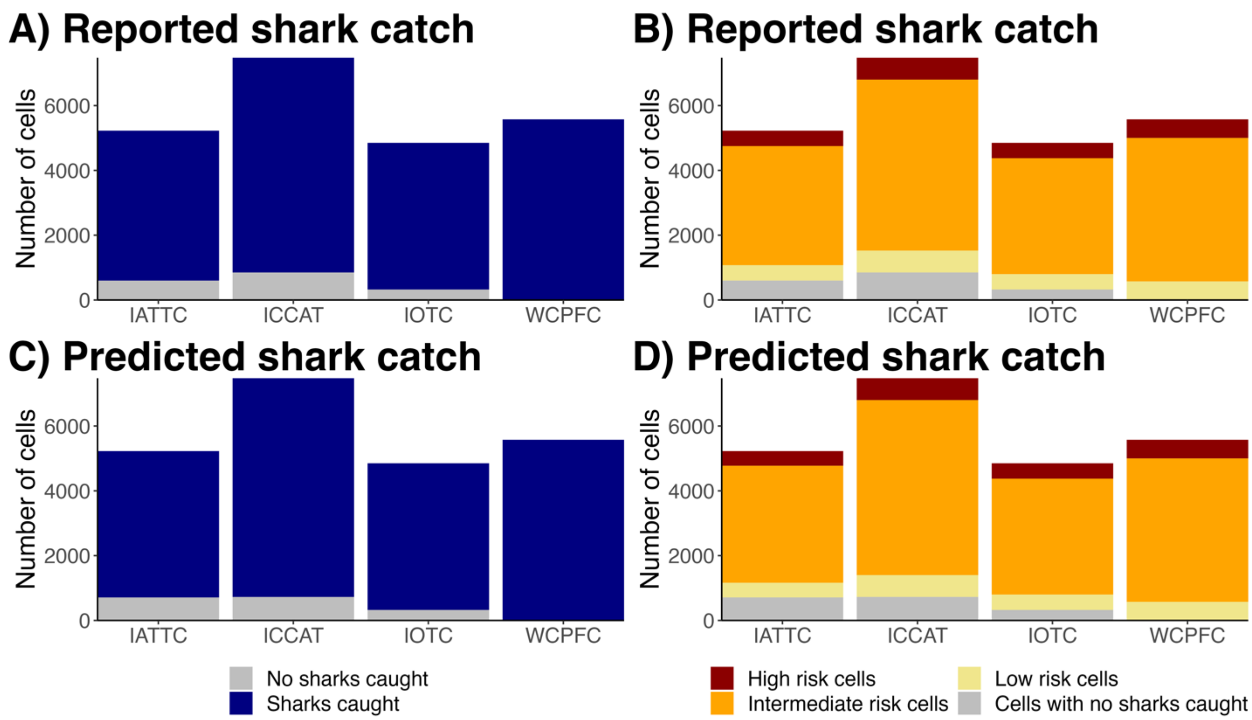

Figure S23. The number of grid cells with non-zero fishing effort that have zero shark catch (gray bars) and non-zero shark catch (blue bars) for the tRFMO reported data (A) and the model-predicted data (C). The number of grid cells considered high-risk (≥ 90% quantile calculated from non-zero catch values independently for each tRFMO; dark red bars), low-risk (≤ 10% quantile calculated from non-zero catch values independently for each tRFMO; light yellow bars), intermediate-risk (all remaining non-zero cells), or with no shark catch (gray bars) for the tRFMO reported data (B) and the model-predicted data (D).

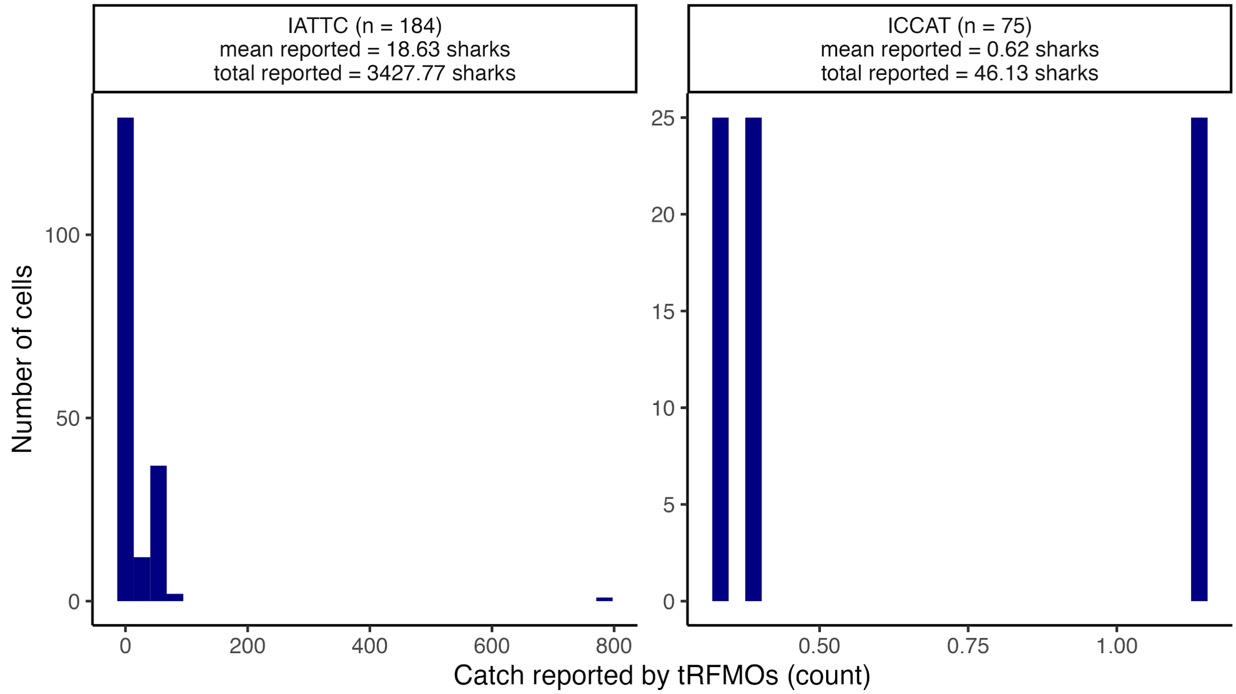

Figure S24. The distribution of the number of grid cells (n), with non-zero fishing effort that have non-zero shark catch in the tRFMO reported data but have zero shark catch in the predicted model. WCPFC and IOTC did not have any grid cells with zero predicted catch and non-zero reported catch. The mean and total refer to the mean and summed reported tRFMO catch for those cells.

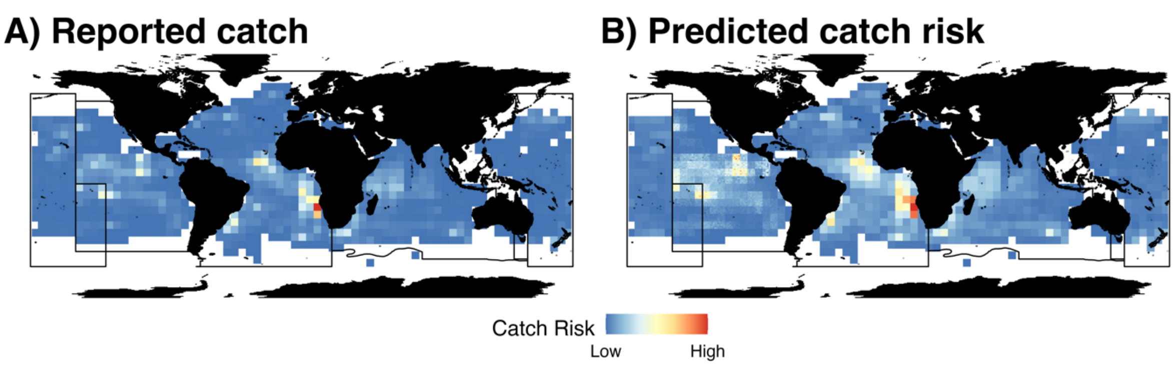

Figure S25. Mean shark catch observed globally for all reported species from tRFMO reported data (A) and the predicted shark catch risk for all reported shark species (B). Areas in blue represent low shark catch risk, while areas in red represent high shark catch risk. Black lines represent RFMO boundaries.

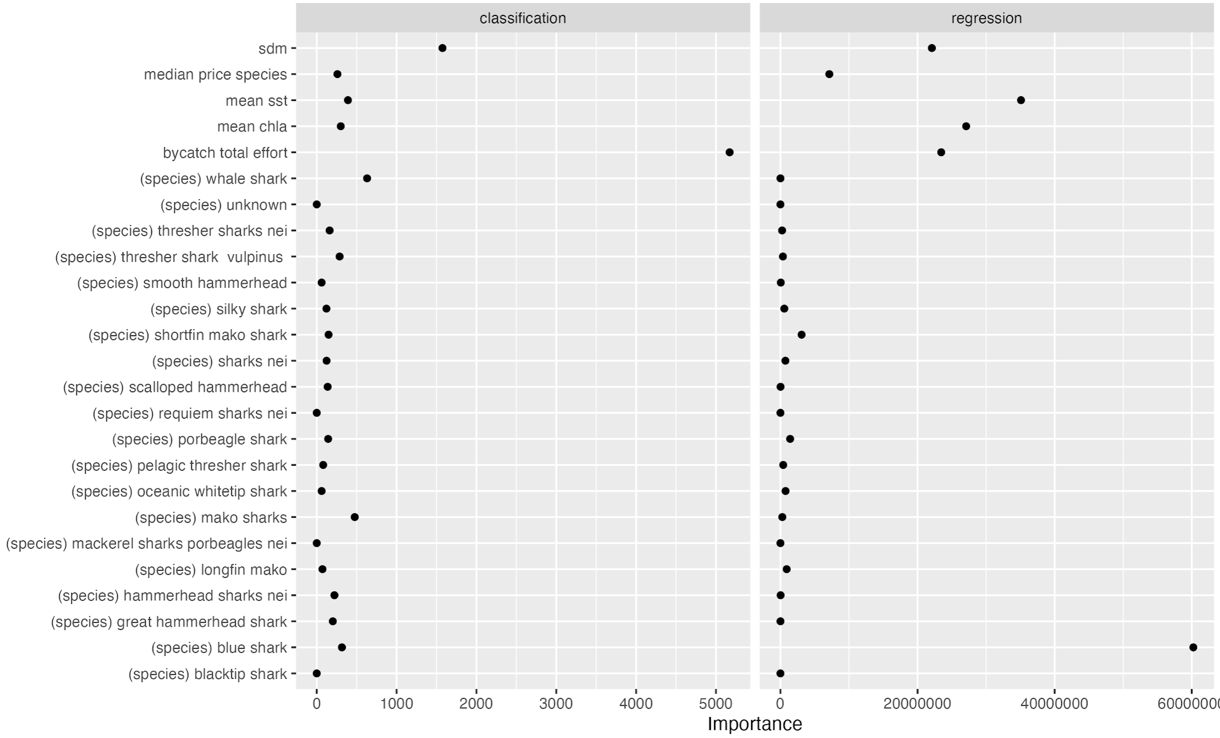

Figure S26. Feature importance of predictor variables associated with the best-fitting model for WCPFC. Importance was calculated using the impurity metric.

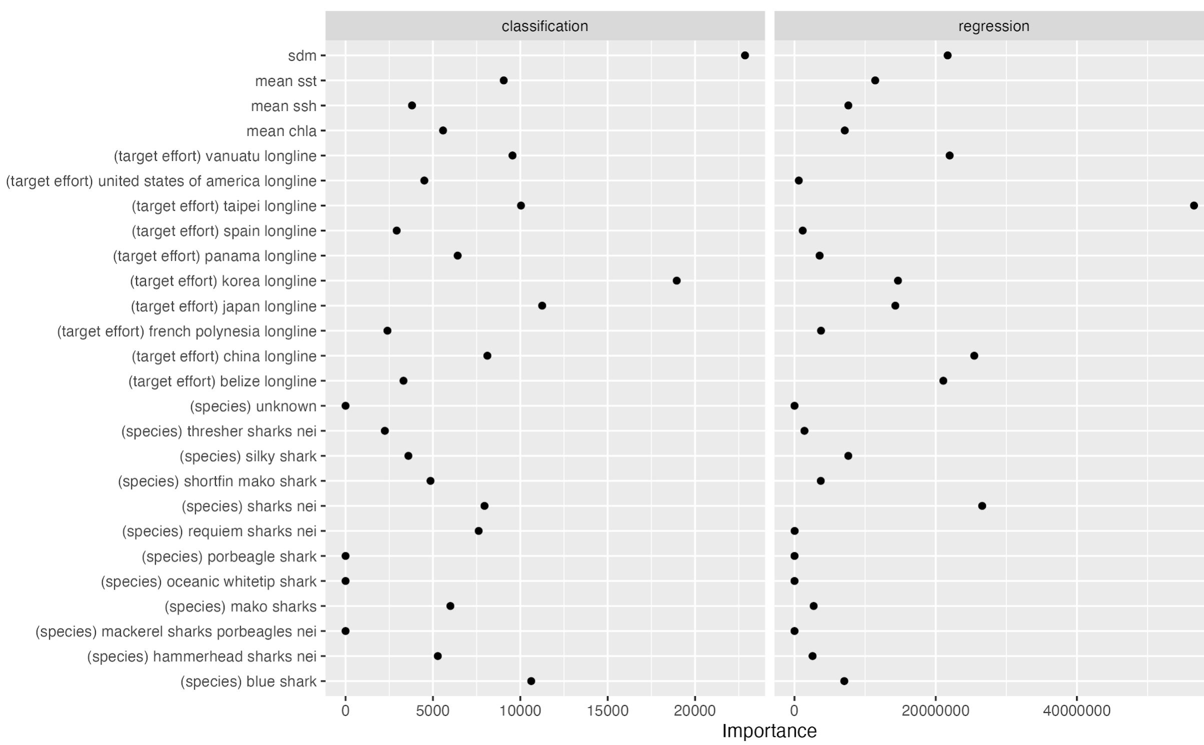

Figure S27. Feature importance of predictor variables associated with the best-fitting model for IATTC. Importance was calculated using the impurity metric.

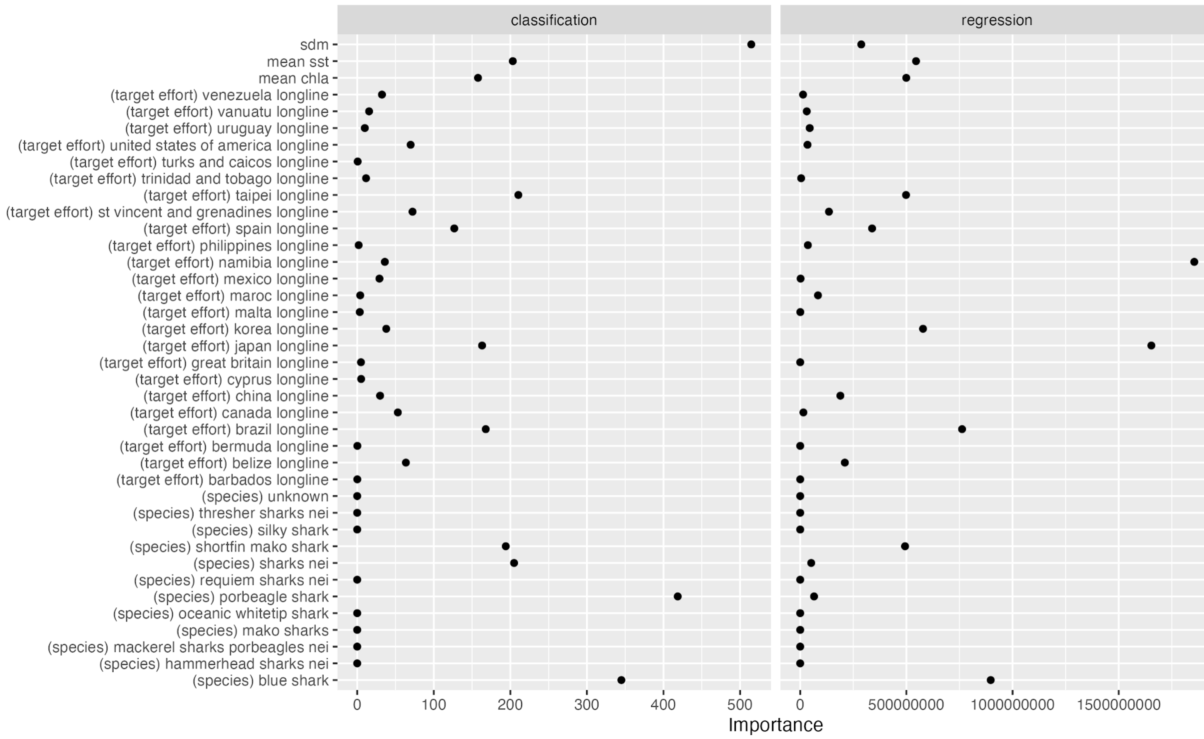

Figure S28. Feature importance of predictor variables associated with the best-fitting model for ICCAT. Importance was calculated using the impurity metric.

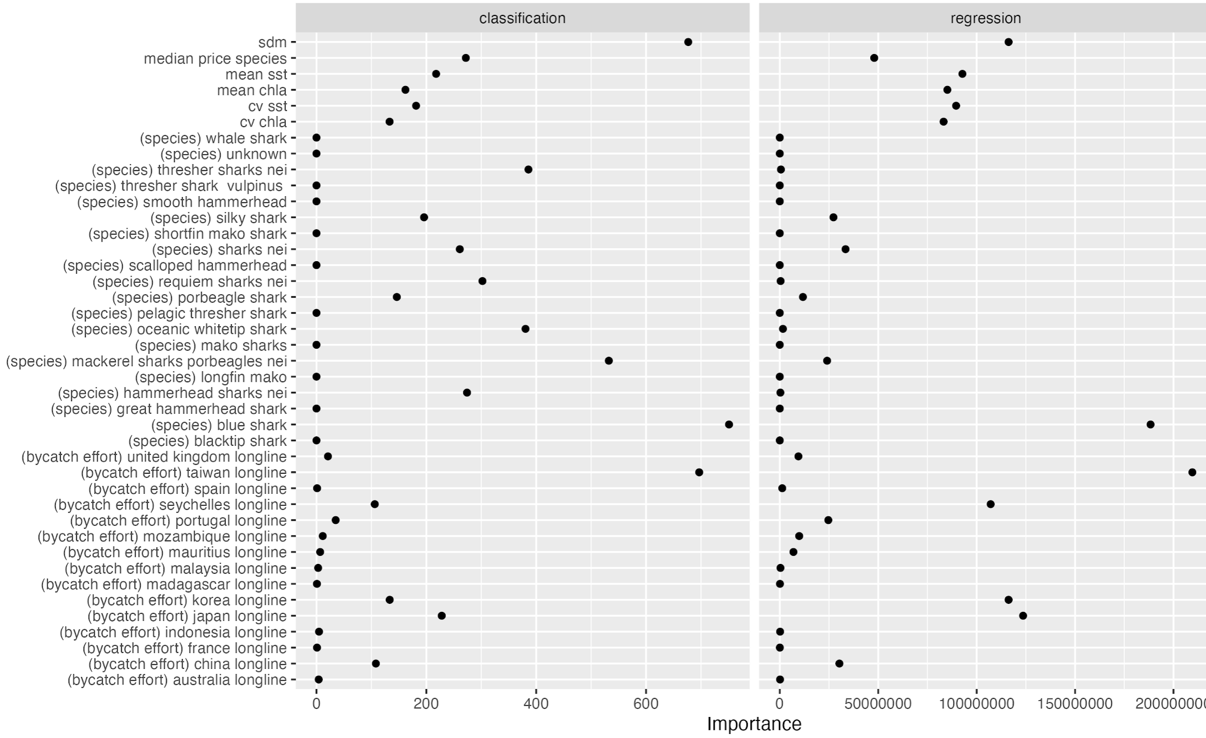

Figure S29. Feature importance of predictor variables associated with the best-fitting model for IOTC. Importance was calculated using the impurity metric.

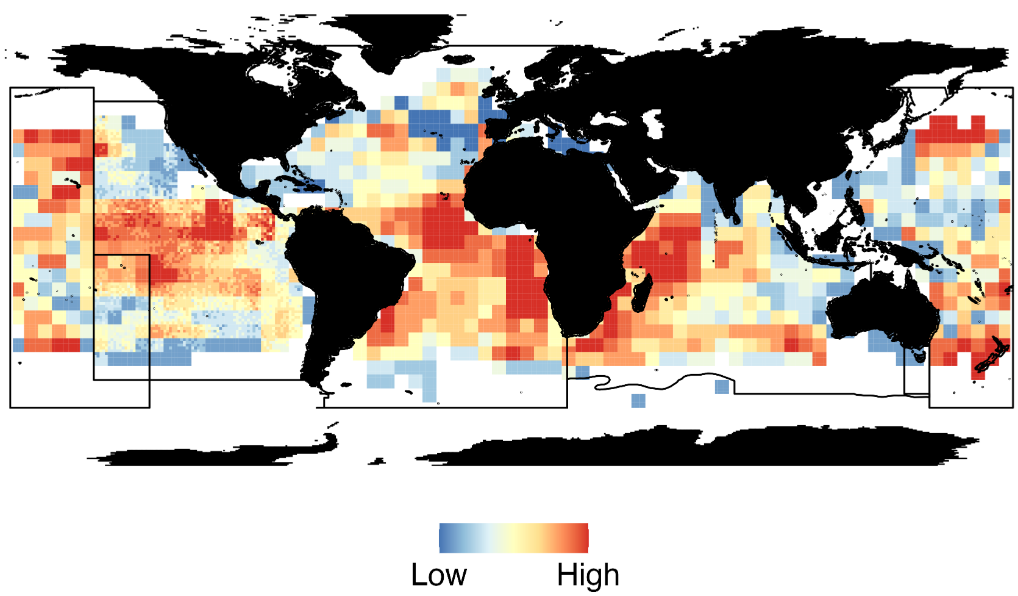

Figure S30. Mean global predicted shark catch risk for all reported shark species. Data from each RFMO were scaled independently using quantiles between 0 and 1 at 0.1 increments. Blue colors indicate areas of low shark catch risk while red colors indicate areas of high shark catch risk. Black lines indicate RFMO boundaries.

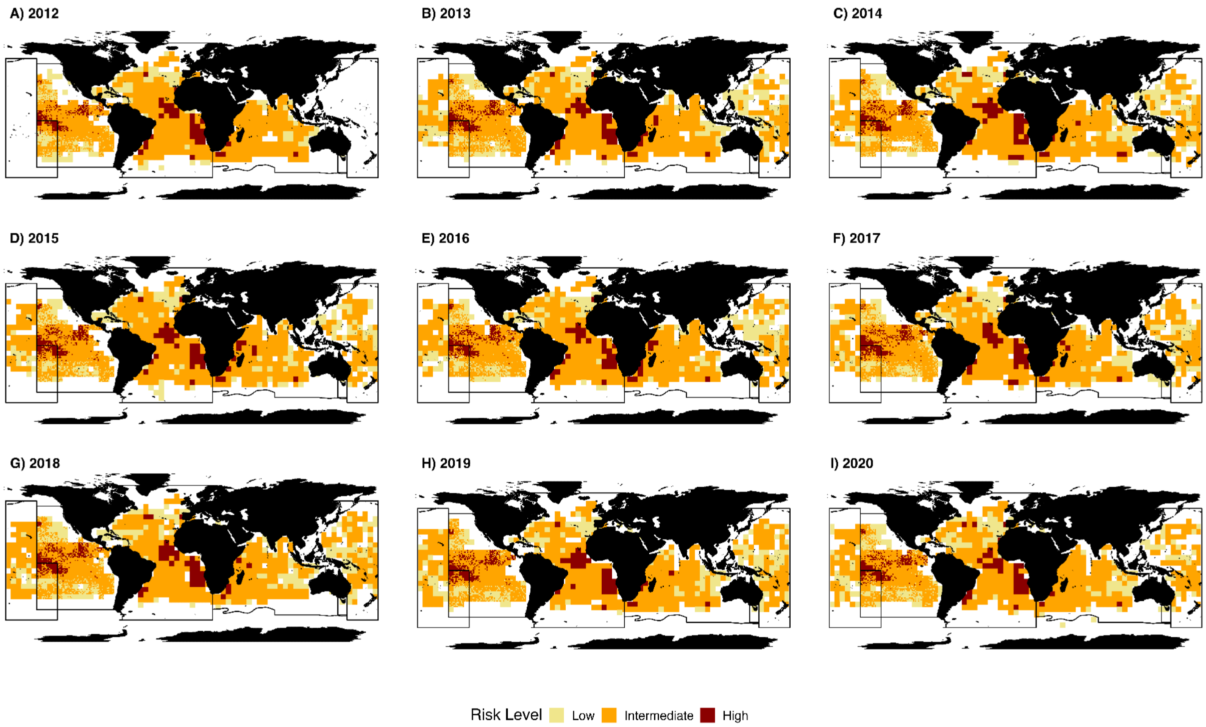

Figure S31. The yearly global distribution of high-risk (≥ 90% quantile calculated yearly from non-zero predicted values), intermediate risk, and low-risk grid cells (≤ 10% quantile calculated yearly from non-zero predicted values). Values were calculated using total predicted catch for all shark species. Black lines represent RFMO boundaries. Note that the WCPFC observer program was not yet established in 2012.

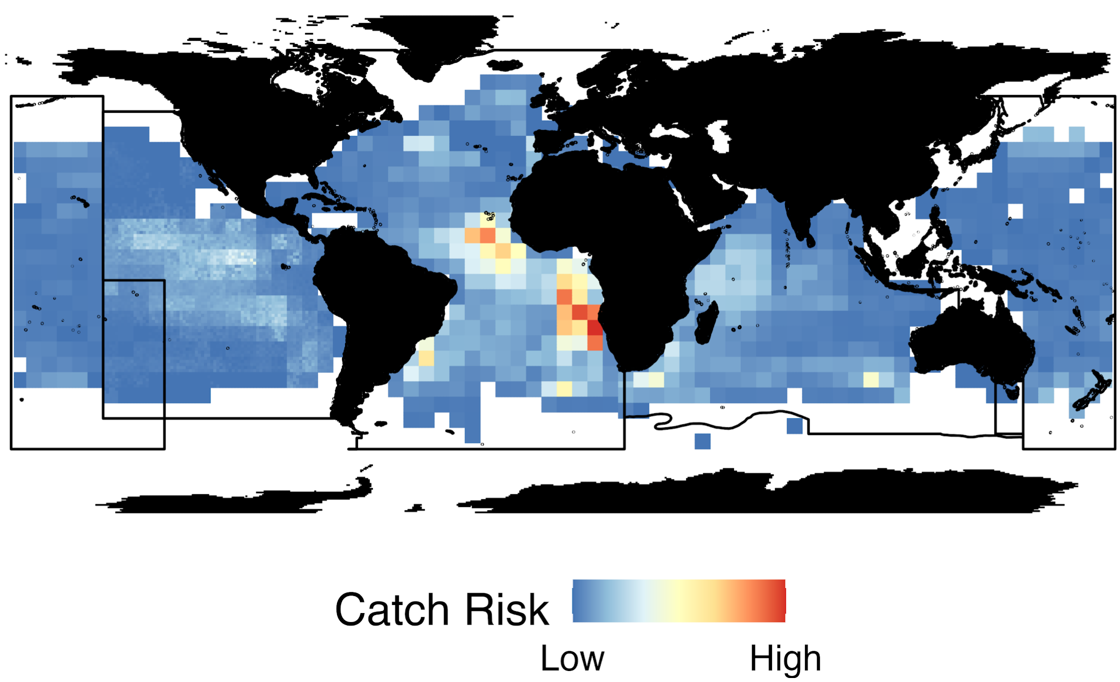

Figure S32. Predicted catch risk for blue sharks (*Prionace glauca*).

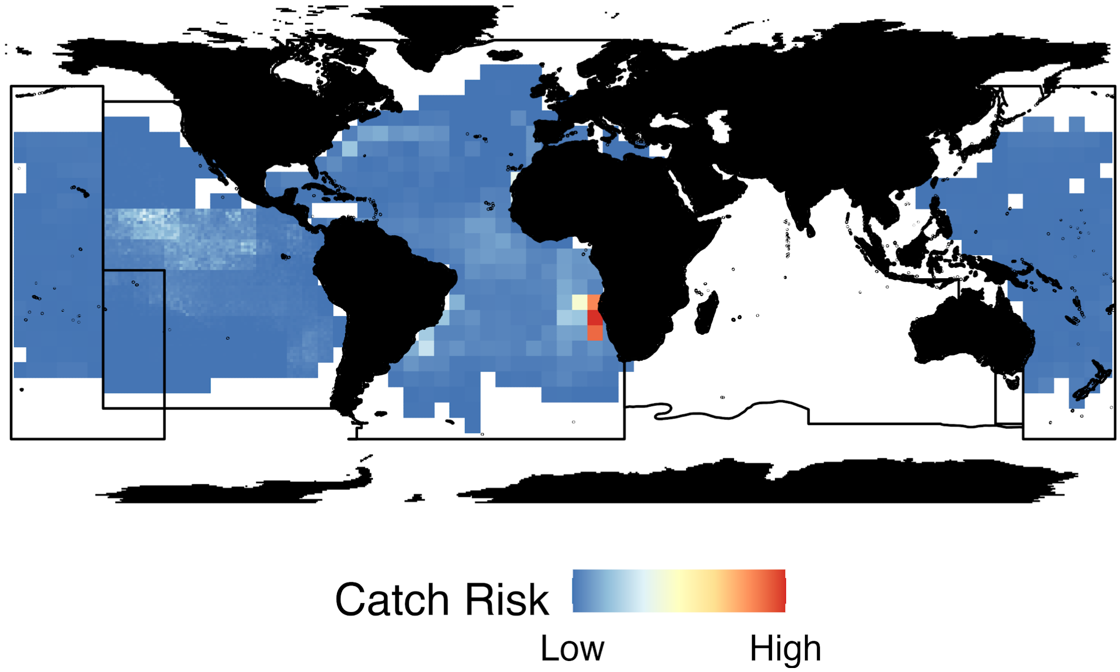

Figure S33. Predicted catch risk for shortfin mako sharks (*Isurus oxyrinchus*).

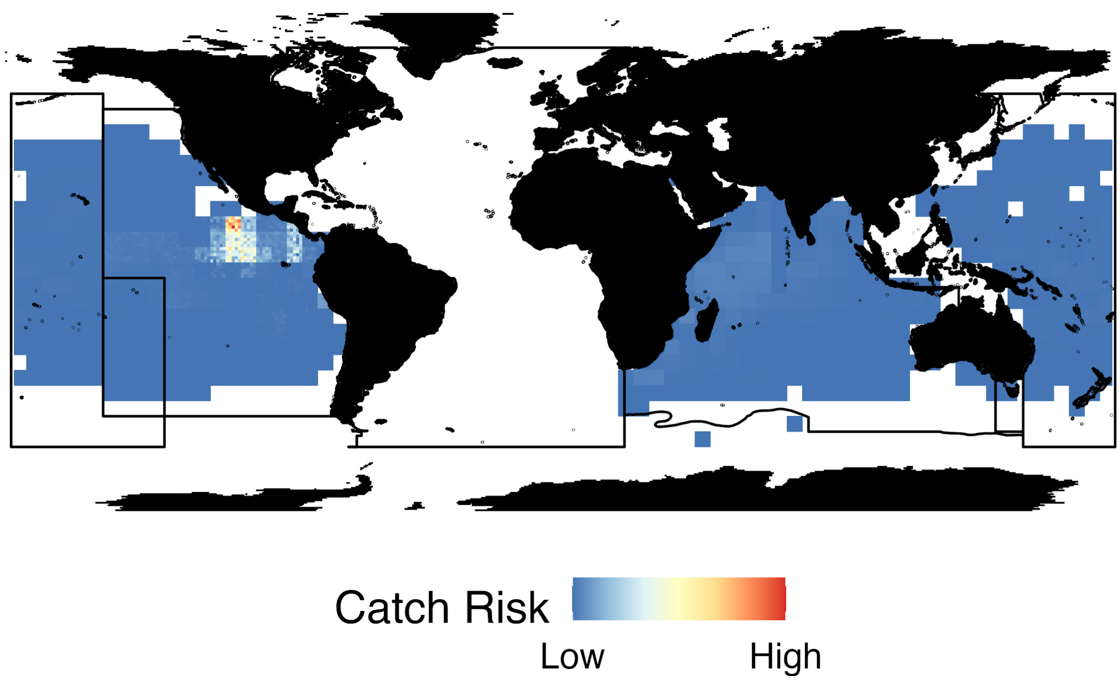

Figure S34. Predicted catch risk for silky sharks (*Carcharhinus falciformis*).

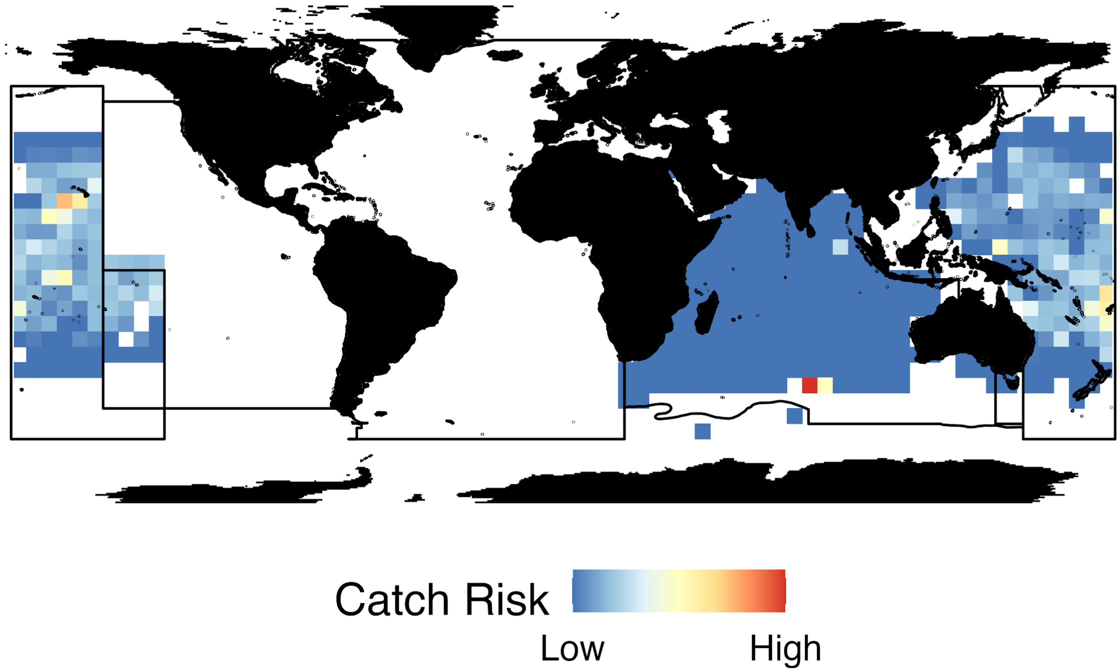

Figure S35. Predicted catch risk for oceanic whitetip sharks (*Carcharhinus longimanus*)

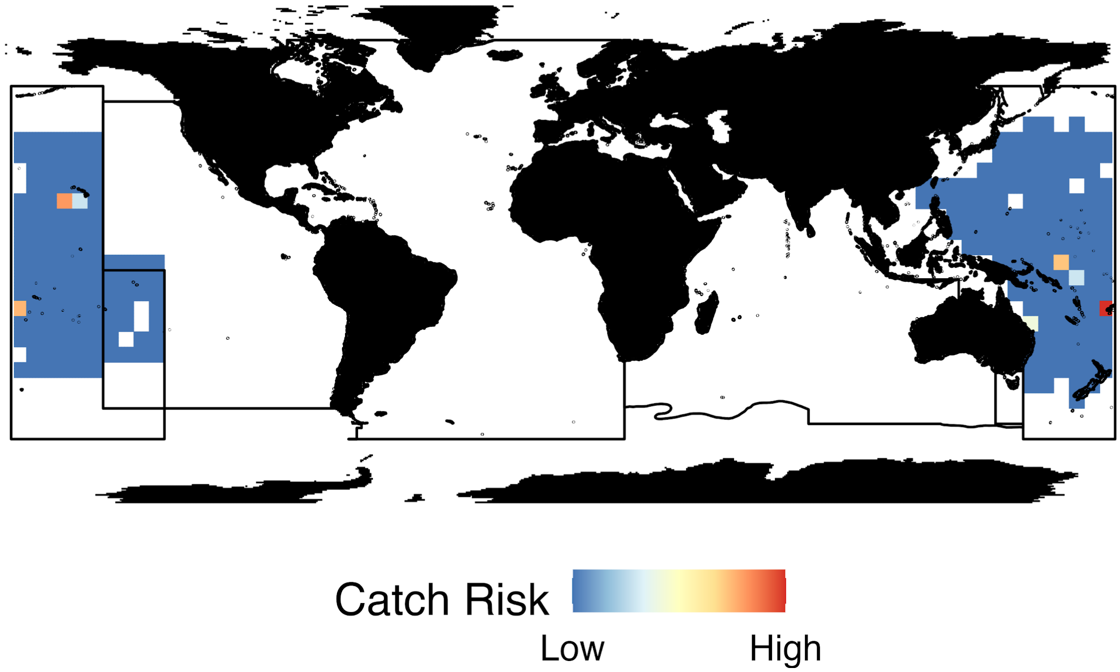

Figure S36. Predicted catch risk for scalloped hammerhead sharks (*Sphyrna lewini*).

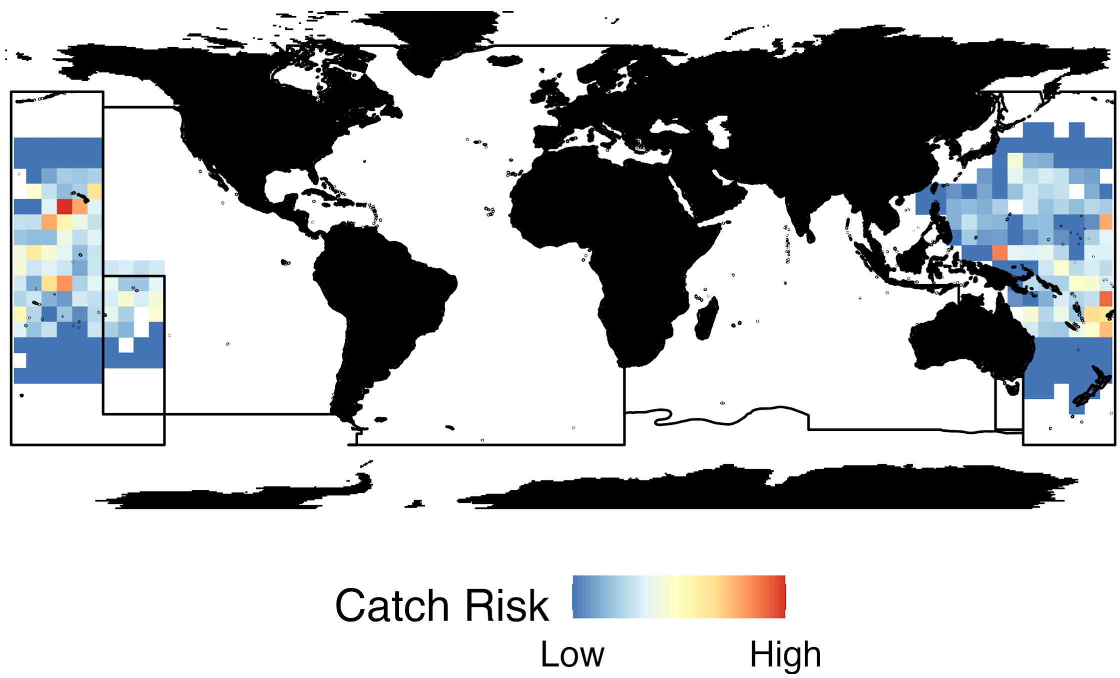

Figure S37. Predicted catch risk for pelagic thresher sharks (*Alopias pelagicus*).

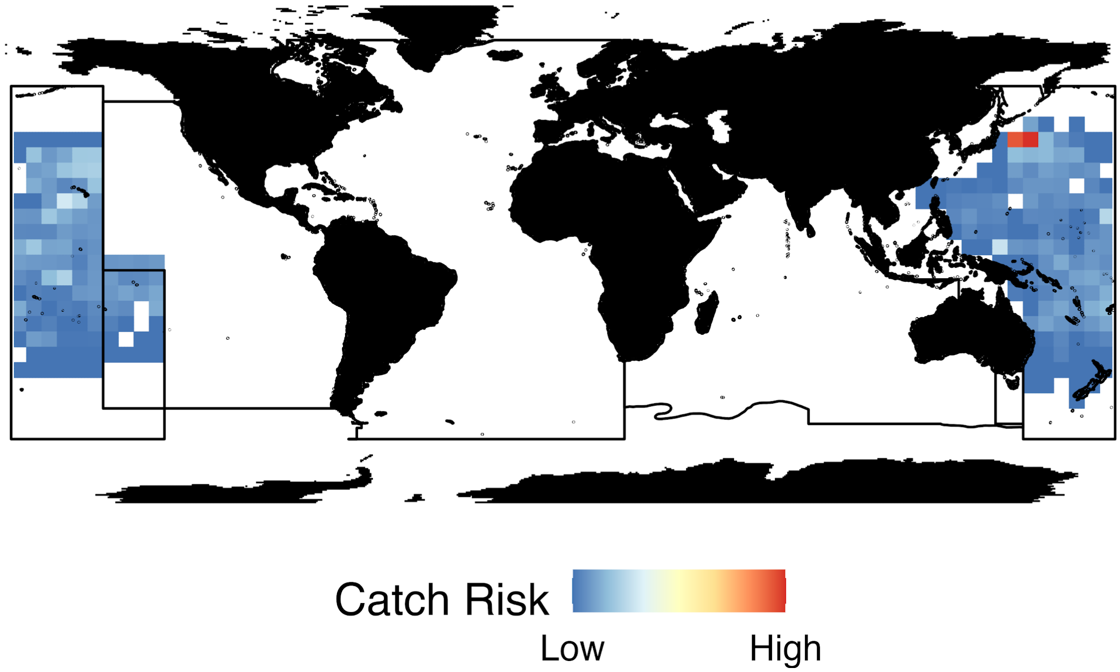

Figure S38. Predicted catch risk for longfin mako sharks (*Isurus paucus*).

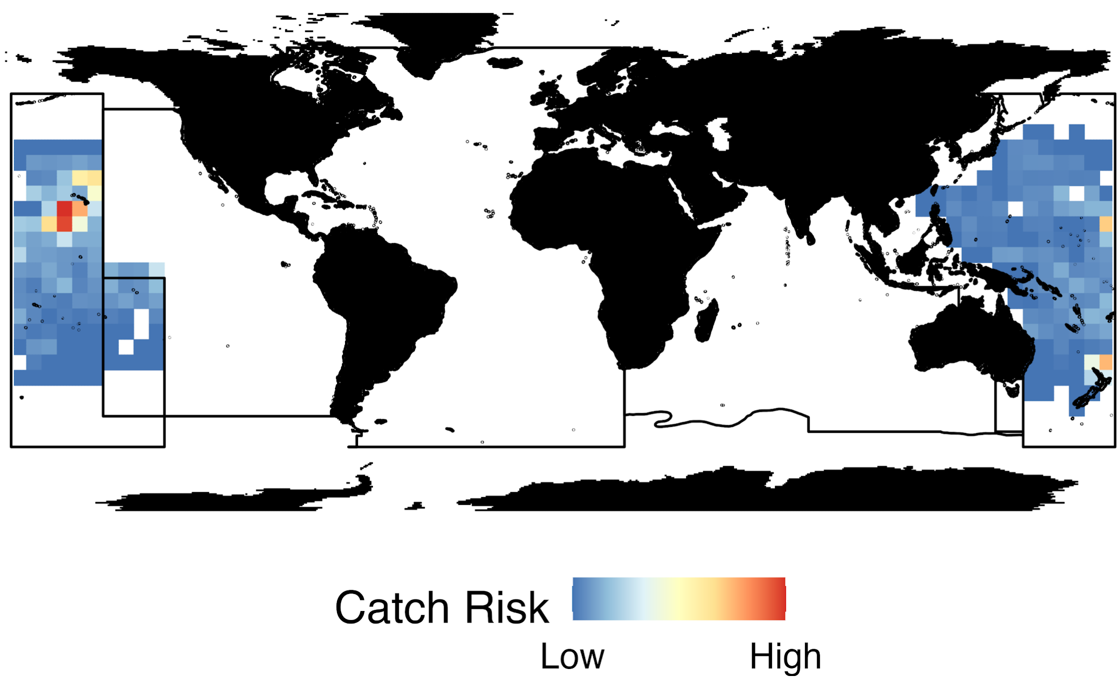

Figure S39. Predicted catch risk for bigeye thresher sharks (*Alopias superciliosus*).

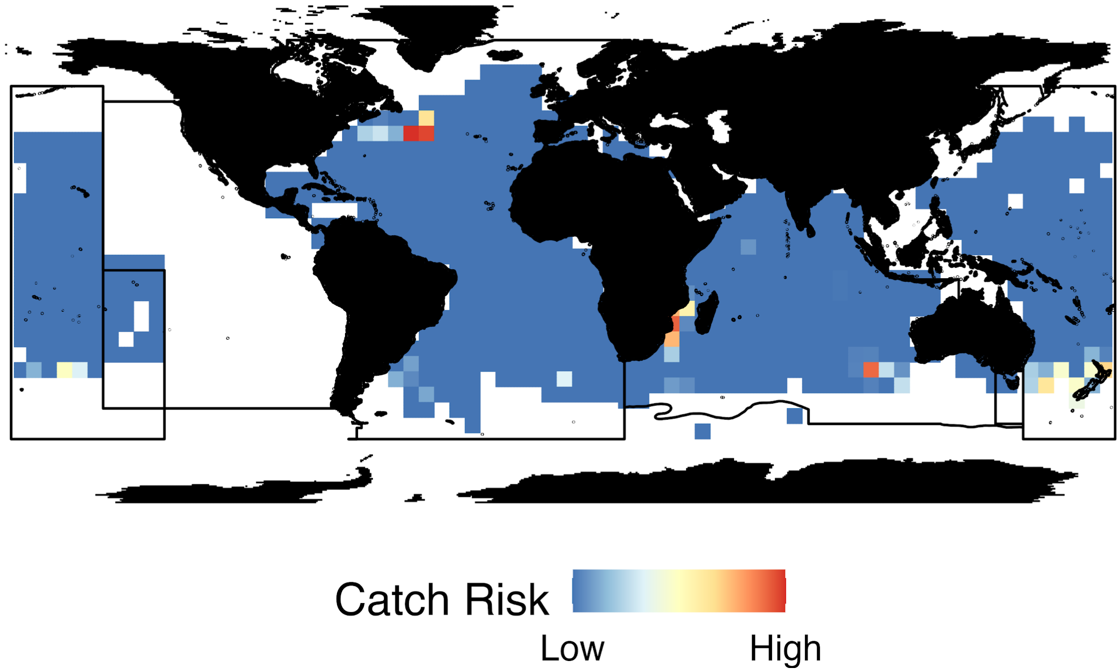

Figure S40. Predicted catch risk for porbeagle sharks (*Lamna nasus*).

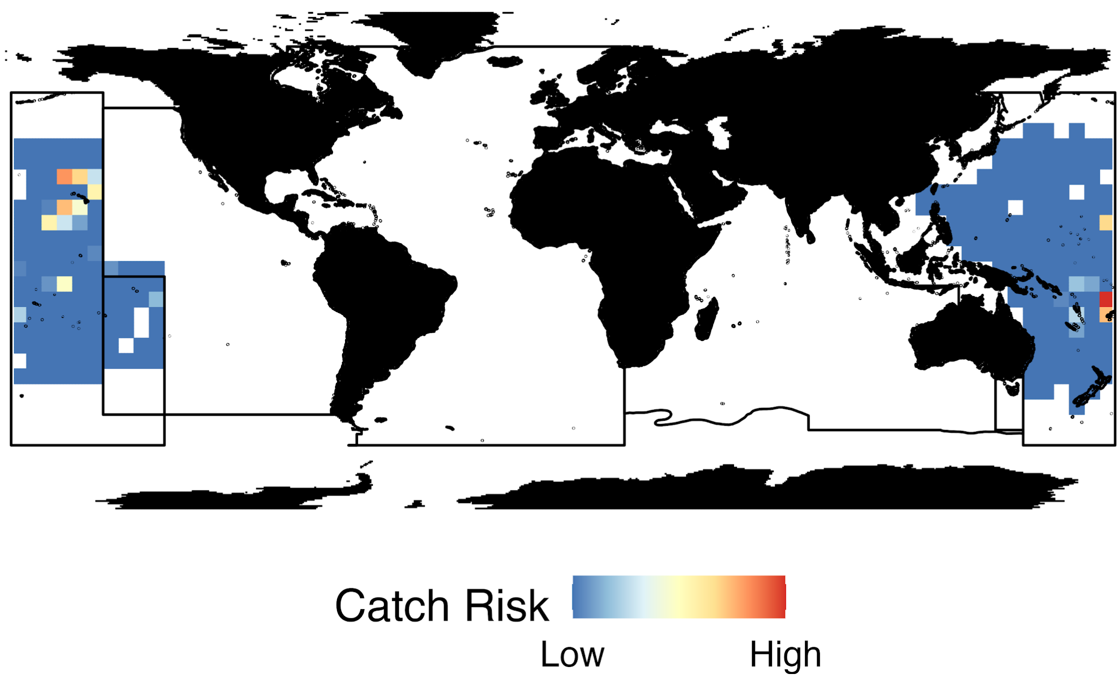

Figure S41. Predicted catch risk for smooth hammerhead sharks (*Sphyrna zygaena*).

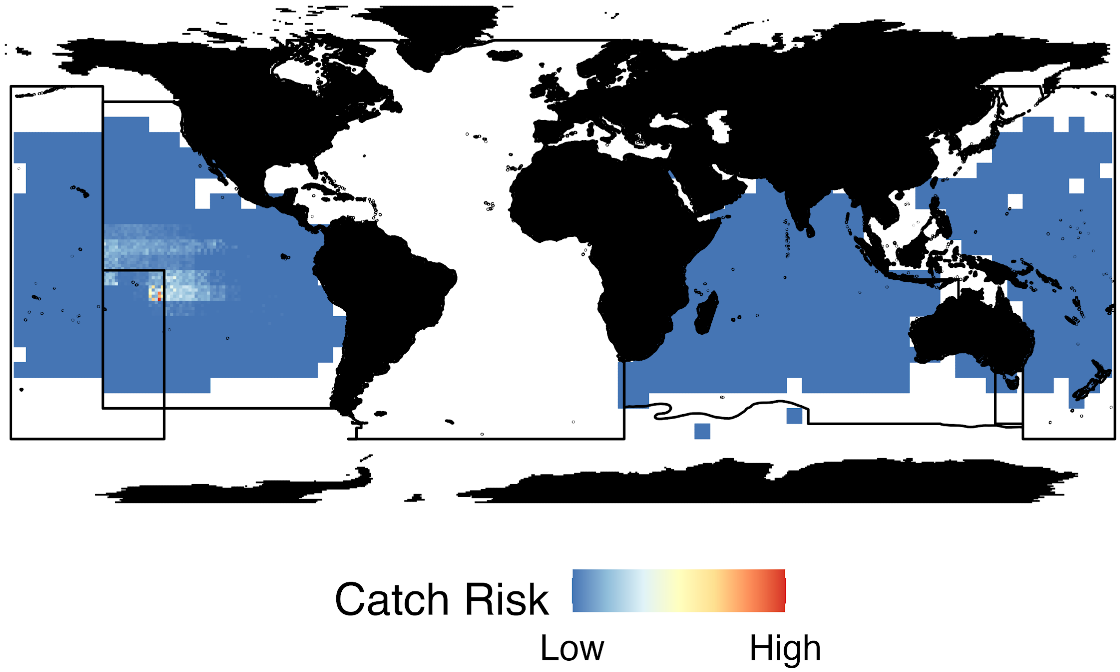

Figure S42. Predicted catch risk for hammerhead sharks (*Sphyrna*).

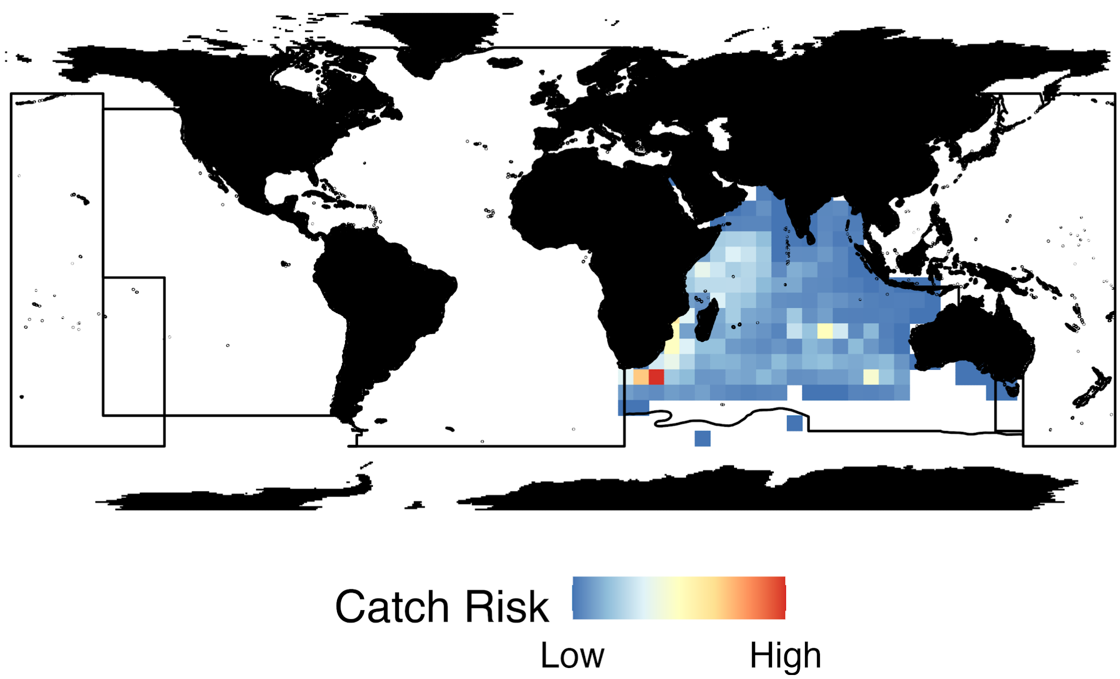

Figure S43. Predicted catch risk for mackerel and porbeagle sharks (*Lamnidae*).

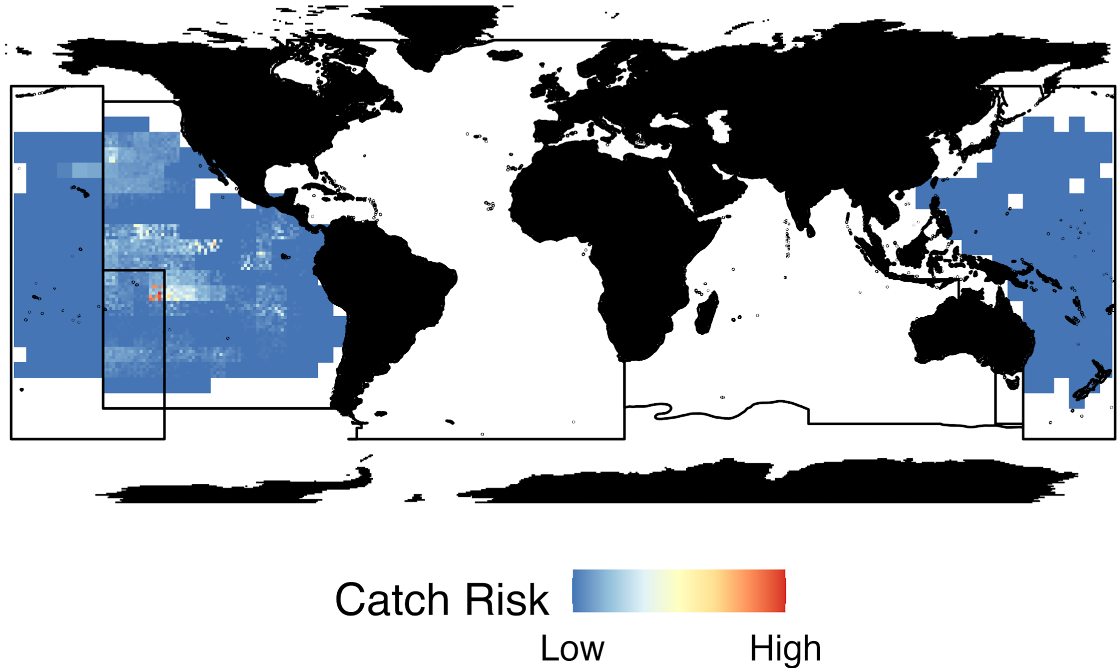

Figure S44. Predicted catch risk for mako sharks (*Isurus*).

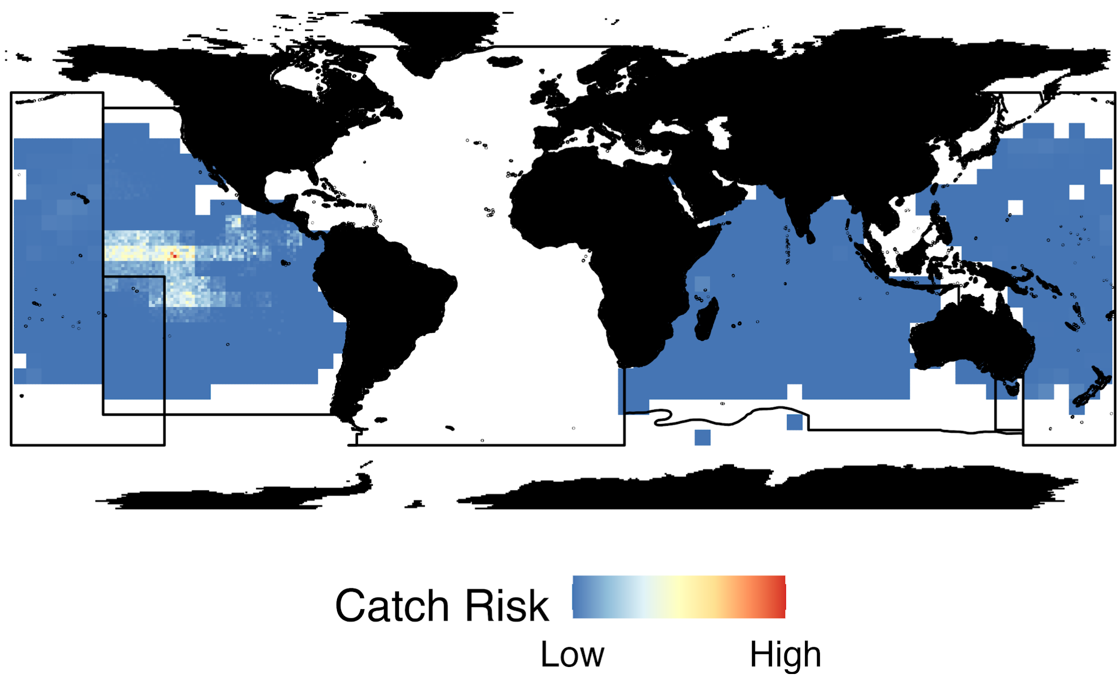

Figure S45. Predicted catch risk for thresher sharks (*Alopias*).

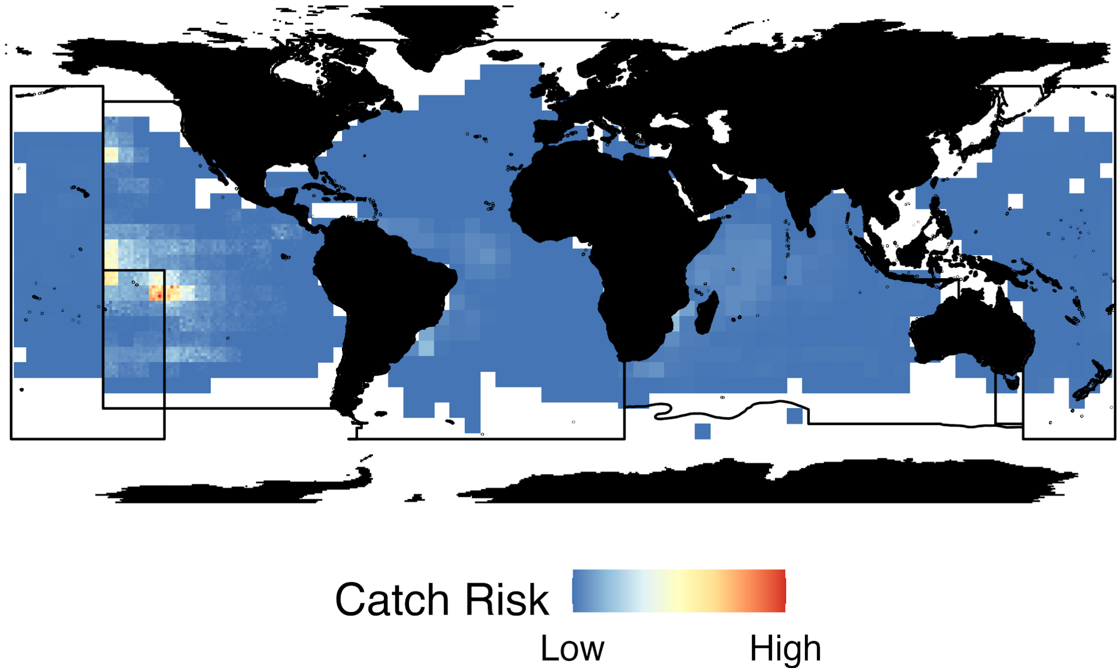

Figure S46. Predicted catch risk for unidentified sharks.

1.2 Supplementary Tables

Table S1. Data overview of catch and effort data reported by tRFMOs. The spatial resolution, temporal resolution, catch units, and data sources in which shark catch data were reported by each of the tRFMOs analyzed in the present study. All effort data were reported as hooks.

RFMO	Spatial Resolution	Temporal Resolution	Catch Units	Shark Catch and Effort Data Source	Target Effort Data Source
WCPFC	5x5 degree cell	yearly	count	Regional Observer Program	Self-reported by fishers
IATTC	5x5 degree cell	monthly	count and metric tonnes	Self-reported by fishers	Self-reported by fishers
	1x1 degree cell	monthly	count	Self-reported by fishers	Self-reported by fishers
ICCAT	5x5 degree cell	monthly	count and metric tonnes	Self-reported by fishers	Self-reported by fishers
	1x1 degree cell	monthly	count and metric tonnes	Self-reported by fishers	Self-reported by fishers

IOTC	5x5 degree cell	monthly	count and metric tonnes	Self-reported by fishers	Self-reported by fishers
	1x1 degree cell	monthly	count and metric tonnes	Self-reported by fishers	Self-reported by fishers

Table S2. The percentage of cells with zero and non-zero catch for any shark species. We filled in values of zero catch for cells in which no data for a particular shark species was reported, but effort or shark catch from another species was reported. We then aggregated cells at the spatiotemporal resolution. Cells are at the 1x1 degree resolution for each year in the dataset (2012–2020).

RFMO	Percentage of Zero Catch Cells (cells with no shark catch, but fishing effort)	Percentage of Non-Zero Catch Cells (cells with shark catch from at least one species)
IATTC	25.3% (96,012 cells)	74.7% (284,004 cells)
ICCAT	18.3% (44,268 cells)	81.7% (197,884 cells)
IOTC	10.2% (38,907 cells)	89.8% (340,920 cells)
WCPFC	38.6% (19,958 cells)	61.4% (31,756 cells)

Table S3. The percentage of data rows with zero and non-zero catch for a particular shark species. We filled in values of zero catch for cells in which no data for a particular shark species was reported, but effort or shark catch from another species was reported. Each row of data represents a single species in a single cell in a single year. Cells are at the 1x1 degree resolution for each year in the dataset (2012–2020).

RFMO	Percentage of Taxa-Level Zero Catch Rows	Percentage of Taxa-Level Non-Zero Catch Rows
IATTC	77.5% (294,470 rows)	22.5% (85,546 rows)
ICCAT	61.1% (148,073 rows)	38.9% (94,079 rows)
IOTC	68.9% (261,840 rows)	31.1% (117,987 rows)
WCPFC	78.4% (40,546 rows)	21.6% (11,168 rows)

Table S4. Overview of the datasets used to build Random Forest models.

Feature	Feature Type	Temporal Resolution	Spatial Resolution	Species Resolution	Units	Data Source(s)

longline shark catch by species	response	annual	1x1 or 5x5 degree	species-specific where applicable	count, metric tonnes	Western and Central Pacific Fisheries Commission. 2022. "Public Domain Bycatch Data." https://www.wcpfc.int/public-domain-bycatch. Indian Ocean Tuna Commission. 2022. "IOTC-2022-DATASETS-CEAll." https://iotc.org/data/datasets/latest/CEAll. International Commission for the Conservation of Atlantic Tunas. 2022. "Task 2 Catch/Effort." https://www.iccat.int/en/accesingdb.html. Inter-American Tropical Tuna Commission. 2022. "Shark EPO Longline Catch and Effort Aggregated by Year, Month, Flag, 5°x5°." https://www.iattc.org/en-US/Data/Public-domain.
species	predictor	annual	1x1 or 5x5 degree	species-specific where applicable		Western and Central Pacific Fisheries Commission. 2022. "Public Domain Bycatch Data." https://www.wcpfc.int/public-domain-bycatch. Indian Ocean Tuna Commission. 2022. "IOTC-2022-DATASETS-CEAll." https://iotc.org/data/datasets/latest/CEAll. International Commission for the Conservation of Atlantic Tunas. 2022. "Task 2 Catch/Effort." https://www.iccat.int/en/accesingdb.html. Inter-American Tropical Tuna Commission. 2022. "Shark EPO Longline Catch and Effort Aggregated by Year, Month, Flag, 5°x5°." https://www.iattc.org/en-US/Data/Public-domain.
remotely-sensed longline fishing effort	predictor	annual	1x1 or 5x5 degree		kwh	Kroodsma, David A., Juan Mayorga, Timothy Hochberg, Nathan A. Miller, Kristina Boerder, Francesco Ferretti, Alex Wilson, et al. 2018. "Tracking the Global Footprint of Fisheries." *Science* 359 (6378): 904–8. https://doi.org/10.1126/science.aao5646.
fishing effort associated with shark catch (by flag, if applicable)	predictor	annual	1x1 or 5x5 degree		hooks	Western and Central Pacific Fisheries Commission. 2022. "Public Domain Bycatch Data." https://www.wcpfc.int/public-domain-bycatch. Indian Ocean Tuna Commission. 2022. "IOTC-2022-DATASETS-CEAll." https://iotc.org/data/datasets/latest/CEAll. International Commission for the Conservation of Atlantic Tunas. 2022. "Task 2 Catch/Effort." https://www.iccat.int/en/accesingdb.html. Inter-American Tropical Tuna Commission. 2022. "Shark EPO Longline Catch and Effort Aggregated by Year, Month, Flag, 5°x5°." https://www.iattc.org/en-US/Data/Public-domain.
fishing effort associated with target catch (by flag, if applicable)	predictor	annual	1x1 or 5x5 degree		hooks	Western and Central Pacific Fisheries Commission [WCPFC]. 2022. "Public Domain Aggregated Catch/Effort Data." https://www.wcpfc.int/public-domain. Indian Ocean Tuna Commission. 2022. "IOTC-2022-DATASETS-CEAll." https://iotc.org/data/datasets/latest/CEAll. International Commission for the Conservation of Atlantic Tunas. 2022. "Task 2 Catch/Effort." https://www.iccat.int/en/accesingdb.html. Inter-American Tropical Tuna Commission [IATTC]. 2022. "Tuna and Billfish EPO Longline Catch and Effort Aggregated by Year, Month, Flag, 5°x5°." https://www.iattc.org/en-US/Data/Public-domain.
chlorophyll-A (mean)	predictor	annual	1x1 or 5x5 degree		milligram m-3	Plymouth Marine Laboratory. 2020. "ESA CCI Ocean Colour Product (CCI ALL-v4.2-MONTHLY), 0.04166666°, 1997-2020." https://coastwatch.pfeg.noaa.gov/erddap/griddap/pmlEsaCCI42OceanColorMonthly.html.
chlorophyll-A (coefficient of variation)	predictor	annual	1x1 or 5x5 degree		milligram m-3	Plymouth Marine Laboratory. 2020. "ESA CCI Ocean Colour Product (CCI ALL-v4.2-MONTHLY), 0.04166666°, 1997-2020." https://coastwatch.pfeg.noaa.gov/erddap/griddap/pmlEsaCCI42OceanColorMonthly.html.
sea surface temperature (mean)	predictor	annual	1x1 or 5x5 degree		°C	Met Office Hadley Center. 2022. "HadISST Average Sea Surface Temperature, 1°, Global, Monthly, 1870-Present." https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdHadISST.html.
sea surface temperature (coefficient of variation)	predictor	annual	1x1 or 5x5 degree		°C	Met Office Hadley Center. 2022. "HadISST Average Sea Surface Temperature, 1°, Global, Monthly, 1870-Present." https://coastwatch.pfeg.noaa.gov/erddap/griddap/erdHadISST.html.
sea surface height (mean)	predictor	annual	1x1 or 5x5 degree		meters	Zlotnicki, Victor, Zheng Qu, and Joshua Willis. 2019. "MEaSUREs Gridded Sea Surface Height Anomalies Version 1812." CA, USA: PO.DAAC. https://doi.org/10.5067/SLREF-CDRV2.
sea surface height (coefficient of variation)	predictor	annual	1x1 or 5x5 degree		meters	Zlotnicki, Victor, Zheng Qu, and Joshua Willis. 2019. "MEaSUREs Gridded Sea Surface Height Anomalies Version 1812." CA, USA: PO.DAAC. https://doi.org/10.5067/SLREF-CDRV2.
ex-vessel price (species-specific)	predictor	annual			USD	Melnychuk, Michael C., Tyler Clavelle, Brandon Owashi, and Kent Strauss. 2017. "Reconstruction of Global Ex-Vessel Prices of Fished Species." *ICES Journal of Marine Science* 74 (1): 121–33.

ex-vessel price (group price)	predictor	annual			USD	Melnychuk, Michael C., Tyler Clavelle, Brandon Owashi, and Kent Strauss. 2017. "Reconstruction of Global Ex-Vessel Prices of Fished Species." *ICES Journal of Marine Science* 74 (1): 121–33.
species distribution model	predictor		1x1 or 5x5 degree	species-specific	probability	IUCN. 2022. "The IUCN Red List of Threatened Species." Version 2021-3. https://www.iucnredlist.org.

Table S5. Species-specific ex-vessel prices. Ex-vessel prices (USD) were generated using methods from Melnychuk et al., 2017 for 2012–2020. For species with catch data, but no ex-vessel price information, a median ex-vessel price was calculated by year for all shark species collectively. Values for the year 2020 were inferred by multiplying the 2019 ex-vessel price by the estimated inflation rate for the US in 2020 (1.2%).

Year	Species Scientific Name	Ex-vessel Price (USD)
2012	*Alopias*	1187.26
2013	*Alopias*	1396.65
2014	*Alopias*	1940.81
2015	*Alopias*	1877.80
2016	*Alopias*	1597.66
2017	*Alopias*	2477.15
2018	*Alopias*	2306.37
2019	*Alopias*	2305.37
2020	*Alopias*	2333.03
2012	*Alopias pelagicus*	1187.26
2013	*Alopias pelagicus*	1396.65
2014	*Alopias pelagicus*	1940.81
2015	*Alopias pelagicus*	1877.80
2016	*Alopias pelagicus*	1597.66
2017	*Alopias pelagicus*	2477.15
2018	*Alopias pelagicus*	2306.37
2019	*Alopias pelagicus*	2305.37
2020	*Alopias pelagicus*	2333.03
2012	*Alopias superciliosus*	1187.26
2013	*Alopias superciliosus*	1396.65
2014	*Alopias superciliosus*	1940.81
2015	*Alopias superciliosus*	1877.80
2016	*Alopias superciliosus*	1597.66
2017	*Alopias superciliosus*	2477.15
2018	*Alopias superciliosus*	2306.37
2019	*Alopias superciliosus*	2305.37
2020	*Alopias superciliosus*	2333.03
2012	*Alopias vulpinus*	1187.26
2013	*Alopias vulpinus*	1396.65
2014	*Alopias vulpinus*	1940.81

2015	*Alopias vulpinus*	1877.80
2016	*Alopias vulpinus*	1597.66
2017	*Alopias vulpinus*	2477.15
2018	*Alopias vulpinus*	2306.37
2019	*Alopias vulpinus*	2305.37
2020	*Alopias vulpinus*	2333.03
2012	*Carcharhinidae*	1187.26
2013	*Carcharhinidae*	1396.65
2014	*Carcharhinidae*	1940.81
2015	*Carcharhinidae*	1877.80
2016	*Carcharhinidae*	1597.66
2017	*Carcharhinidae*	2477.15
2018	*Carcharhinidae*	2306.37
2019	*Carcharhinidae*	2305.37
2020	*Carcharhinidae*	2333.03
2012	*Carcharhinus brachyurus*	1187.26
2013	*Carcharhinus brachyurus*	1396.65
2014	*Carcharhinus brachyurus*	1940.81
2015	*Carcharhinus brachyurus*	1877.80
2016	*Carcharhinus brachyurus*	1597.66
2017	*Carcharhinus brachyurus*	2477.15
2018	*Carcharhinus brachyurus*	2306.37
2019	*Carcharhinus brachyurus*	2305.37
2020	*Carcharhinus brachyurus*	2333.03
2012	*Carcharhinus falciformis*	1187.26
2013	*Carcharhinus falciformis*	1396.65
2014	*Carcharhinus falciformis*	1940.81
2015	*Carcharhinus falciformis*	1877.80
2016	*Carcharhinus falciformis*	1597.66
2017	*Carcharhinus falciformis*	2477.15
2018	*Carcharhinus falciformis*	2306.37
2019	*Carcharhinus falciformis*	2305.37
2020	*Carcharhinus falciformis*	2333.03
2012	*Carcharhinus limbatus*	1187.26
2013	*Carcharhinus limbatus*	1396.65
2014	*Carcharhinus limbatus*	1940.81
2015	*Carcharhinus limbatus*	1877.80
2016	*Carcharhinus limbatus*	1597.66
2017	*Carcharhinus limbatus*	2477.15
2018	*Carcharhinus limbatus*	2306.37
2019	*Carcharhinus limbatus*	2305.37

2020	*Carcharhinus limbatus*	2333.03
2012	*Carcharhinus longimanus*	1187.26
2013	*Carcharhinus longimanus*	1396.65
2014	*Carcharhinus longimanus*	1940.81
2015	*Carcharhinus longimanus*	1877.80
2016	*Carcharhinus longimanus*	1597.66
2017	*Carcharhinus longimanus*	2477.15
2018	*Carcharhinus longimanus*	2306.37
2019	*Carcharhinus longimanus*	2305.37
2020	*Carcharhinus longimanus*	2333.03
2012	*Carcharhinus sorrah*	1187.26
2013	*Carcharhinus sorrah*	1396.65
2014	*Carcharhinus sorrah*	1940.81
2015	*Carcharhinus sorrah*	1877.80
2016	*Carcharhinus sorrah*	1597.66
2017	*Carcharhinus sorrah*	2477.15
2018	*Carcharhinus sorrah*	2306.37
2019	*Carcharhinus sorrah*	2305.37
2020	*Carcharhinus sorrah*	2333.03
2012	*Centrophorus squamosus*	656.25
2013	*Centrophorus squamosus*	1041.77
2014	*Centrophorus squamosus*	1298.53
2015	*Centrophorus squamosus*	1248.67
2016	*Centrophorus squamosus*	1209.67
2017	*Centrophorus squamosus*	1036.51
2018	*Centrophorus squamosus*	728.48
2019	*Centrophorus squamosus*	558.77
2020	*Centrophorus squamosus*	565.47
2012	*Galeocerdo cuvier*	1187.26
2013	*Galeocerdo cuvier*	1396.65
2014	*Galeocerdo cuvier*	1940.81
2015	*Galeocerdo cuvier*	1877.80
2016	*Galeocerdo cuvier*	1597.66
2017	*Galeocerdo cuvier*	2477.15
2018	*Galeocerdo cuvier*	2306.37
2019	*Galeocerdo cuvier*	2305.37
2020	*Galeocerdo cuvier*	2333.03
2012	*Isurus*	1187.26
2013	*Isurus*	1396.65
2014	*Isurus*	1940.81
2015	*Isurus*	1877.80

2016	*Isurus*	1597.66
2017	*Isurus*	2477.15
2018	*Isurus*	2306.37
2019	*Isurus*	2305.37
2020	*Isurus*	2333.03
2012	*Isurus oxyrinchus*	1187.26
2013	*Isurus oxyrinchus*	1396.65
2014	*Isurus oxyrinchus*	1940.81
2015	*Isurus oxyrinchus*	1877.80
2016	*Isurus oxyrinchus*	1597.66
2017	*Isurus oxyrinchus*	2477.15
2018	*Isurus oxyrinchus*	2306.37
2019	*Isurus oxyrinchus*	2305.37
2020	*Isurus oxyrinchus*	2333.03
2012	*Isurus paucus*	1187.26
2013	*Isurus paucus*	1396.65
2014	*Isurus paucus*	1940.81
2015	*Isurus paucus*	1877.80
2016	*Isurus paucus*	1597.66
2017	*Isurus paucus*	2477.15
2018	*Isurus paucus*	2306.37
2019	*Isurus paucus*	2305.37
2020	*Isurus paucus*	2333.03
2012	*Lamna nasus*	526.40
2013	*Lamna nasus*	1171.84
2014	*Lamna nasus*	1150.18
2015	*Lamna nasus*	1017.23
2016	*Lamna nasus*	1014.43
2017	*Lamna nasus*	1095.02
2018	*Lamna nasus*	821.77
2019	*Lamna nasus*	572.35
2020	*Lamna nasus*	579.21
2012	*Lamnidae*	1187.26
2013	*Lamnidae*	1396.65
2014	*Lamnidae*	1940.81
2015	*Lamnidae*	1877.80
2016	*Lamnidae*	1597.66
2017	*Lamnidae*	2477.15
2018	*Lamnidae*	2306.37
2019	*Lamnidae*	2305.37
2020	*Lamnidae*	2333.03

2012	*Prionace glauca*	1187.26
2013	*Prionace glauca*	1396.65
2014	*Prionace glauca*	1940.81
2015	*Prionace glauca*	1877.80
2016	*Prionace glauca*	1597.66
2017	*Prionace glauca*	2477.15
2018	*Prionace glauca*	2306.37
2019	*Prionace glauca*	2305.37
2020	*Prionace glauca*	2333.03
2012	*Pseudocarcharias kamoharai*	1187.26
2013	*Pseudocarcharias kamoharai*	1396.65
2014	*Pseudocarcharias kamoharai*	1940.81
2015	*Pseudocarcharias kamoharai*	1877.80
2016	*Pseudocarcharias kamoharai*	1597.66
2017	*Pseudocarcharias kamoharai*	2477.15
2018	*Pseudocarcharias kamoharai*	2306.37
2019	*Pseudocarcharias kamoharai*	2305.37
2020	*Pseudocarcharias kamoharai*	2333.03
2012	*Rhincodon typus*	1187.26
2013	*Rhincodon typus*	1396.65
2014	*Rhincodon typus*	1940.81
2015	*Rhincodon typus*	1877.80
2016	*Rhincodon typus*	1597.66
2017	*Rhincodon typus*	2477.15
2018	*Rhincodon typus*	2306.37
2019	*Rhincodon typus*	2305.37
2020	*Rhincodon typus*	2333.03
2012	*Sharks nei*	1187.26
2013	*Sharks nei*	1396.65
2014	*Sharks nei*	1940.81
2015	*Sharks nei*	1877.80
2016	*Sharks nei*	1597.66
2017	*Sharks nei*	2477.15
2018	*Sharks nei*	2306.37
2019	*Sharks nei*	2305.37
2020	*Sharks nei*	2333.03
2012	*Sphyrna*	1187.26
2013	*Sphyrna*	1396.65
2014	*Sphyrna*	1940.81
2015	*Sphyrna*	1877.80
2016	*Sphyrna*	1597.66

2017	*Sphyrna*	2477.15
2018	*Sphyrna*	2306.37
2019	*Sphyrna*	2305.37
2020	*Sphyrna*	2333.03
2012	*Sphyrna lewini*	1187.26
2013	*Sphyrna lewini*	1396.65
2014	*Sphyrna lewini*	1940.81
2015	*Sphyrna lewini*	1877.80
2016	*Sphyrna lewini*	1597.66
2017	*Sphyrna lewini*	2477.15
2018	*Sphyrna lewini*	2306.37
2019	*Sphyrna lewini*	2305.37
2020	*Sphyrna lewini*	2333.03
2012	*Sphyrna mokarran*	1187.26
2013	*Sphyrna mokarran*	1396.65
2014	*Sphyrna mokarran*	1940.81
2015	*Sphyrna mokarran*	1877.80
2016	*Sphyrna mokarran*	1597.66
2017	*Sphyrna mokarran*	2477.15
2018	*Sphyrna mokarran*	2306.37
2019	*Sphyrna mokarran*	2305.37
2020	*Sphyrna mokarran*	2333.03
2012	*Sphyrna zygaena*	1187.26
2013	*Sphyrna zygaena*	1396.65
2014	*Sphyrna zygaena*	1940.81
2015	*Sphyrna zygaena*	1877.80
2016	*Sphyrna zygaena*	1597.66
2017	*Sphyrna zygaena*	2477.15
2018	*Sphyrna zygaena*	2306.37
2019	*Sphyrna zygaena*	2305.37
2020	*Sphyrna zygaena*	2333.03
2012	*Squalus*	656.25
2013	*Squalus*	1041.77
2014	*Squalus*	1298.53
2015	*Squalus*	1248.67
2016	*Squalus*	1209.67
2017	*Squalus*	1036.51
2018	*Squalus*	728.48
2019	*Squalus*	558.77
2020	*Squalus*	565.47

Table S6. Median ex-vessel prices for shark species. Ex-vessel prices (USD) were generated using methods from Melnychuk et al., 2017 for 2012–2020. The median ex-vessel prices for shark species were calculated for each year. Values for the year 2020 were inferred by multiplying the 2019 ex-vessel price by the estimated inflation rate for the US in 2020 (1.2%).

Year	Median Ex-vessel Price (USD)
2012	1187.26
2013	1396.65
2014	1940.81
2015	1877.80
2016	1597.66
2017	2477.15
2018	2306.37
2019	2305.37
2020	2333.03

Table S7. Model selection. For each RFMO, we ran a series of Phase 1 models to determine the appropriate spatial resolution, catch units, and effort metric to predict shark catch. The most appropriate model was chosen by comparing R^2 among models. Once a model for an RFMO was selected in Phase 1, we conducted an exhaustive search via a series of Phase 2 models to determine the most appropriate environmental variables and metrics to predict shark catch. The final model chosen for each RFMO was determined by the highest R^2.

Model Phase	Dataset	Response Variable	Reported effort associated with shark catch (by flag, if available)	Self-reported effort with target catch (by flag if available)	Global Fishing Watch Effort (kwh)	Species Distribution Model	Sea Surface Temperature	Chlorophyll-A	Sea Surface Height	Ex-vessel Price
Phase 1	5x5 resolution, count only	catch	✓			✓	mean	mean		
	5x5 resolution, count only	catch		✓		✓	mean	mean		
	5x5 resolution, count only	catch			✓	✓	mean	mean		
	5x5 resolution, count and mt converted to count	catch	✓			✓	mean	mean		
	5x5 resolution, count and mt converted to count	catch		✓		✓	mean	mean		
	5x5 resolution, count and mt converted to count	catch			✓	✓	mean	mean		
	1x1 resolution, count only	catch	✓			✓	mean	mean		
	1x1 resolution, count only	catch		✓		✓	mean	mean		
	1x1 resolution, count only	catch			✓	✓	mean	mean		

	1x1 resolution, count and mt converted to count	catch	✓			✓	mean	mean		
	1x1 resolution, count and mt converted to count	catch		✓		✓	mean	mean		
	1x1 resolution, count and mt converted to count	catch			✓	✓	mean	mean		
Phase 2	Selected in Phase 1	catch	Selected in Phase 1	Selected in Phase 1	Selected in Phase 1	✓	mean	mean		
	Selected in Phase 1	catch	Selected in Phase 1	Selected in Phase 1	Selected in Phase 1	✓	mean	mean	mean	
	Selected in Phase 1	catch	Selected in Phase 1	Selected in Phase 1	Selected in Phase 1	✓	mean	mean	mean	group-wide price
	Selected in Phase 1	catch	Selected in Phase 1	Selected in Phase 1	Selected in Phase 1	✓	mean	mean	mean	species-specific price
	Selected in Phase 1	catch	Selected in Phase 1	Selected in Phase 1	Selected in Phase 1	✓	mean and CV	mean and CV		
	Selected in Phase 1	catch	Selected in Phase 1	Selected in Phase 1	Selected in Phase 1	✓	mean and CV	mean and CV	mean and CV	
	Selected in Phase 1	catch	Selected in Phase 1	Selected in Phase 1	Selected in Phase 1	✓	mean and CV	mean and CV	mean and CV	group-wide price
	Selected in Phase 1	catch	Selected in Phase 1	Selected in Phase 1	Selected in Phase 1	✓	mean and CV	mean and CV	mean and CV	species-specific price

Table S8. Overlap between shark catch, effort, and CPUE. The percent of cells with the highest shark catch, effort associated with shark catch, or CPUE of shark catch within each RFMO that overlap with other metrics. Data from each RFMO were scaled independently using quantiles between 0 and 1 at 0.1. The highest quantile group was used to select areas with high metrics.

tRFMO	% of cells with overlap of high shark catch and high shark CPUE	% of cells with overlap of high shark catch and high effort associated with shark catch	% of cells with no overlap among high shark catch, shark CPUE, or effort associated with shark catch
IATTC	10.12%	2.53%	87.35%
ICCAT	5.69%	18.75%	75.56%
IOTC	0%	33.43%	66.75%
WCPFC	21.05%	20.71%	58.23%

Table S9. Representation of captured shark species reported by tRFMOs. The percent of catch in the tRFMO raw datasets attributed to each species reported in count and metric tonnes.

Species Common Name	Species Scientific Name	Catch Units	IATTC	ICCAT	IOTC	WCPFC	Global Total %
Blacktip shark	*Carcharhinus limbatus*	count	0.14	0	0	0	0.03
		metric tonnes	0.21	0	0	0	0.01
Blue shark	*Prionace glauca*	count	52.7	88.68	75.19	77.36	78.23
		metric tonnes	29.1	85.95	64.99	0	78.85
Hammerhead sharks nei	*Sphyrna*	count	0.47	0	0.07	0.01	0.1
		metric tonnes	0.99	0	0.09	0	0.08
Mako sharks	*Isurus*	count	0.47	0	0	0.03	0.09
		metric tonnes	0.48	0	0	0	0.03
Requiem sharks nei	*Carcharhinidae*	count	0.04	0	0.01	0	0.01
		metric tonnes	0.05	0	0.19	0	0.04
Sharks nei	*Sharks nei*	count	19.73	4.49	11.71	5.09	8.96
		metric tonnes	44.29	1.53	16.7	0	6.77
Shortfin mako shark	*Isurus oxyrinchus*	count	8.03	6.32	0	3.55	4.99
		metric tonnes	6.37	12.44	0	0	9.87
Silky shark	*Carcharhinus falciformis*	count	16.23	0	4.42	5.33	4.35
		metric tonnes	15.47	0	3.67	0	1.57
Thresher sharks nei	*Alopias*	count	2.18	0	0.11	0.26	0.44
		metric tonnes	3.04	0	0.01	0	0.18
Porbeagle shark	*Lamna nasus*	count	0	0.52	0.17	1.01	0.38
		metric tonnes	0	0.07	0	0	0.06
Mackerel sharks,porbeagles nei	*Lamnidae*	count	0	0	8.01	0	1.83
		metric tonnes	0	0	14.15	0	2.51
Oceanic whitetip shark	*Carcharhinus longimanus*	count	0	0	0.32	1.39	0.17
		metric tonnes	0	0	0.19	0	0.03
Bigeye thresher shark	*Alopias superciliosus*	count	0	0	0	4.76	0.34
Great hammerhead shark	*Sphyrna mokarran*	count	0	0	0	0.02	0
Longfin mako	*Isurus paucus*	count	0	0	0	0.58	0.04
Pelagic thresher shark	*Alopias pelagicus*	count	0	0	0	0.42	0.03
Scalloped hammerhead	*Sphyrna lewini*	count	0	0	0	0.03	0
Smooth hammerhead	*Sphyrna zygaena*	count	0	0	0	0.07	0
Thresher shark (vulpinus)	*Alopias vulpinus*	count	0	0	0	0.1	0.01
Whale shark	*Rhincodon typus*	count	0	0	0	0	0
Column Totals		count	100	100	100	100	100
		metric tonnes	100	100	100	0	100

Table S10. Degree of zero-inflation by tRFMO. The percent of rows (unique combination of latitude, longitude, year, species) with zero catch in the tRFMO raw datasets that are predicted as zero catch or non-zero catch by the machine learning model.

tRFMO	Rows with zero catch predicted (% of total)	Rows with non-zero catch predicted (% of total)	Total number of rows with zero catch reported (tRFMO data)
IATTC	87.65%	12.35%	262,450
ICCAT	86.17%	13.83%	128,675
IOTC	91.75%	8.25%	238,200
WCPFC	81.17%	18.82%	506,825