Food and Agriculture Organization of the United Nations

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi

ESTIMATION OF SPATIALIZED HISTORICAL CATCHES FOR THE FIVE MAJOR IOTC SPECIES

12TH IOTC TECHNICAL COMMITTEE ON ALLOCATION CRITERIA, 16-19 OCTOBER 2023

IOTC SECRETARIAT

OBJECTIVE

To provide the TCAC12 with an overview of the process implemented by the Secretariat to estimate raised geo-referenced catches of the five major IOTC species, and how these are further aggregated to provide **inputs** for allocation estimations.

Outline:

- Materials
- Methods
- Results
- Interactive tools

MATERIALS

MAIN INPUT DATASETS (RES. 15/02)

- **1-RC**: Retained catches in weight
  Total annual retained catches in live-weight equivalent, stratified by year, IO major area (East / West), fleet, gear, and species

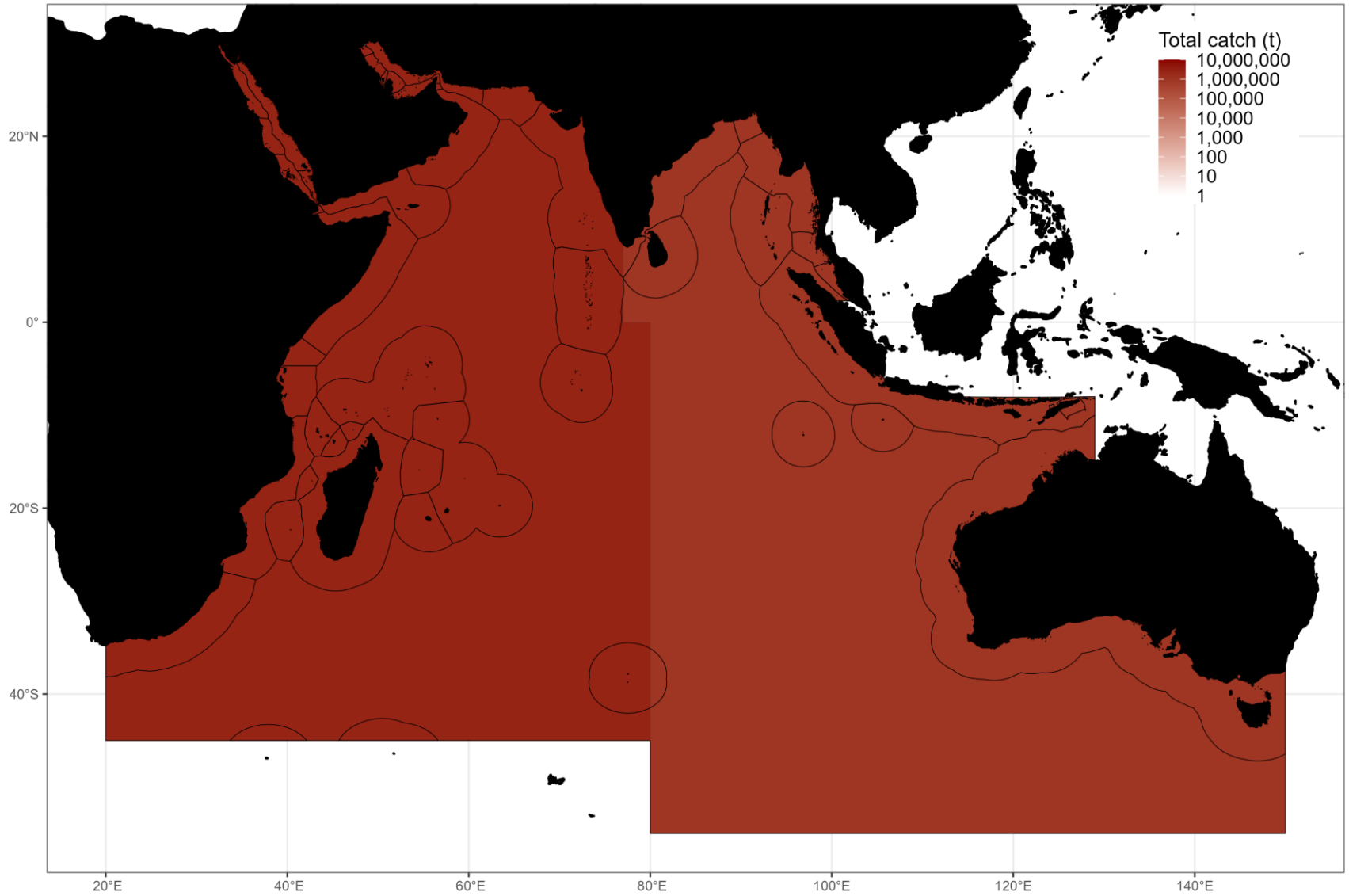
- **3-CE**: Georeferenced monthly catch and effort data
  Sampled retained catches either in live-weight equivalent or in numbers (for LL fleets), stratified by year, month, grid / area, fleet, gear, school type, and species

- **4-SF:** Georeferenced monthly size-frequency data
  Sampled size-frequency data (either lengths or weights), stratified by type of measurement, year, month, grid, fleet, gear, school type, and species

KNOWN LIMITS AND ISSUES

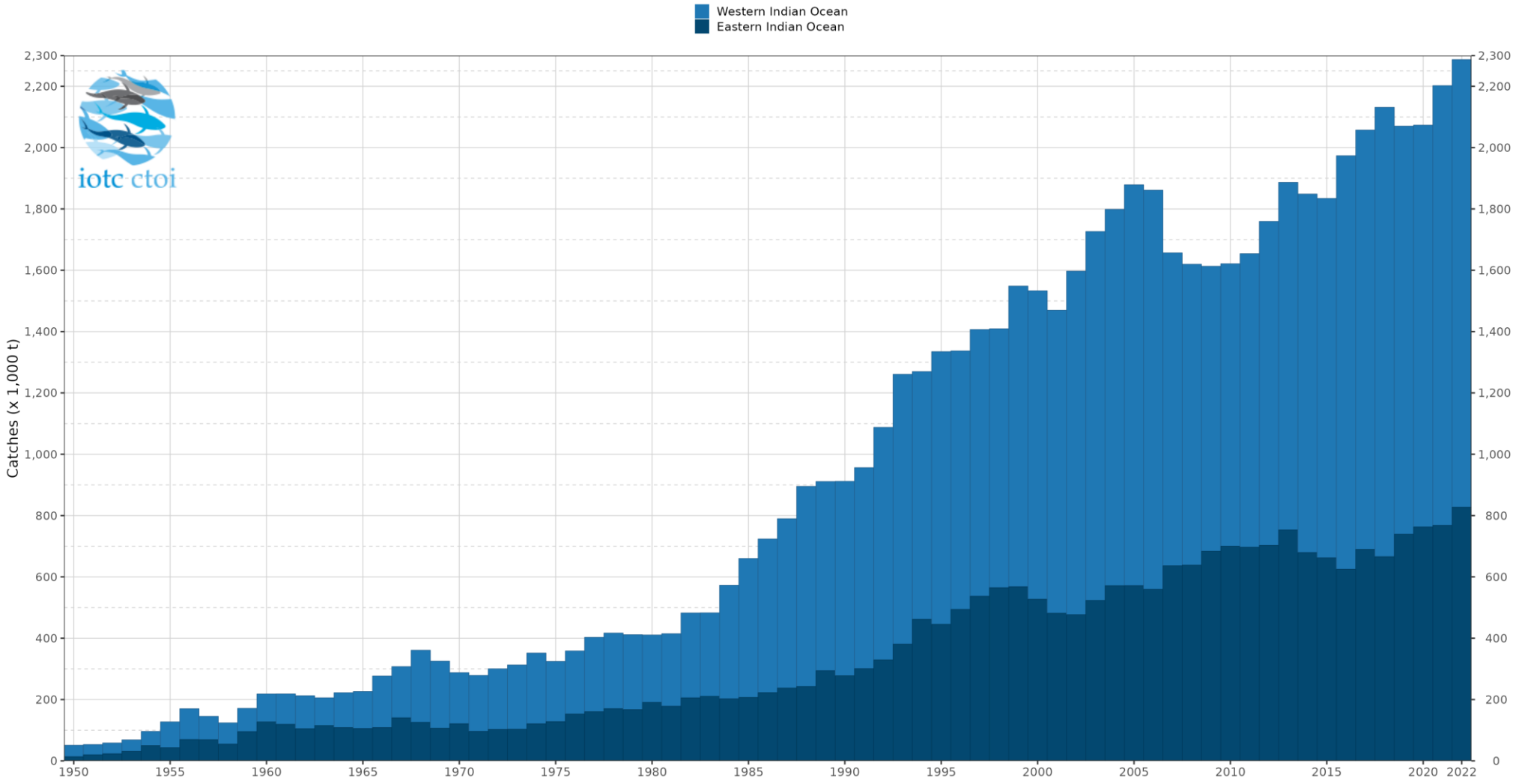
1-RC: Retained annual catches in weight

1) Data quality strongly dependent on the type of fishery (ART / IND)
2) Original data might include information reported for gear and / or species aggregates
3) Original data is re-estimated by the Secretariat under advice from the SC
4) Data might be repeated from previous year (non-reporting CPCs)
5) Data includes historical estimations of data for NEI fleets operating in the IO
6) Discrepancies between reported IO areas and georeferenced catch and effort for the same stratum


Total catch (t)
10,000,000
1,000,000
100,000
10,000
1,000
100
10
1
20°N
0°
20°S
40°S
20°E
40°E
60°E
80°E
100°E
120°E
140°E

Yearly catches by (1950 - 2022)

Generated by IOTC from raw nominal catches on 2023-10-09 08:30:12 GMT. Data last updated on 2023-09-28



Yearly catches by fishery type (1950 - 2022)

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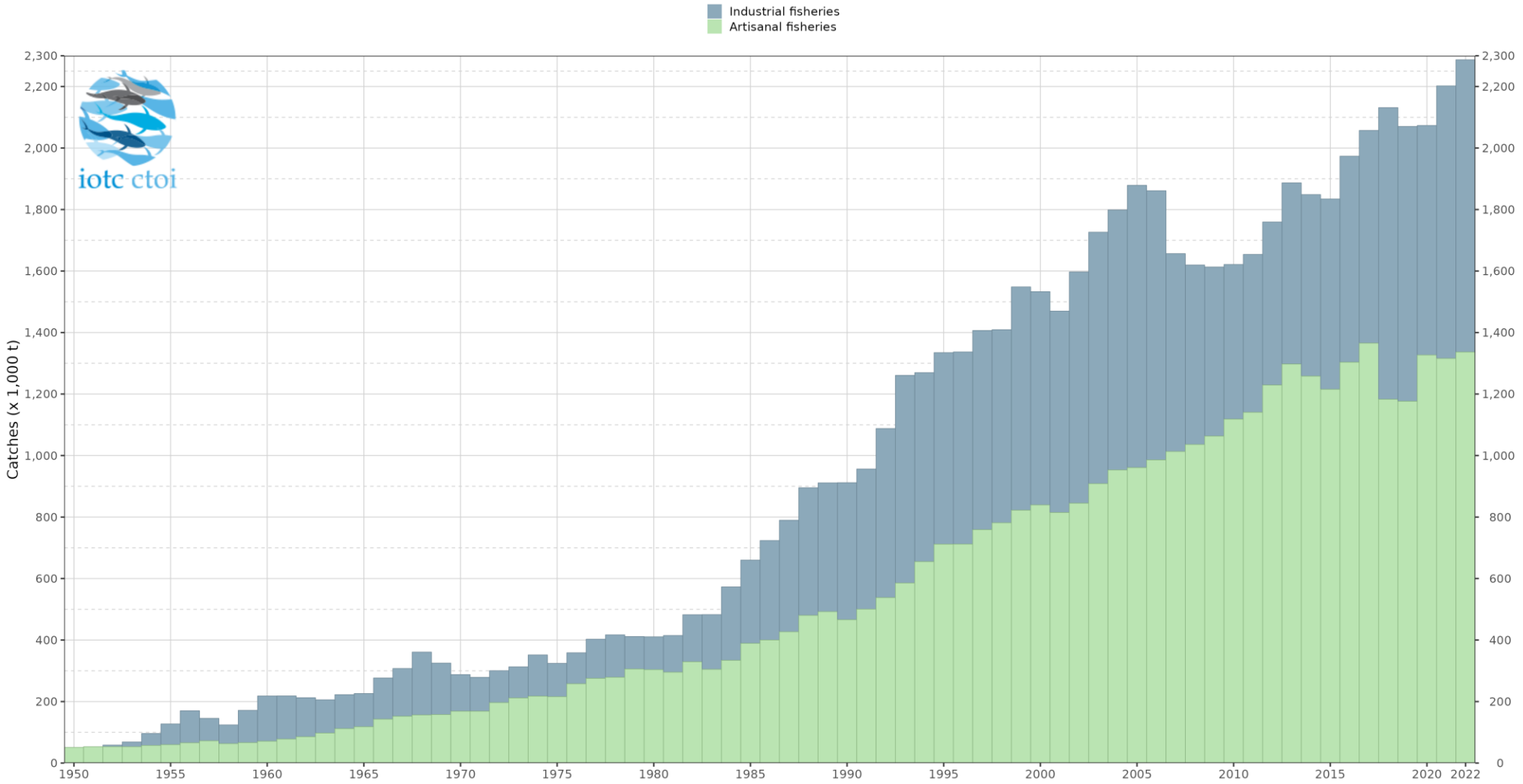
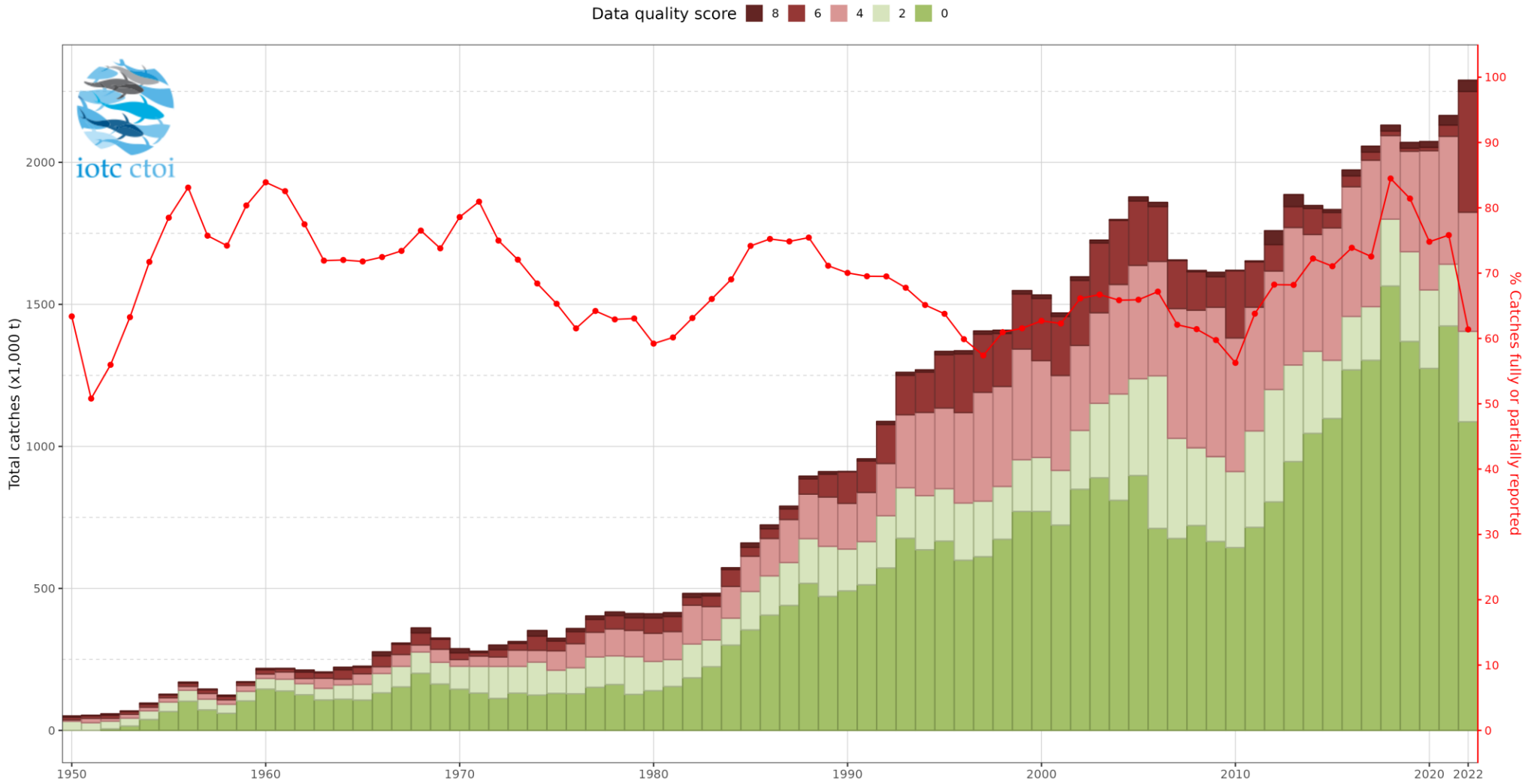


Yearly quality of nominal catches (1950 - 2022)

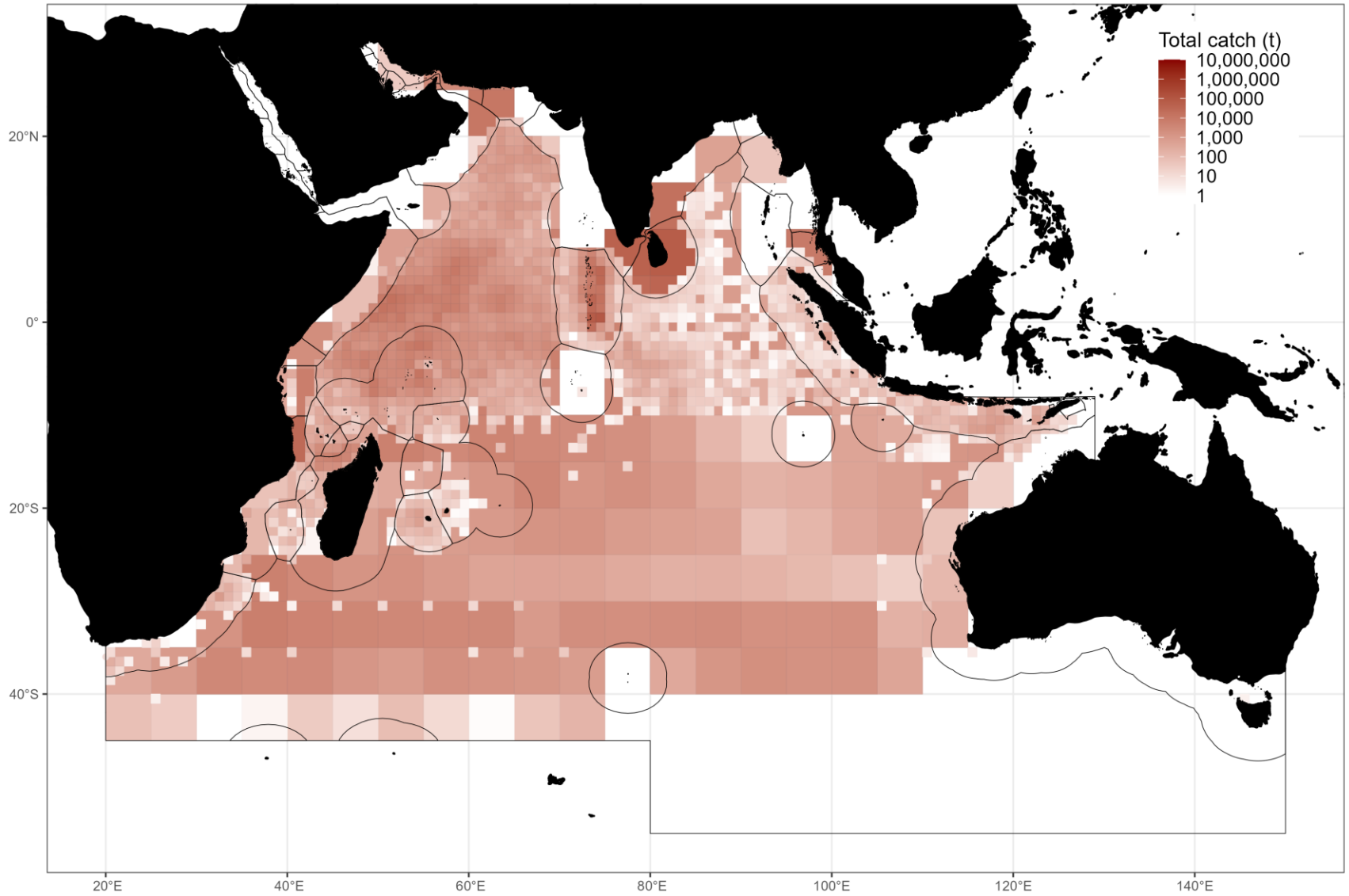
Generated by IOTC from raw nominal catches on 2023-10-09 08:38:16 GMT. Data last updated on 2023-09-28



KNOWN LIMITS AND ISSUES

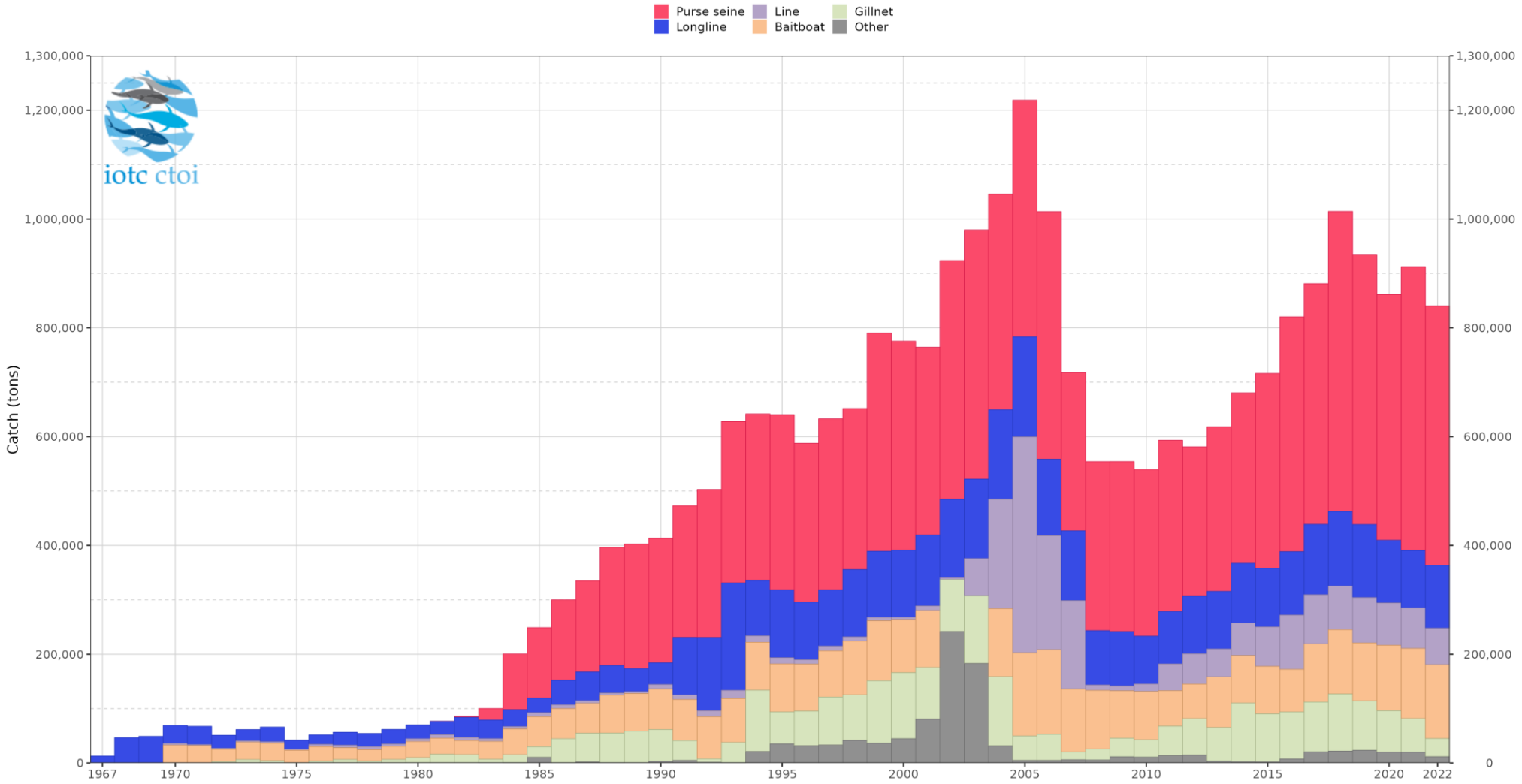
3-CE: Georeferenced monthly catch and effort data

1) Data quality and availability strongly dependent on the type of fishery
2) Data not always raised to totals
3) Data only available in numbers for some longline fisheries
4) School association not always provided
5) Discrepancies in geospatial information
6) Use of non-standard areas for reporting
7) Low coverage level, particularly for some artisanal fleets


Total catch (t)
10,000,000
1,000,000
100,000
10,000
1,000
100
10
1
20°N
0°
20°S
40°S
20°E
40°E
60°E
80°E
100°E
120°E
140°E

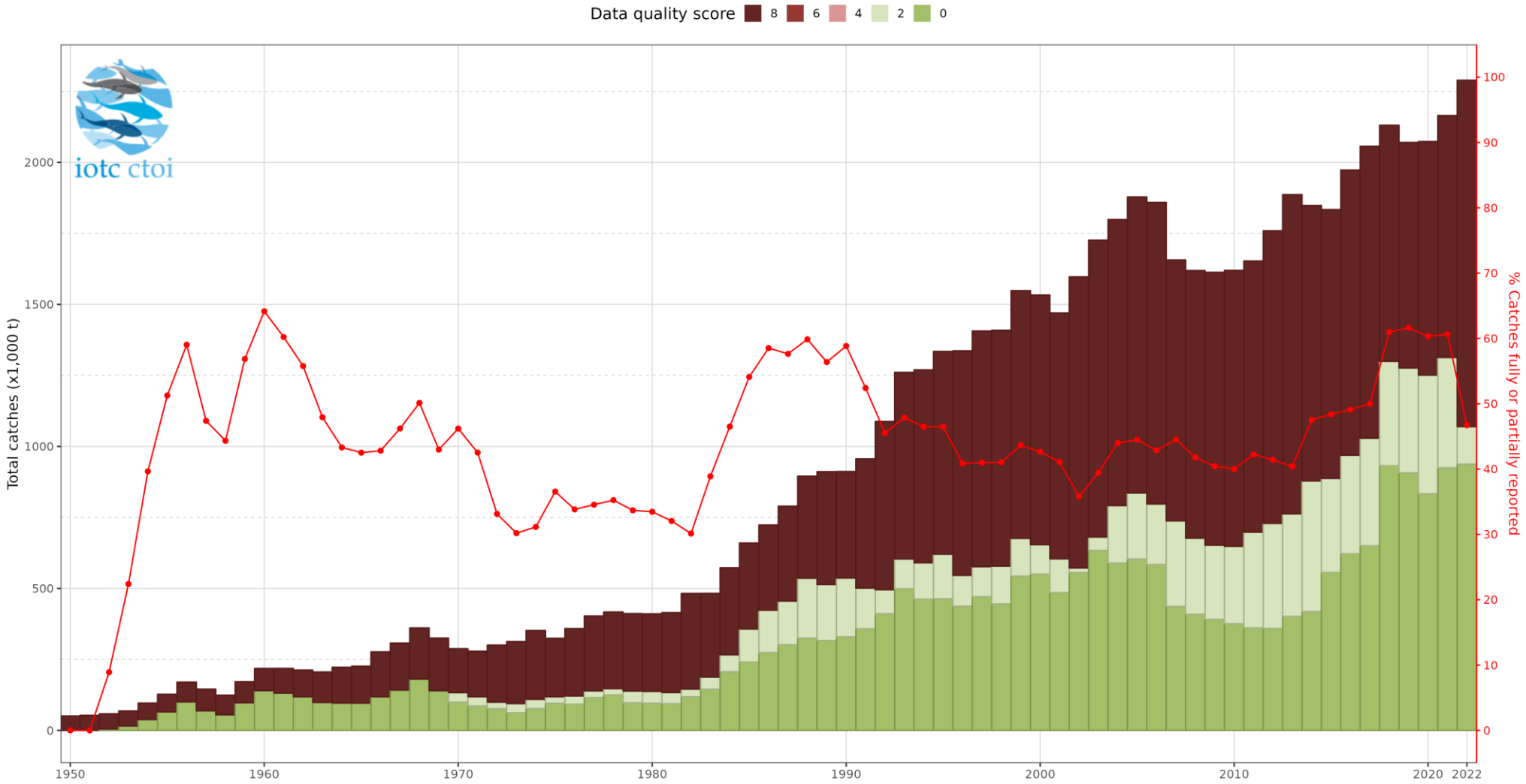
Yearly catches in tons by fishery group (1952 - 2022)

Generated by IOTC from raw georeferenced catches on 2023-10-09 08:35:32 GMT. Data last updated on 2023-09-28



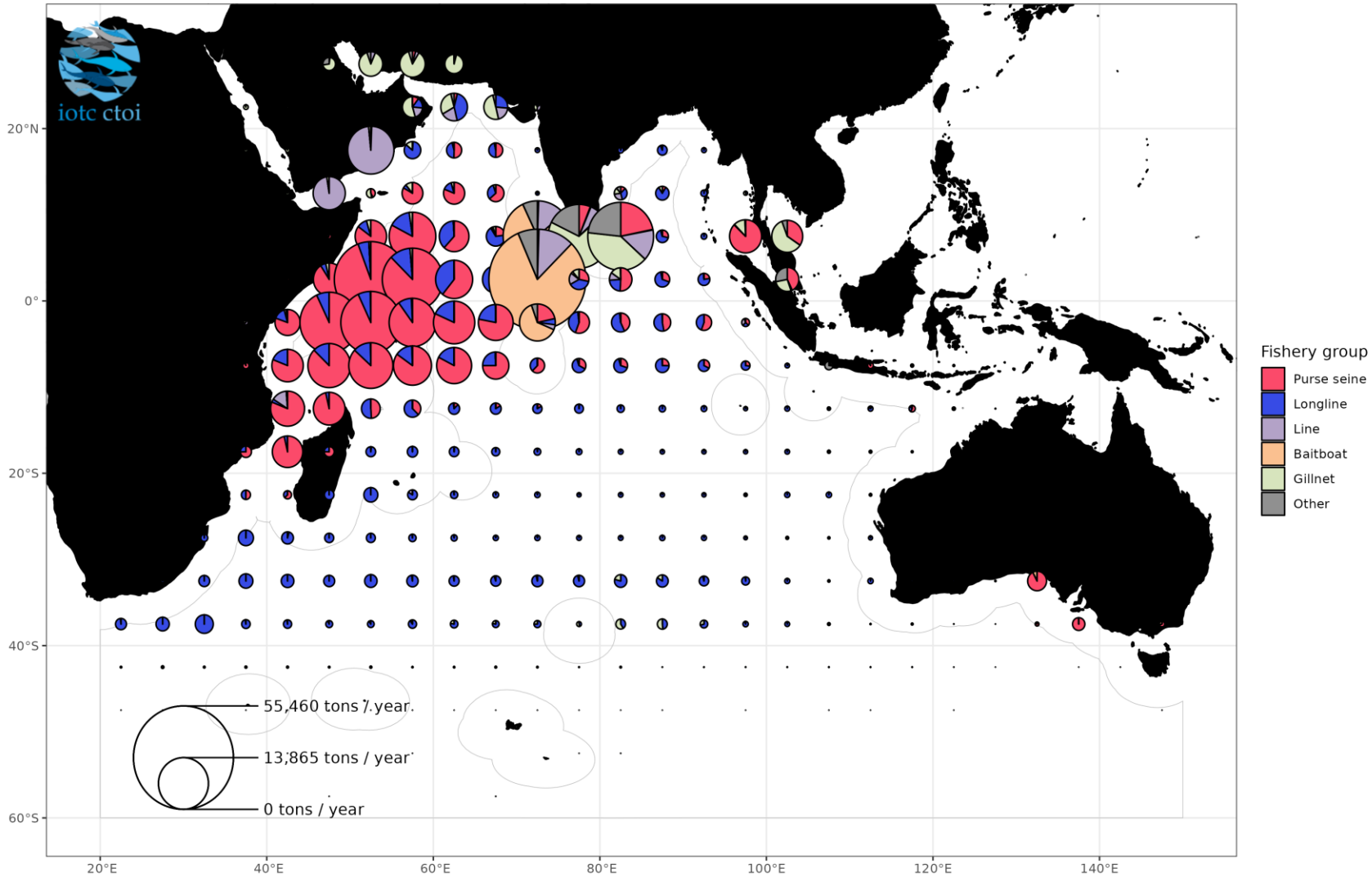
Yearly quality of raw georeferenced catches (1950 - 2022)

Generated by IOTC from raw nominal catches on 2023-10-09 08:38:31 GMT. Data last updated on 2023-09-28



Average yearly catches in tons by fishery group (1952 - 2022)

Generated by IOTC from raw georeferenced catches on 2023-10-09 08:32:25 GMT. Data last updated on 2023-09-28



Average yearly catches in numbers by fishery group (1952 - 2022)

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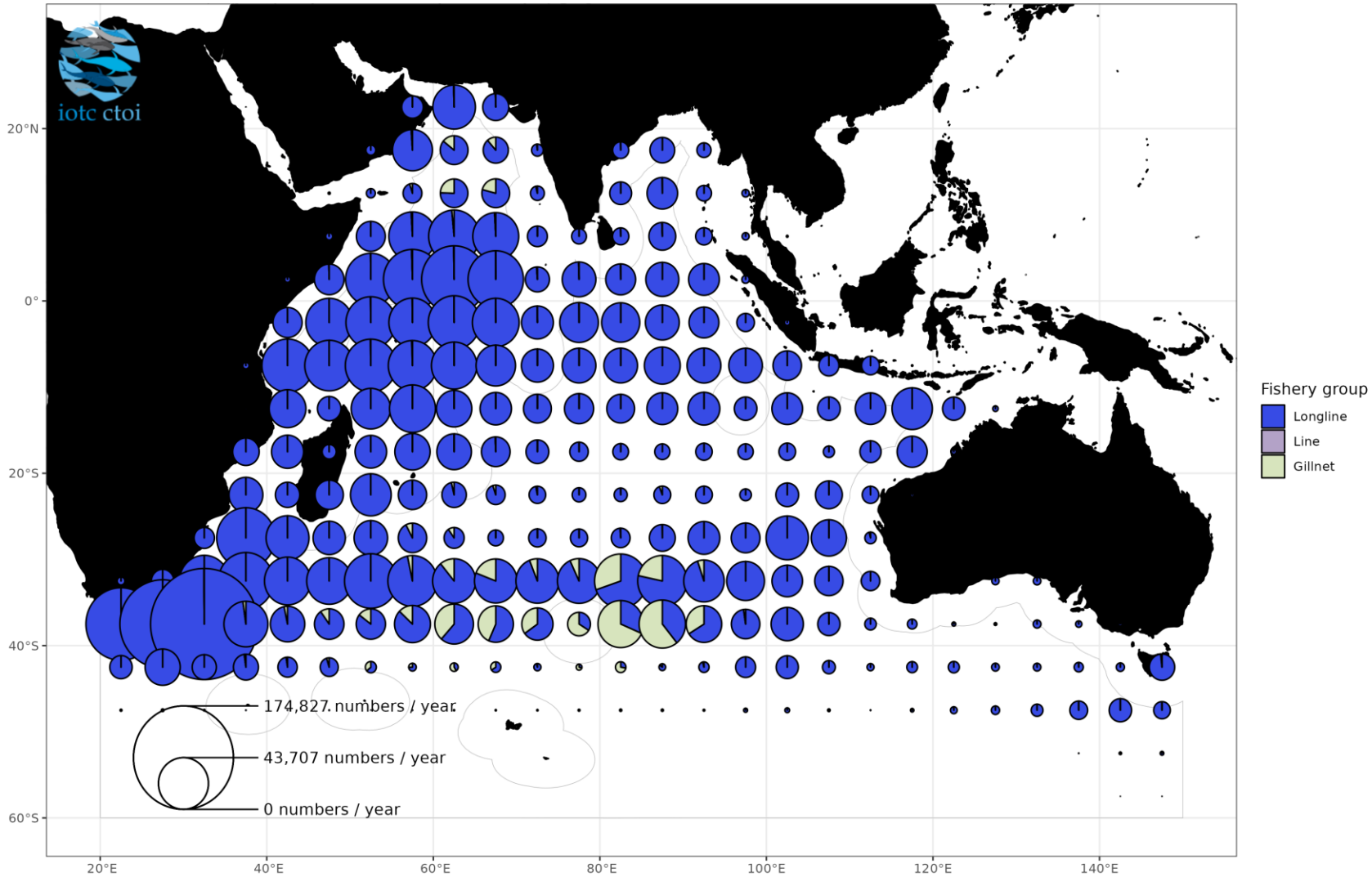


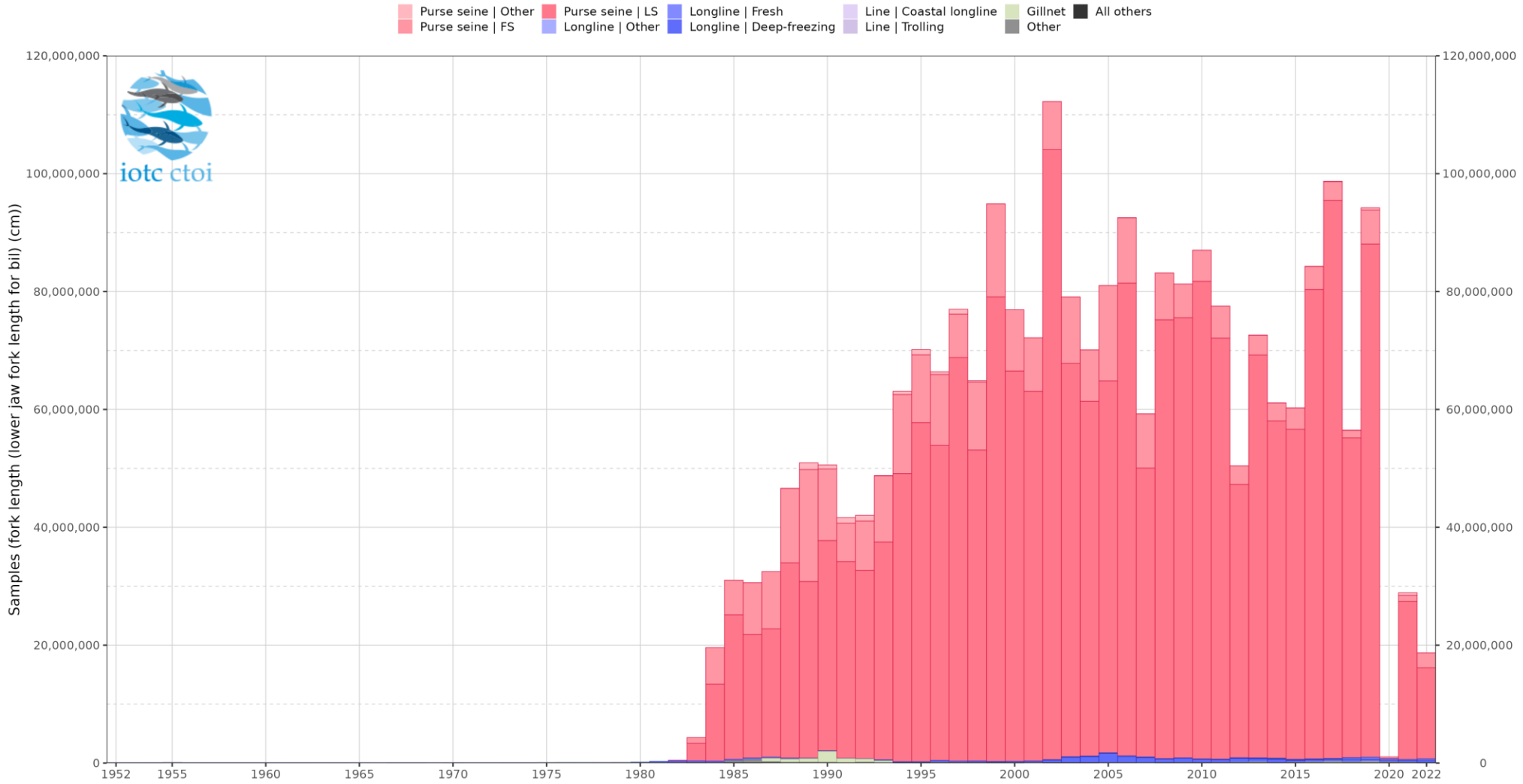
KNOWN LIMITS AND ISSUES

4-SF: Georeferenced monthly size-frequency data

1) Data quality and availability strongly dependent on the type of fishery and species
2) Use of non-standard areas, measurement types, and size bins for reporting
3) Discrepancies in geospatial information
4) Low coverage level, particularly for some artisanal fleets (less than 1 fish / t)
5) Potential bias (grading) in some historical data
6) Lack of *raw* samples (or samples overall) for important fisheries
7) L-W conversion equations need to be reviewed

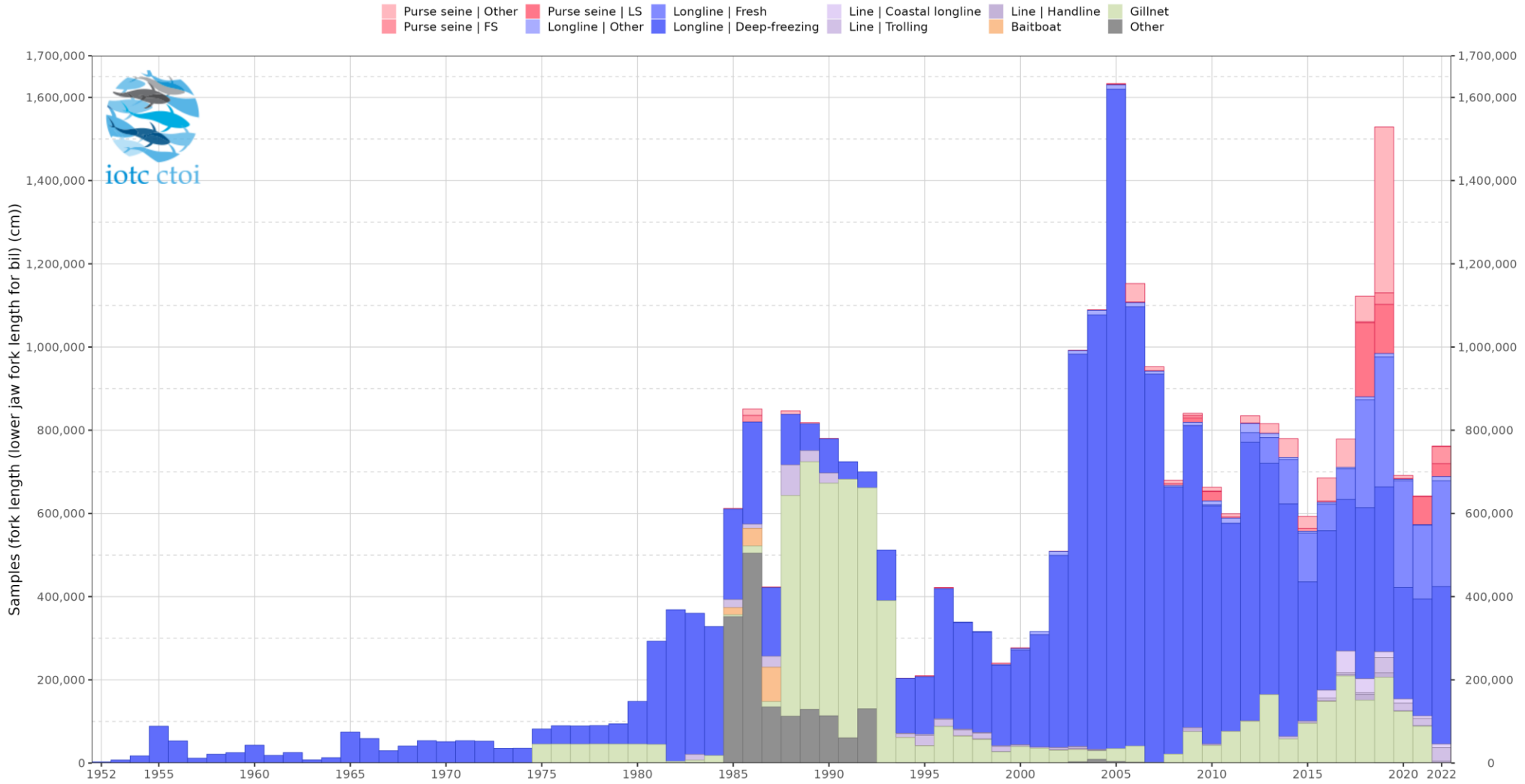
Yearly number of samples in fork length (lower jaw fork length for bil) (cm) by fishery (1952 - 2022)

Generated by IOTC from raw georeferenced size-frequencies on 2023-10-09 08:40:27 GMT. Data last updated on 2023-09-28



Yearly number of samples in fork length (lower jaw fork length for bil) (cm) by fishery (1952 - 2022 / OS + UNCL)

Generated by IOTC from raw georeferenced size-frequencies on 2023-10-09 08:40:50 GMT. Data last updated on 2023-09-28



Average yearly number of samples in fork length (lower jaw fork length for bil) (cm) by fishery (1952 - 2022 / SD)

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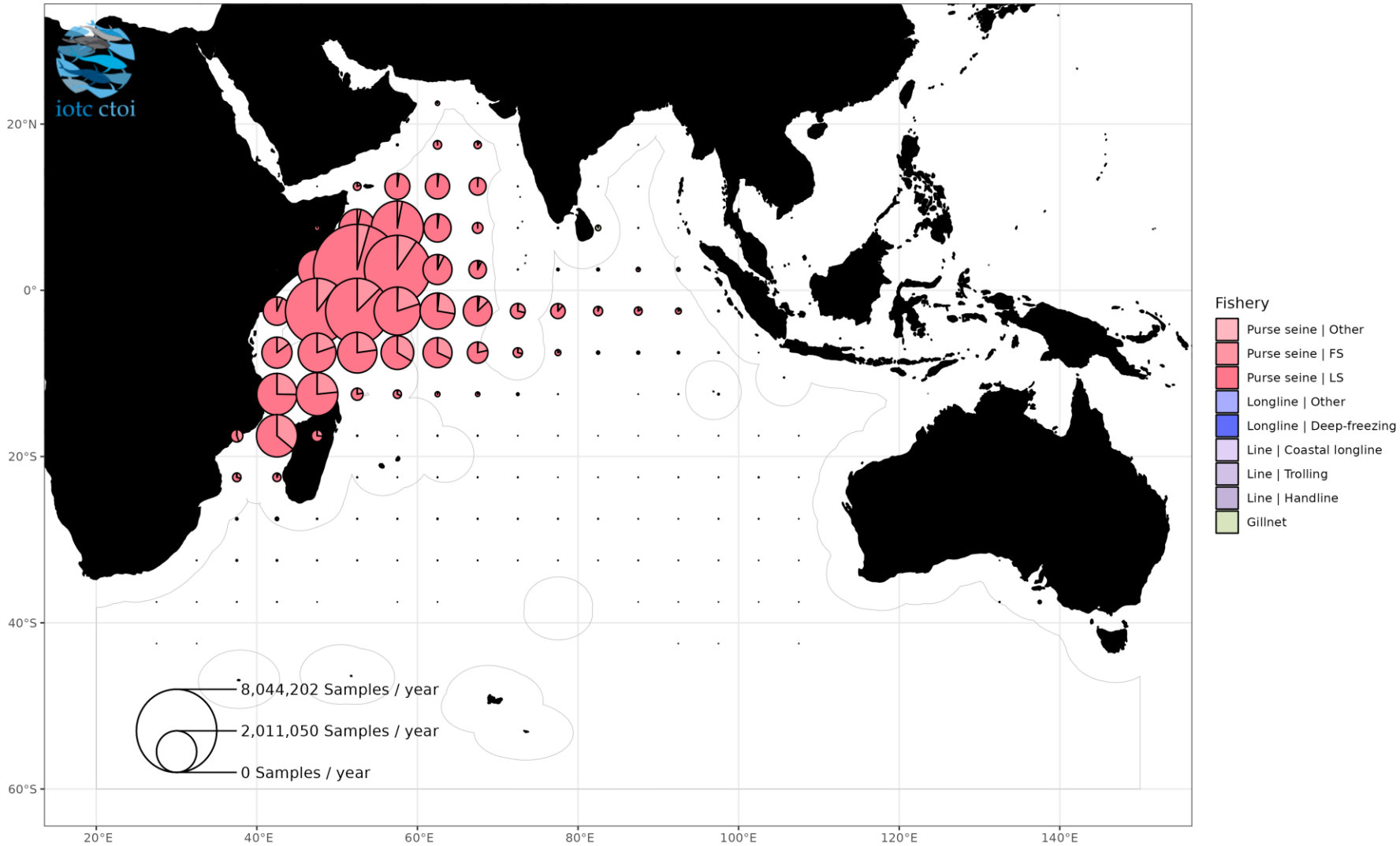

Average yearly number of samples in fork length (lower jaw fork length for bil) (cm) by fishery (1952 - 2022 / OS + UNCL)

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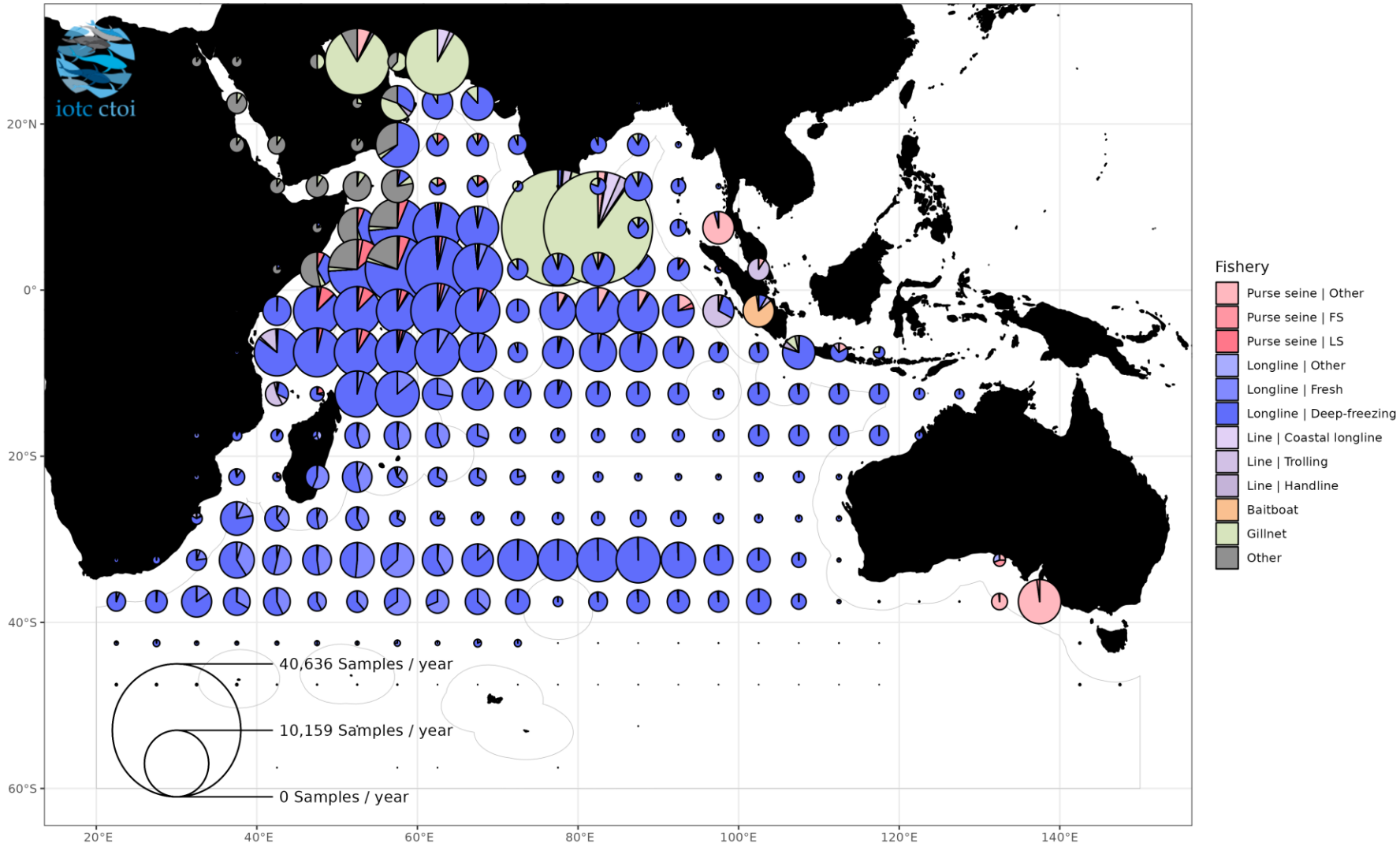
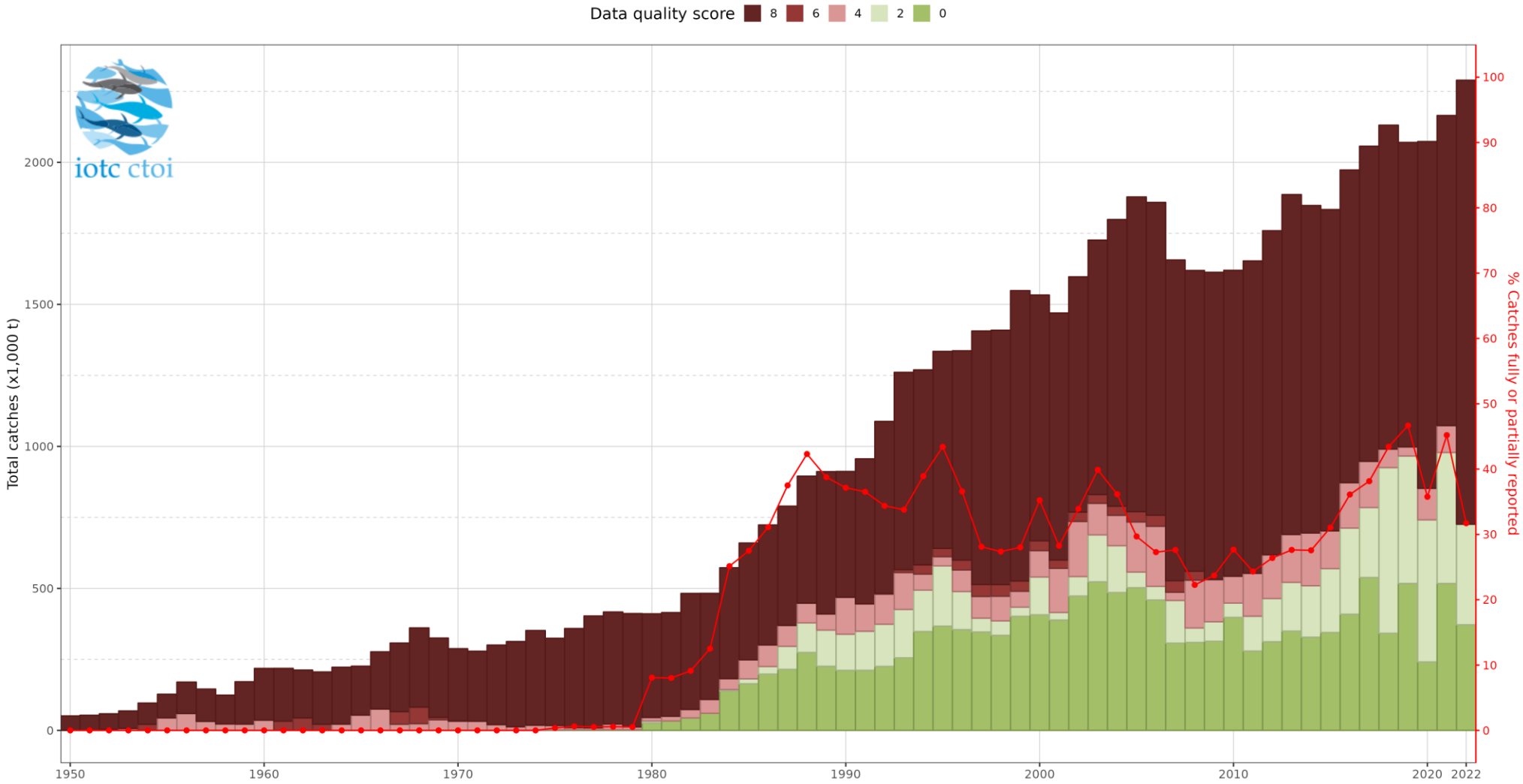


Yearly quality of raw georeferenced size-frequencies (1950 - 2022)

Generated by IOTC from raw nominal catches on 2023-10-09 08:38:38 GMT. Data last updated on 2023-09-28



METHODS

Fisheries data as originally reported by CPCs are often found to be:

- **Uncertain**
- **Incomplete**
- **Non standardized**
- ***Partially* spatialized**

For this reason, to support the request of the TCAC to estimate historical catches by fleet and *National Jurisdiction Area* (NJA), it is necessary to fully break down annual total catches by IO major area into finer scale regular grids (typically, 5°x5° in size) and assign these *spatialized* catches to the areas of interest (NJAs and high seas).

This is a **three-steps**, **heuristic** process which requires **expert knowledge** and several **assumptions**.

METHODS - *INPUT STANDARDIZATION*

All *raw* information is converted in standardized form:

1-RC: Retained catches → **1-RC$_{bse}$**: *Best scientific estimates*

- ✓Recovering missing information from alternative sources (e.g., FAO)
- ✓Repetition of previous years' data for non-reporting CPCs
- ✓Re-estimation of gear / species composition for some fleets (IOTC SC)
- ✓Filtering data to exclude non IOTC species
- ✓Disaggregation of remaining catches until these are all assigned to single gears and species (spatio-temporal proxies and expert knowledge)

METHODS - *INPUT STANDARDIZATION*

All *raw* information is converted in standardized form:

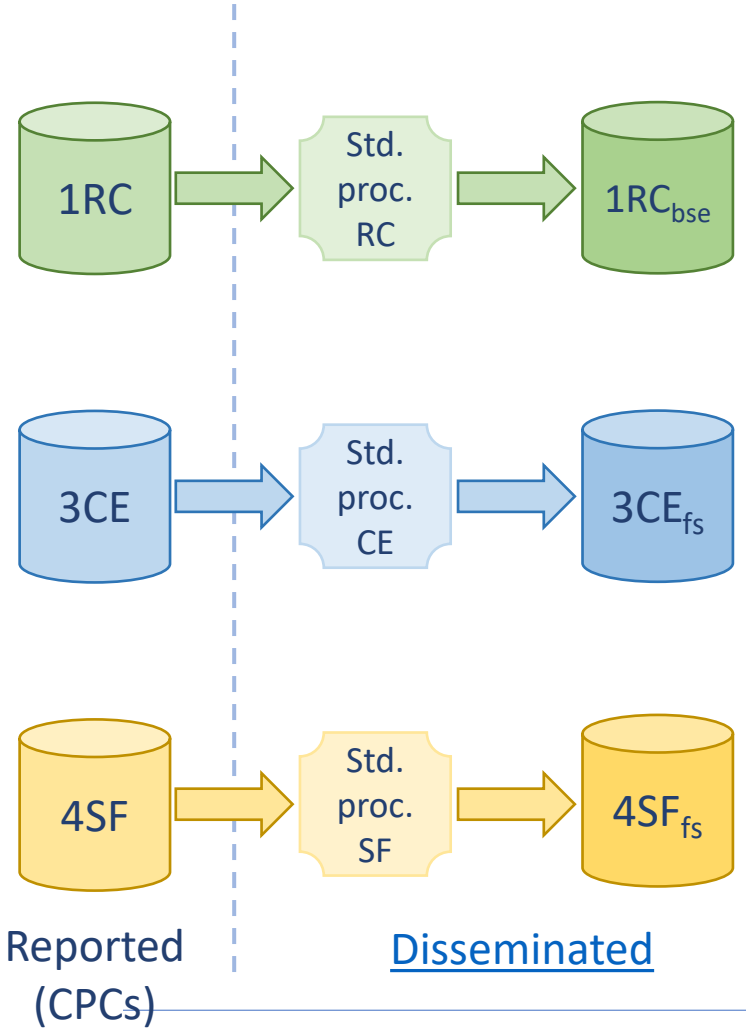
3-CE: Catch and effort → **3-CE$_{fs}$**: *Filtered, standardized catch and effort*

- ✓Removal of strata referencing gear or species aggregates
- ✓Irregular areas assigned to regular grids

4-SF: Size-frequency → **4-SF$_{fs}$**: *Filtered, standardized size-frequency*

- ✓Removal of strata referencing gear or species aggregates
- ✓Irregular areas assigned to regular grids
- ✓Standardization of lengths by default measure (FL, EF for some billfish)
- ✓Conversion of size bins into species-specific defaults

METHODS - *INPUT STANDARDIZATION*



METHODS - *INPUT STANDARDIZATION*

RC standardization

IO Area	Year	Fishery type	Gear code	Species code	Species	Catch (t)	% estimated by gear	% estimated by species
Western Indian Ocean	2021	IND	FLL	ALB	Albacore	0.67	0.00	0.00
Western Indian Ocean	2021	IND	FLL	BET	Bigeye tuna	24.30	0.00	0.00
Western Indian Ocean	2021	IND	FLL	BLM	Black Marlin	2.30	0.00	0.00
Western Indian Ocean	2021	IND	FLL	BUM	Blue Marlin	1.38	0.00	0.00
Western Indian Ocean	2021	IND	FLL	MLS	Striped marlin	0.34	0.00	0.00
Western Indian Ocean	2021	IND	FLL	SFA	Indo-Pacific sailfish	5.86	0.00	0.00
Western Indian Ocean	2021	IND	FLL	SWO	Swordfish	41.87	0.00	0.00
Western Indian Ocean	2021	IND	FLL	YFT	Yellowfin tuna	714.25	0.00	0.00
Western Indian Ocean	2021	ART	HAND	**BET**	Bigeye tuna	**0.52**	0.00	100.00
Western Indian Ocean	2021	ART	HAND	**KAW**	Kawakawa	**4.74**	0.00	100.00
Western Indian Ocean	2021	ART	**HAND**	**SFA**	Indo-Pacific sailfish	**0.51**	100.00	100.00
Western Indian Ocean	2021	ART	**HAND**	**YFT**	Yellowfin tuna	**42.96**	80.22	100.00

METHODS - *INPUT STANDARDIZATION*

CE standardization

Fleet	Gear	Year	MonthStart	MonthEnd	iGrid	Grid	Effort	EffortUnits	YFT-NO	YFT-MT	BET-NO	BET-MT	SKJ-NO	SKJ-MT	ALB-NO	ALB-MT	SBF-NO	SBF-MT	LOT-NO	LOT-MT
LKA	GIOF	2019	4	4	5100056	5100056	2	TRIPS						0.1						
SYC	LLCO	2019	3	3	5100056	5100056	4055	HOOKS		1.49										
SYC	LLCO	2008	9	9	5100056	5100056	970	HOOKS		0.2		0.05								
SYC	LLCO	2006	3	3	5100056	5100056	815	HOOKS		0.03										
OMN	GIHA	2000	1	1	BAKHA	**5125057**	1415	TRIPS		0.12										1.11
OMN	GIHA	2000	2	2	BAKHA	**5125057**	1282	TRIPS		0.48										0.03
OMN	GIHA	2000	3	3	BAKHA	**5125057**	1397	TRIPS		4.91										
OMN	GIHA	2000	4	4	BAKHA	**5125057**	2123	TRIPS		4.08										1131.65
OMN	GIHA	2000	5	5	BAKHA	**5125057**	1531	TRIPS												4.35
OMN	GIHA	2000	6	6	BAKHA	**5125057**	2620	TRIPS												26.18
TWN	GILL	1990	3	3	6240060	6240060	47555	NETS							**28110**	**275.84**				
TWN	GILL	1990	4	4	6240060	6240060	24910	NETS							**20094**	**197.18**				
TWN	GILL	1988	3	3	6240090	6240090	4190	NETS			1	0.02			**324**	**3.17**				
IRN	GILL	1994	1	1	JASK	**6125055**	542	FDAYS		22.17				16.18						4.38
IRN	GILL	1994	2	2	JASK	**6125055**	819	FDAYS												2.23
IRN	GILL	1994	4	4	JASK	**6125055**	1054	FDAYS		93.47				6.88						19.63
IRN	GILL	1994	5	5	JASK	**6125055**	2681	FDAYS		257.3				22.33						154.65
IRN	GILL	1994	10	10	JASK	**6125055**	1329	FDAYS		42.33				0.55						23.52
IRN	GILL	1994	11	11	JASK	**6125055**	686	FDAYS		7.84				0.61						10.75
IRN	GILL	1994	12	12	JASK	**6125055**	2206	FDAYS		47.2										3.94

METHODS - *INPUT STANDARDIZATION*

SF standardization

FLEET	YEAR	MONTH_S	MONTH_E	GRID	GEAR	SPECIES	SCHOOL	MEAS	1ST_CLASS	SIZE_INT	NO_FISH	KG_FISH	AVG_WGT	C001	C002	C...	C031	C032	C033	C034	C035	C036	C037	C038
JPN	2020	1	1	5201076	PSOB	SKJ	UNCL	FL	10	1	145	252.10	1.74	0	0	...	22	26	36	20	16	15	3	0
JPN	2020	1	1	5201081	PSOB	SKJ	UNCL	FL	10	1	144	234.42	1.63	0	0	...	43	33	9	7	4	7	0	2
JPN	2020	1	1	5201086	PSOB	SKJ	UNCL	FL	10	1	234	365.70	1.56	0	0	...	62	27	10	3	4	18	10	9
JPN	2020	1	1	5202079	PSOB	SKJ	UNCL	FL	10	1	270	439.23	1.63	0	0	...	70	51	22	16	8	11	3	6
JPN	2020	1	1	5202080	PSOB	SKJ	UNCL	FL	10	1	293	501.75	1.71	0	0	...	55	77	61	27	19	14	7	3
JPN	2020	1	1	5202082	PSOB	SKJ	UNCL	FL	10	1	236	527.14	2.23	0	0	...	27	34	12	24	15	23	17	10
JPN	2020	1	1	5202083	PSOB	SKJ	UNCL	FL	10	1	147	484.70	3.30	0	0	...	15	13	11	5	13	6	7	4
JPN	2020	1	1	5202086	PSOB	SKJ	UNCL	FL	10	1	188	519.00	2.76	0	0	...	7	9	16	19	23	23	19	15
JPN	2020	1	1	5203078	PSOB	SKJ	UNCL	FL	10	1	115	234.35	2.04	0	0	...	2	13	15	22	16	20	5	4
JPN	2020	1	1	5204075	PSOB	SKJ	UNCL	FL	10	1	337	693.33	2.06	0	0	...	16	25	54	62	41	51	30	20
JPN	2020	1	1	5205086	PSOB	SKJ	UNCL	FL	10	1	155	282.16	1.82	0	0	...	15	15	18	24	19	12	10	7
JPN	2020	1	1	6220040	LLOB	SKJ	UNCL	FL	10	1	4	41.43	10.36	0	0	...	0	0	0	0	0	0	0	0
JPN	2020	1	1	6225035	LLOB	SKJ	UNCL	FL	10	1	33	403.15	12.22	0	0	...	0	0	0	0	0	0	0	0
JPN	2020	1	1	6225040	LLOB	SKJ	UNCL	FL	10	1	15	204.24	13.62	0	0	...	0	0	0	0	0	0	0	0
JPN	2020	2	2	5101077	PSOB	SKJ	UNCL	FL	10	1	219	347.20	1.59	0	0	...	7	6	15	23	22	18	22	9
JPN	2020	2	2	5200089	PSOB	SKJ	UNCL	FL	10	1	217	357.28	1.65	0	0	...	39	34	29	24	18	17	8	2
JPN	2020	2	2	5202081	PSOB	SKJ	UNCL	FL	10	1	320	712.24	2.23	0	0	...	19	26	38	43	36	37	34	24
JPN	2020	2	2	5203090	PSOB	SKJ	UNCL	FL	10	1	401	1419.25	3.54	0	0	...	5	21	31	41	39	34	25	18
JPN	2020	2	2	5203092	PSOB	SKJ	UNCL	FL	10	1	360	706.16	1.96	0	0	...	19	35	59	64	60	44	39	15
JPN	2020	2	2	5204082	PSOB	SKJ	UNCL	FL	10	1	226	436.07	1.93	0	0	...	16	31	37	31	34	27	15	10
JPN	2020	2	2	5204091	PSOB	SKJ	UNCL	FL	10	1	571	1028.90	1.80	0	0	...	56	86	86	49	48	31	29	18
JPN	2020	2	2	5204092	PSOB	SKJ	UNCL	FL	10	1	258	459.91	1.78	0	0	...	30	42	31	30	26	20	17	7
JPN	2020	2	2	6225035	LLOB	SKJ	UNCL	FL	10	1	1	13.94	13.94	0	0	...	0	0	0	0	0	0	0	0
JPN	2020	3	3	5201081	PSOB	SKJ	UNCL	FL	10	1	223	465.98	2.09	0	0	...	5	9	14	32	38	27	29	22
JPN	2020	3	3	5206096	PSOB	SKJ	UNCL	FL	10	1	81	181.68	2.24	0	0	...	2	0	5	7	11	13	8	11
JPN	2020	3	3	5208094	PSOB	SKJ	UNCL	FL	10	1	194	456.15	2.35	0	0	...	7	17	9	30	15	16	14	16
JPN	2019	1	1	6215040	LLOB	SKJ	UNCL	FL	10	1	6	61.81	10.30	0	0	...	0	0	0	0	0	0	0	0
JPN	2019	2	2	6215040	LLOB	SKJ	UNCL	FL	10	1	10	104.90	10.49	0	0	...	0	0	0	0	0	0	0	0
JPN	2019	3	3	6210045	LLOB	SKJ	UNCL	FL	10	1	1	16.46	16.46	0	0	...	0	0	0	0	0	0	0	0
JPN	2019	4	4	6220100	LLOB	SKJ	UNCL	FL	10	1	1	12.78	12.78	0	0	...	0	0	0	0	0	0	0	0

METHODS - *CATCH RAISING AND SPATIALIZATION*

Proceeding from the outputs of the previous step:

- All data for species other than { ALB, BET, SKJ, SWO, YFT } are removed
- CE and SF records for strata with known issues are removed
- CE and SF records are further standardized by 5°x5° grid and month

At this stage, the goal is to further **break down the best scientific estimates ($1RC_{bse}$) by month and 5°x5° grid for the entire time series**.

Stratum: Year + *Month* + IO area + Fleet + Gear + *School type* + Species + 5°x5° grid

METHODS - *CATCH RAISING AND SPATIALIZATION*

Available time-area catches (CE) are assigned to strata in $1RC_{bse}$ as follows:

- *RC strata for which CE **exist**:*
  - ✓ *RC are assigned proportionally to the catches in CE to obtain catches by month / grid*
- *RC strata for which CE **do not exist**:*
  - *CE for the **same species** and **fleet** exist in a range of **up to ± 25 years***
    - ✓ *CE for the **closest 5 years** are averaged, and RC assigned proportionally to obtain catches by month / grid*
  - *CE for all **other species** and the **same fleet** exist for the **year of reference***
    - ✓ *CE recorded for the **year** are averaged, and RC assigned proportionally to obtain catches by month / grid*
  - *CE for all **other species** and the **same fleet** exist in a range of **up to ± 25 years***
    - ✓ *CE for the **closest 5 years** are averaged, and RC assigned proportionally to obtain catches by month / grid*

METHODS - *CATCH RAISING AND SPATIALIZATION*

*RC strata for which CE **do not exist** (continued):*

- *CE for the **same species** and an **alternative fleet** **with similar operations** exist in a range of **up to ± 25 years*** [industrial fisheries]
  - *CE for the **same species** and the **alternative fleet** exist for the **year of reference***
    - ✓ *CE for the **year** are averaged and RC are assigned proportionally to obtain catches by month / grid*
  - *CE for the **same species** and the **alternative fleet** exist in a range of **up to ± 25 years***
    - ✓ *CE are averaged, and RC assigned proportionally to obtain catches by month / grid*

METHODS - *CATCH RAISING AND SPATIALIZATION*

*RC strata for which CE **do not exist** (continued):*

- *CE for the **same species** from **any fleet** in **specific 5°x5° grids** exist in a range of **up to ± 25 years*** [artisanal fisheries]
  - ✓ *CE from **any fleet** recorded in the **specific 5°x5° grids** are averaged, and RC assigned proportionally to obtain catches by month / grid*
- ✓ *CE for the **fleet concerned** are **broken down by month and 5°x5°grid**, and RC assigned proportionally*

➢ At this stage, ***all strata in RC will have assigned CE records for the same stratum***, with CE that can be either in ***weight*** or in ***numbers*** (requires further processing).

METHODS - *CATCH RAISING AND SPATIALIZATION*

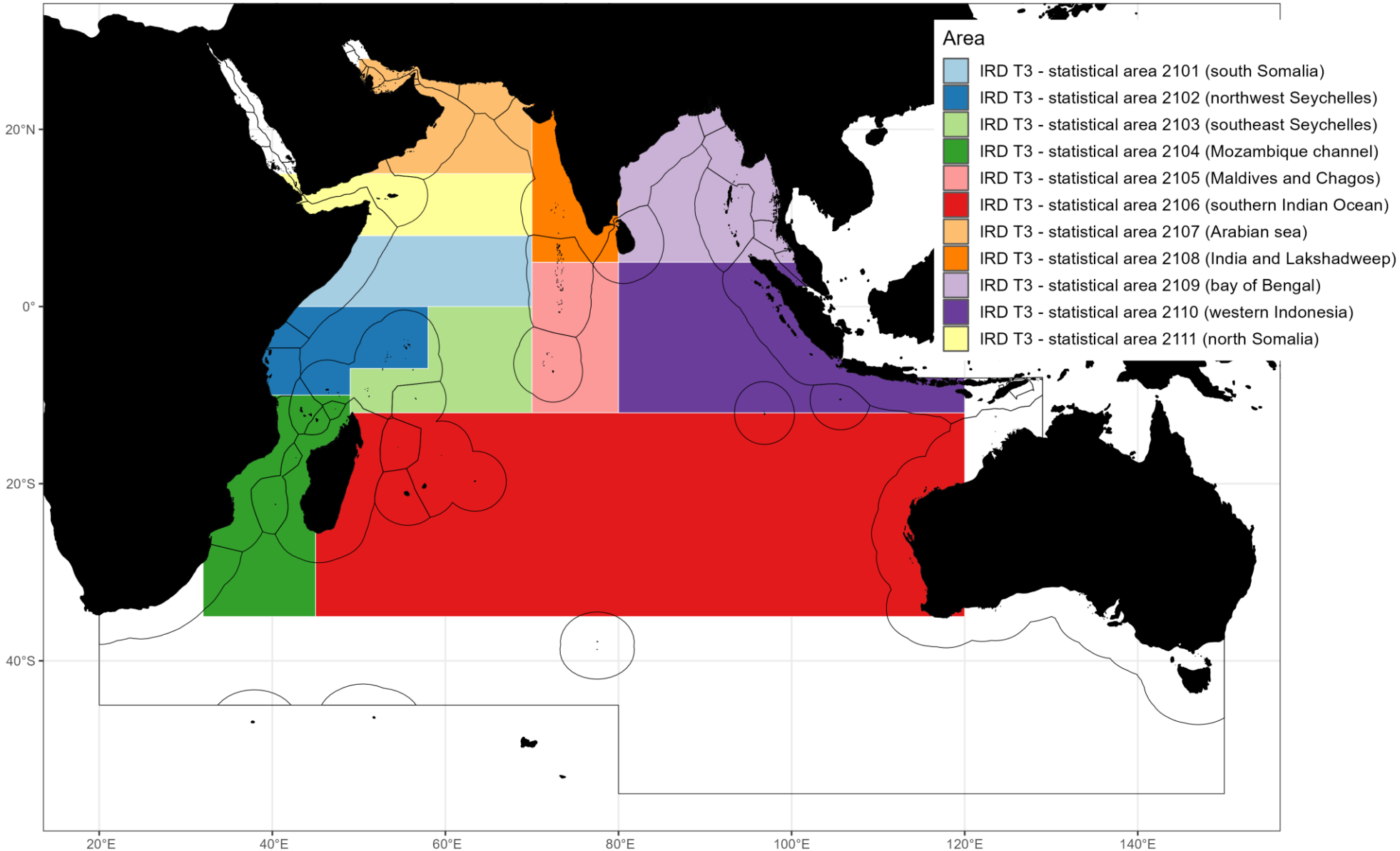
- CE strata with **catches in weight** are scaled up / down to ensure that they sum up to annual totals for the RC stratum they belong to

- CE strata with **catches in number** need to be converted in weights using available or proxy S-F data and L-W equations, and then scaled up / down (as above)

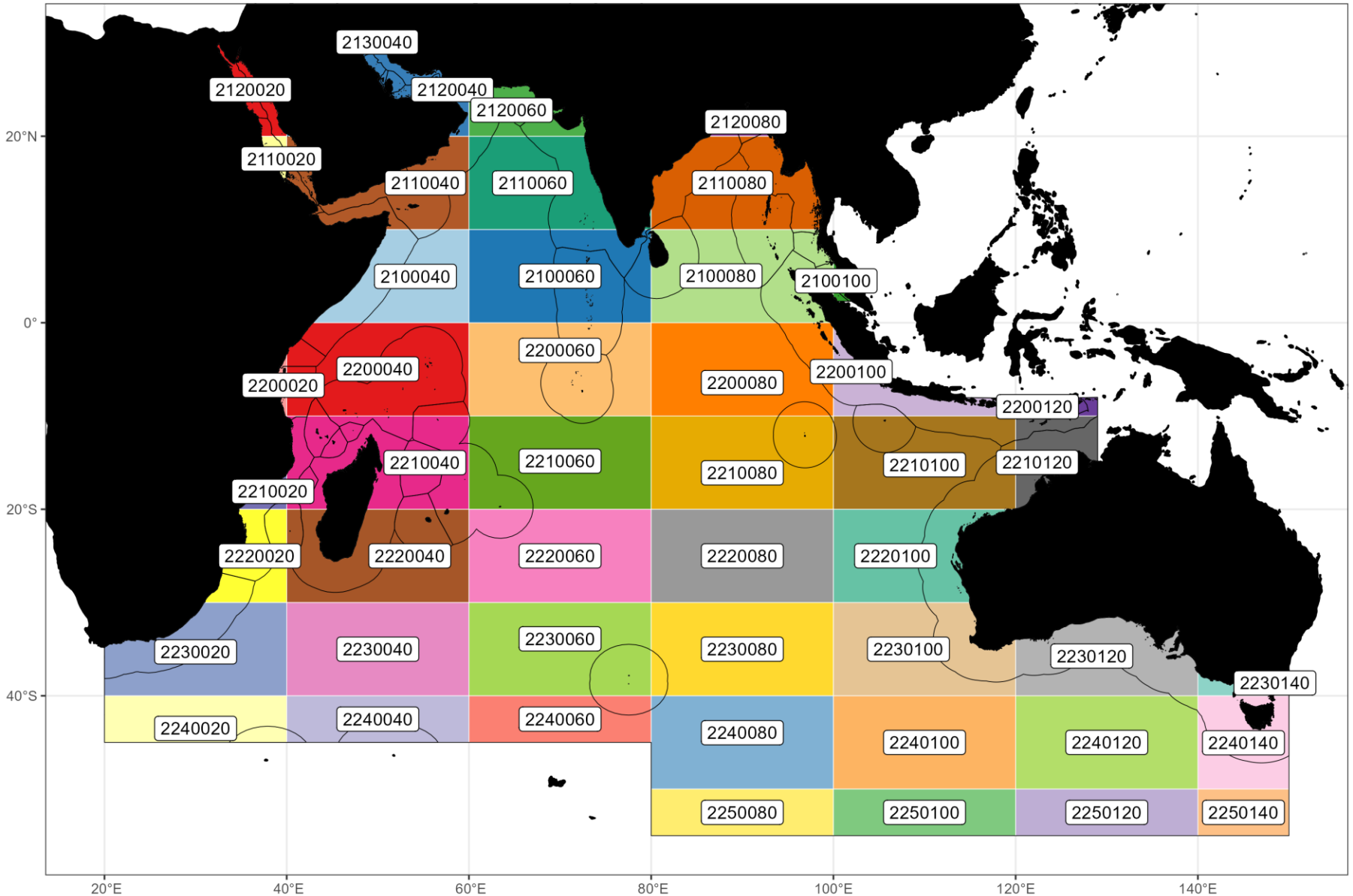
METHODS - *CATCH RAISING AND SPATIALIZATION*

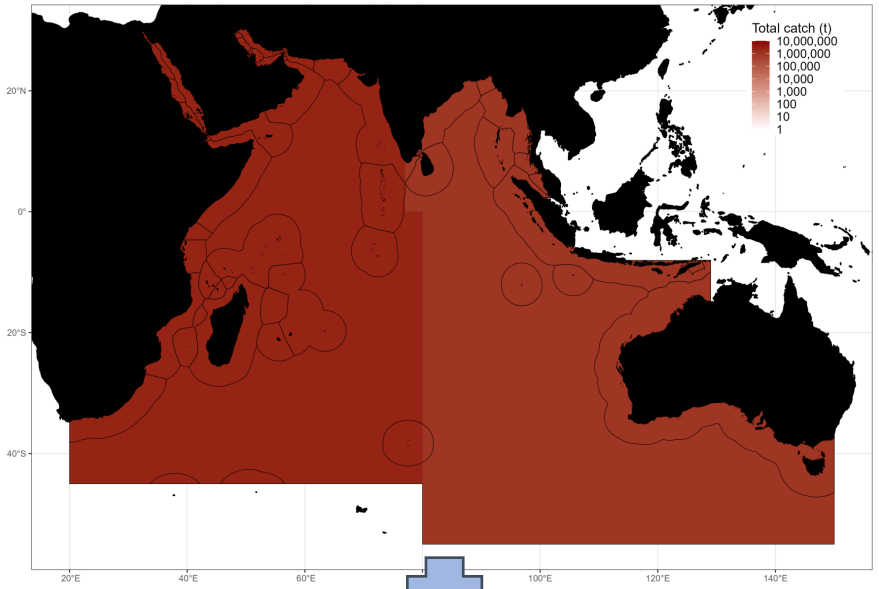
- Conversion of CE strata with catches in numbers follows a similar approach:
  - ✓If **size-frequency data is available for the stratum**, they are used – in combination with **L-W equations** for the species – to estimate the average weight of individuals and eventually convert *numbers* into *weight*
  - **Otherwise**, size-frequency data from **spatial-temporal proxies** are used, and these might depend on the type of fishery

S-F proxy areas for purse seine fisheries

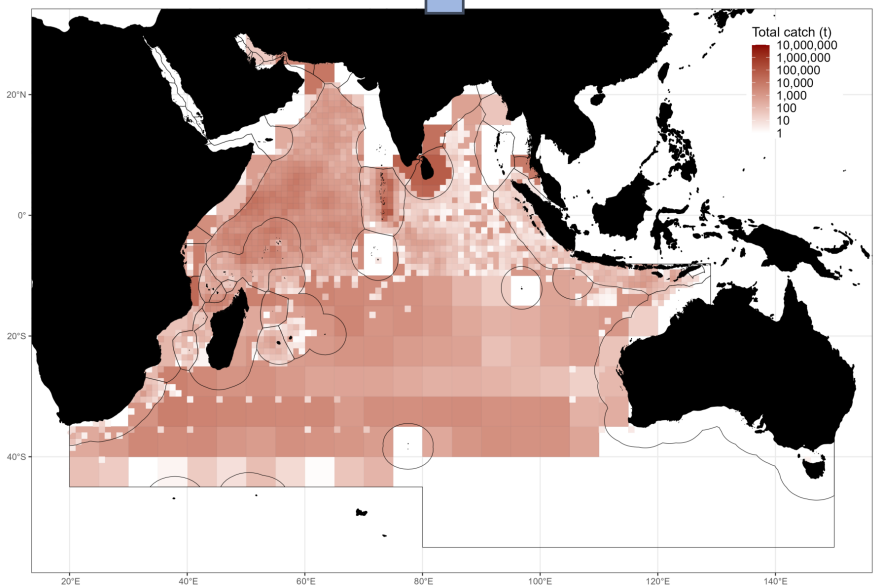


S-F proxy areas for all other fisheries



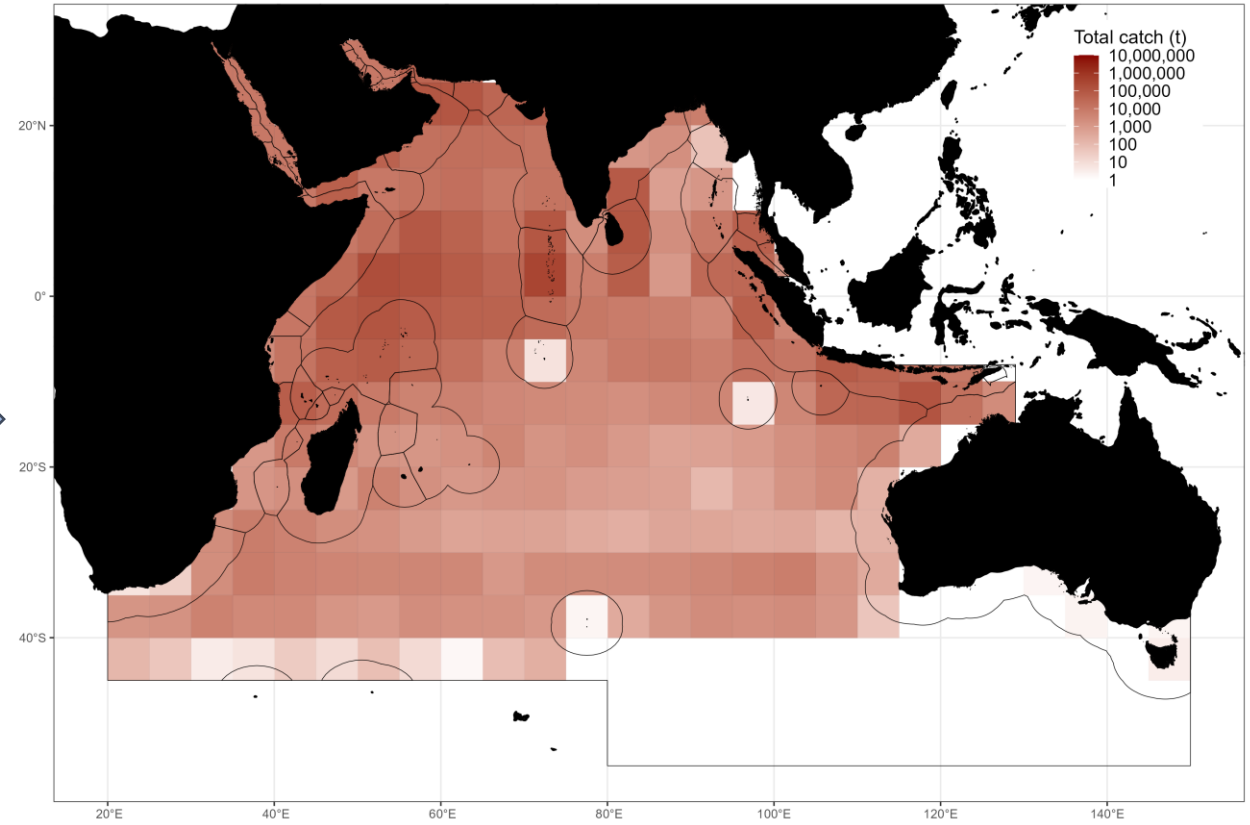


$1RC_{bse}$

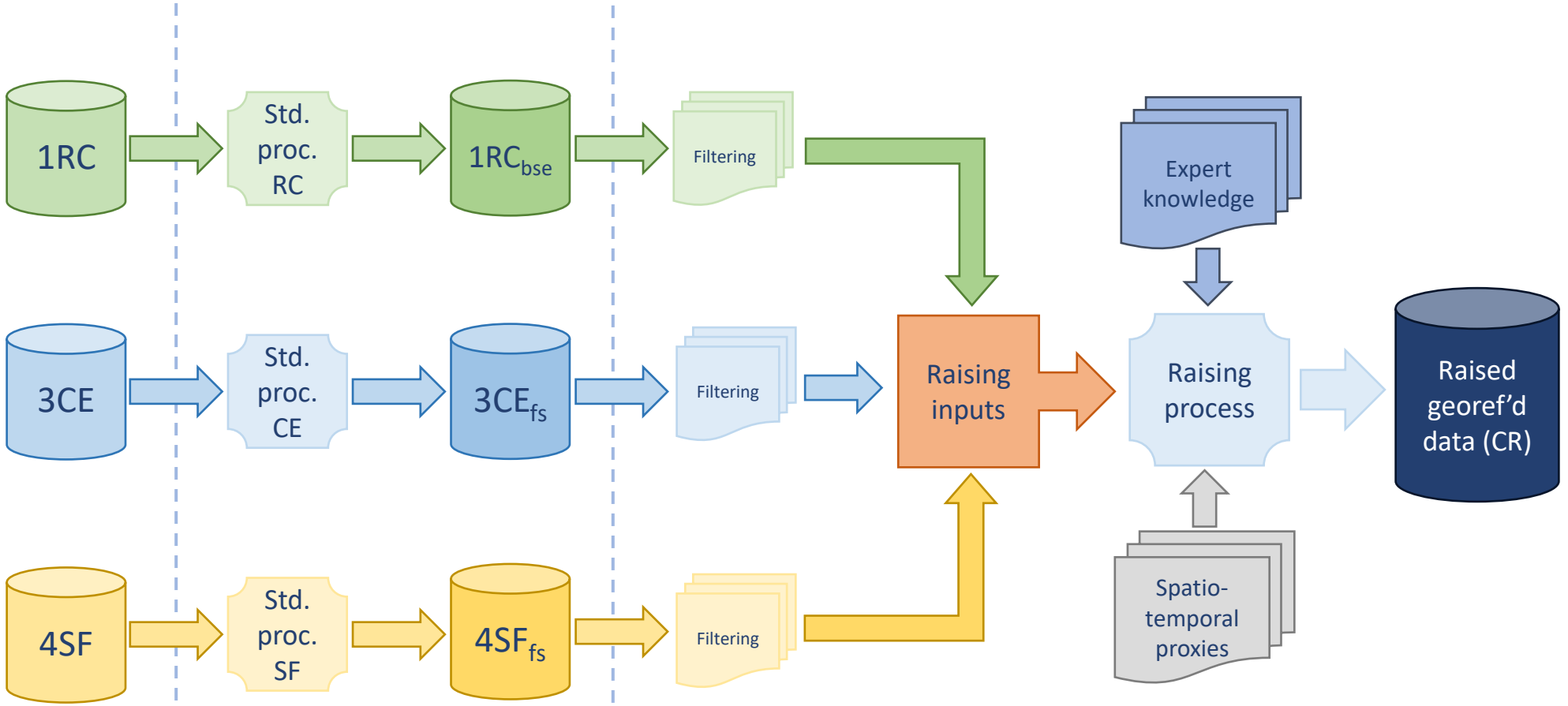


$3CE_{fs}$

CR



METHODS - *CATCH RAISING AND SPATIALIZATION*



METHODS - *ATTRIBUTION OF SPATIALIZED CATCHES*

- At the end of the raising process, each stratum in the raised georeferenced catch datasets (CR) contains an **estimate** of catches in weight *and* numbers

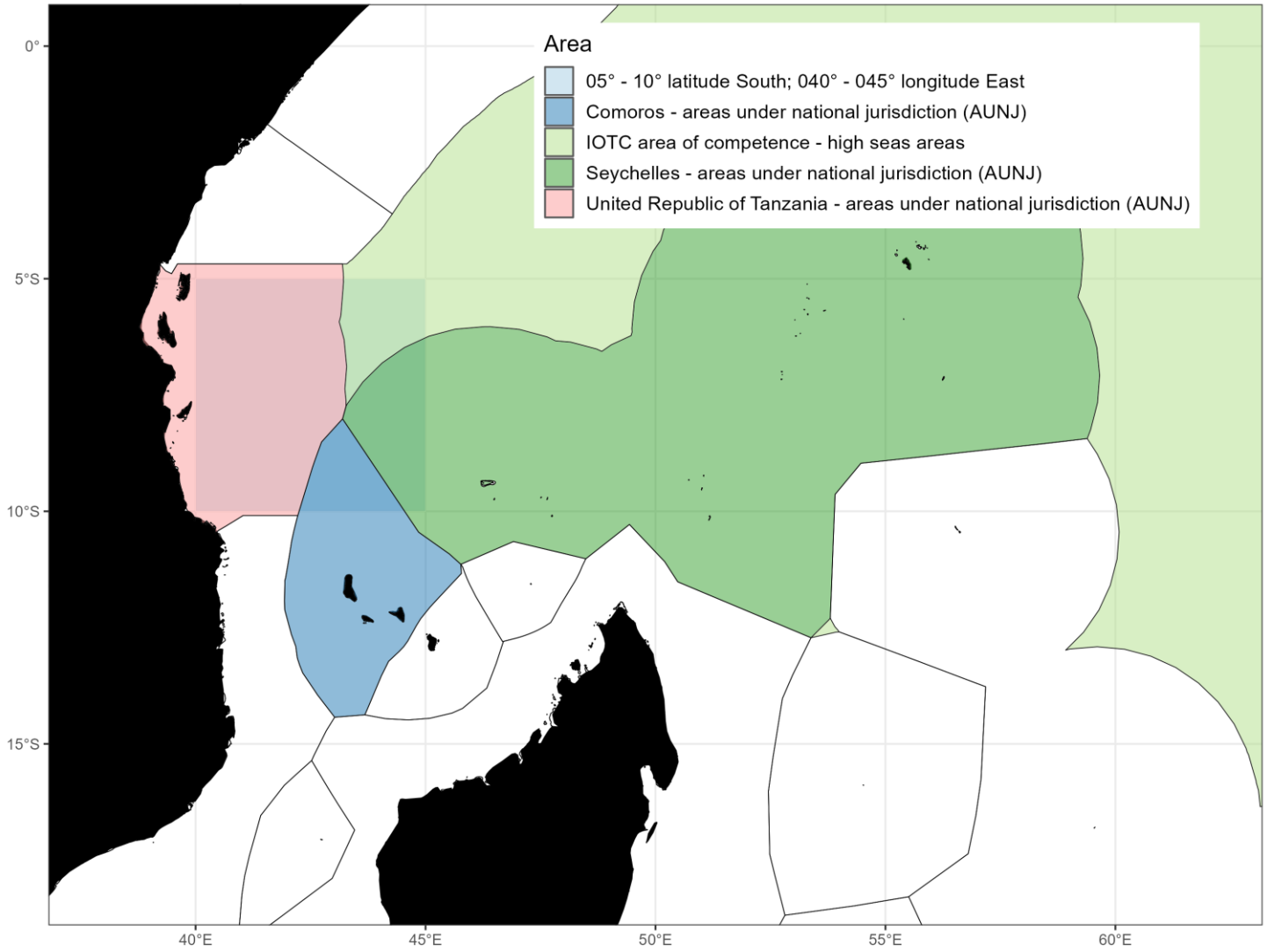
➢ ***Stratum*** here is defined as:

Year + *Month* + *IO area* + *Fleet* + *Gear* + *School type* + *Species* + 5°x5° *grid*

METHODS - *ATTRIBUTION OF SPATIALIZED CATCHES*

- Raised catches for **artisanal** (coastal) fisheries might be assigned to a 5°x5° grid that overlaps with other NJAs and / or the high seas
- By definition (Res. 15/02, footnote 1) **coastal fisheries only operate in the NJA of their flag state**

➢ This means that artisanal catches within such grids should be considered as solely harvested in the fraction of the grid that is **within the NJA of the flag state**


Area
05° - 10° latitude South; 040° - 045° longitude East
Comoros - areas under national jurisdiction (AUNJ)
IOTC area of competence - high seas areas
Seychelles - areas under national jurisdiction (AUNJ)
United Republic of Tanzania - areas under national jurisdiction (AUNJ)
0°
5°S
10°S
15°S
40°E
45°E
50°E
55°E
60°E

METHODS - *ATTRIBUTION OF SPATIALIZED CATCHES*

- All catches from *artisanal* fisheries of TZA estimated in the grid 05°-10° latitude South, 40°-45° longitude East are therefore **fully attributed to TZA** and **allocated to its NJA**
- Similarly, all catches from *artisanal* fisheries of COM / SYC estimated in that grid are fully attributed to COM / SYC and **allocated to their NJAs**
- Conversely, catches from *industrial* fisheries estimated in that grid remain **attributed to the flag state** and **proportionally allocated** to the high seas and the NJAs of TZA, COM, and SYC

METHODS - *ATTRIBUTION OF SPATIALIZED CATCHES*

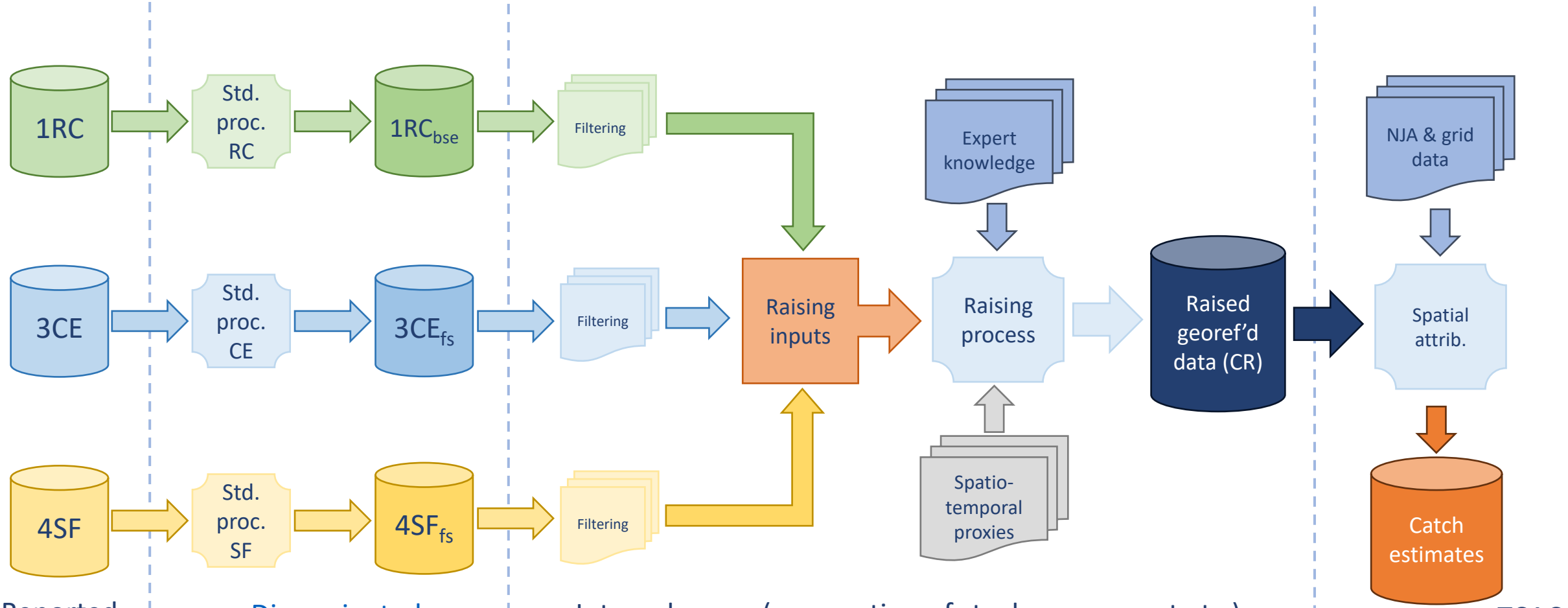
Grids to areas overlapping data

Grid	Area	Grid surface (KM²)	Area surface (KM²)	Overlapping area surface (KM²)	% of overlapping grid surface
6205040	NJA_COM	305,069	164,572	30,465	9.99%
6205040	NJA_SYC	305,069	1,332,252	52,295	17.14%
6205040	NJA_TZA	305,069	240,763	181,757	59.58%
6205040	IOTC_HIGH_SEAS	305,069	39,917,787	40,552	13.29%
…	…	…	…	…	…

Attribution of catches from grid to areas (using the above)

Type of fishery	Flag state	Grid	Catch (t)	Flag state	Area	Catch (t)
ART	TZA	6205040	**1,000.00**	TZA	NJA_TZA	**1,000.00**
ART	COM	6205040	**500.00**	COM	NJA_COM	**500.00**
ART	SYC	6205040	**2,000.00**	SYC	NJA_SYC	**2,000.00**
IND	SYC	6205040	**5,000.00**	SYC	NJA_TZA	2,978.95
					NJA_COM	499.32
					NJA_SYC	857.10
					HIGH_SEAS	664.63
…	…	…	…	…	…	…

METHODS - *ATTRIBUTION OF SPATIALIZED CATCHES*



RESULTS - *ATTRIBUTION OF SPATIALIZED CATCHES*

- At the end of this process, all estimated **catches by grid** are **assigned to one or more flag state / area** (either NJA or high seas) using the described methodology
- Results can be **aggregated by flag** (e.g., EU.FRA, EU.ESP, etc.) or by **fleet** (e.g., EUR)
- These outputs represent one of the **possible inputs** to further support the allocation

RESULTS - *ATTRIBUTION OF SPATIALIZED CATCHES*

Total by area / fleet | Total by fleet / area | Total by grid | Total by area | Density by area

Show 15 entries

Area	AUS	BGD	CHN	COM	EUR	FRAT	GBR	IDN	IND	IRN	JPN	KEN	KOR	LKA	MDG	MDV	MOZ	MUS
NJA_AUS	52,107.45 t		28,440.64 t		568.46 t		6.41 t	82,943.91 t	158.83 t	0.75 t	113,267.86 t	1.90 t	16,212.65 t	2.20 t	0.24 t			
NJA_BGD		7,298.96 t	885.65 t					445.46 t	33.50 t		58.95 t	0.97 t	27.77 t	54.35 t	0.06 t			
NJA_COM			8,670.32 t	339,975.41 t	93,672.68 t	3,955.85 t			77.65 t	1,948.65 t	21,326.01 t	3.83 t	8,367.94 t		67.68 t	3.00 t		374.96 t
NJA_ERI										51,095.15 t	1.23 t		9.28 t					
NJA_EUR			33,015.49 t		156,162.42 t	5,179.73 t	28.04 t		59.96 t	763.98 t	8,902.68 t	39.90 t	3,065.35 t		1,542.99 t	1.57 t		641.10 t
NJA_FRAT			60,996.53 t		106,952.85 t	10,676.41 t	47.72 t	1,356.21 t	449.05 t	1,656.26 t	41,770.74 t	75.22 t	16,365.78 t	2.29 t	2,829.81 t	6.45 t	297.25 t	1,216.42 t
NJA_IDN	3.63 t		57,764.19 t		1,261.90 t			3,645,729.54 t	253.55 t	23.79 t	101,302.12 t	1.40 t	20,667.46 t	96.04 t	0.20 t			22.33 t
NJA_IND			109,674.08 t		1,940.68 t			85,169.41 t	1,145,113.97 t	464.22 t	34,920.26 t	79.27 t	5,557.87 t	12,989.06 t	24.08 t	12,496.92 t		38.61 t
NJA_IRN			9,674.97 t		6,185.99 t				188.81 t	674,382.82 t	2.55 t		36.17 t	0.46 t	3.50 t	1.19 t		0.06 t
NJA_KEN			6,398.51 t		41,084.42 t	299.64 t			182.20 t	1,315.35 t	4,433.75 t	15,988.00 t	6,908.17 t		3.60 t	4.03 t		304.23 t
NJA_LKA			23,956.83 t		156.53 t			12,582.03 t	4,215.97 t	20.47 t	20,513.54 t	22.71 t	5,838.84 t	2,965,948.79 t	1.19 t	115.35 t		11.46 t
NJA_MDG			98,396.07 t		307,205.90 t	6,833.69 t	775.81 t		560.67 t	3,019.73 t	69,808.41 t	76.16 t	19,720.04 t		84,141.14 t	7.59 t	22.80 t	1,471.07 t
NJA_MDV			62,403.27 t		9,966.95 t	81.55 t			1,115.14 t	1,465.14 t	43,105.15 t	86.20 t	19,539.32 t	6,581.03 t	3.56 t	4,413,881.50 t		2,530.09 t
NJA_MOZ			23,054.49 t		107,819.61 t	4,315.67 t	172.64 t		109.50 t	2,369.28 t	80,582.67 t	4.07 t	11,741.96 t		492.44 t	3.36 t	8,432.31 t	1,801.30 t
NJA_MUS			130,783.31 t		94,049.63 t	5,762.61 t	108.13 t		1,527.41 t	1,494.70 t	42,015.35 t	245.89 t	39,427.30 t	10.21 t	247.96 t	25.12 t		19,355.57 t

Showing 1 to 15 of 37 entries Previous 1 2 3 Next

RESULTS - *ATTRIBUTION OF SPATIALIZED CATCHES*

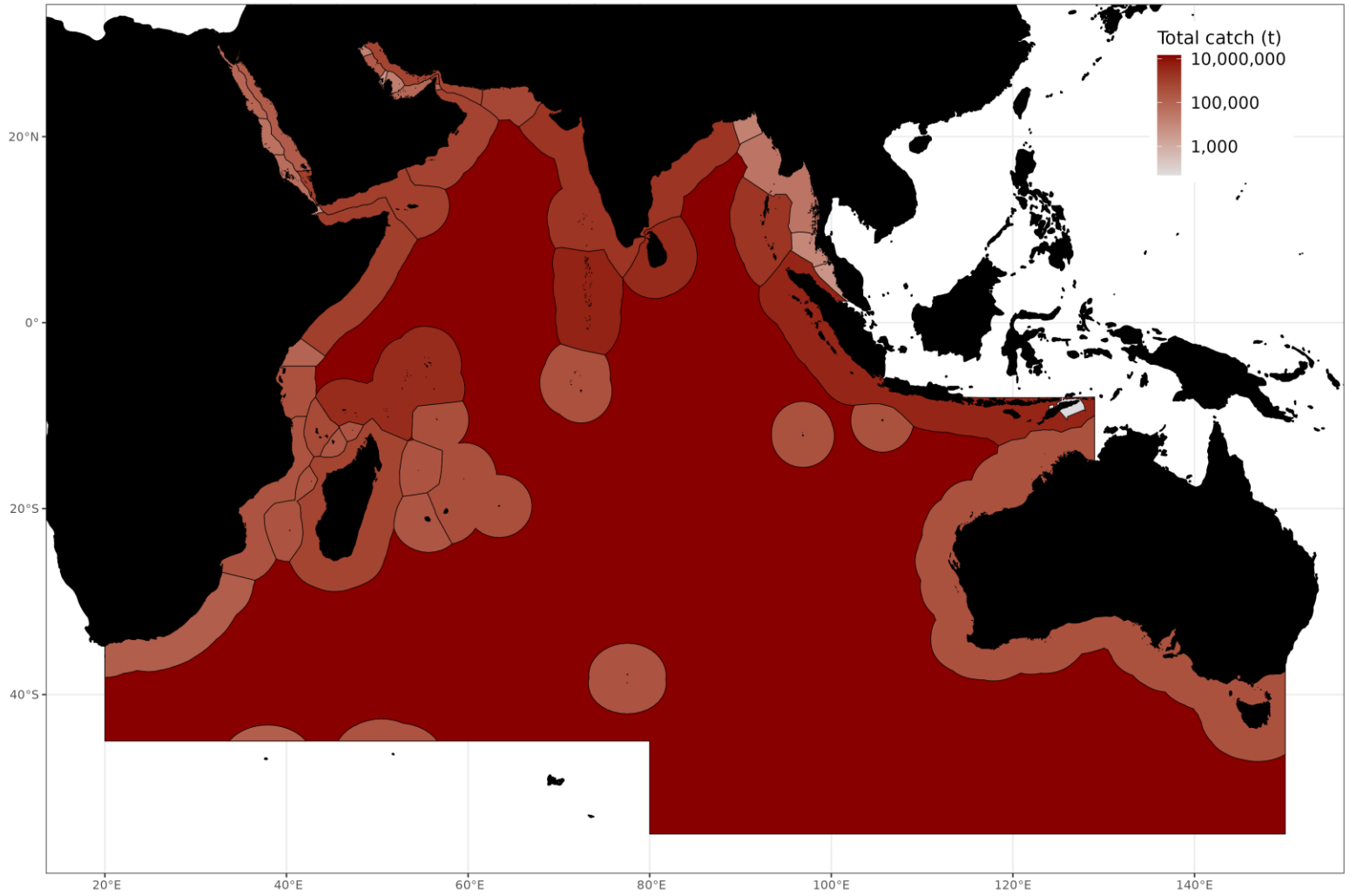
Total by area / fleet | Total by fleet / area | Total by grid | Total by area | Density by area

Show 15 entries

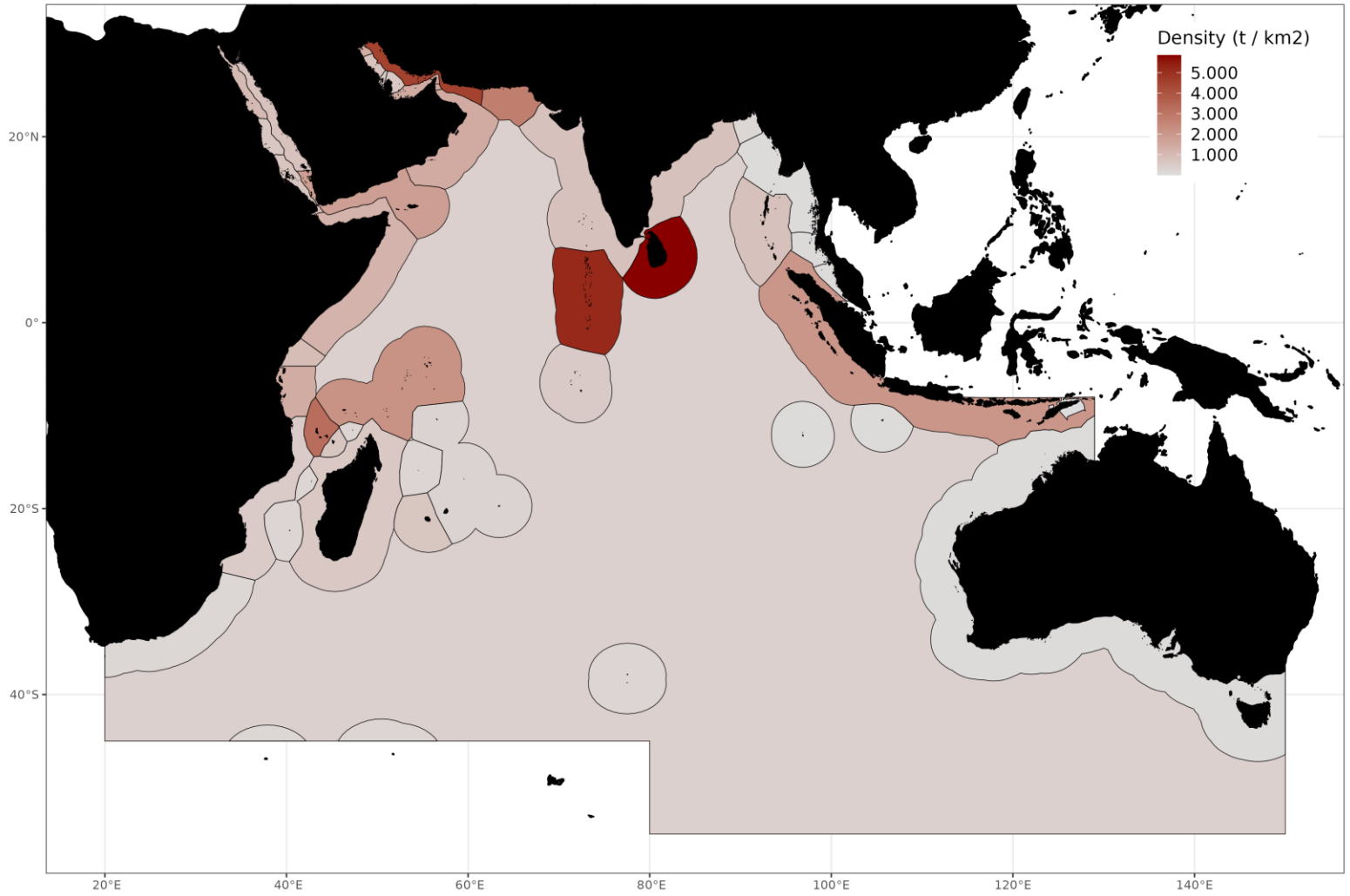
Fleet code	NJA_AUS	NJA_BGD	NJA_COM	NJA_ERI	NJA_EUR	NJA_FRAT	NJA_IDN	NJA_IND	NJA_IRN	NJA_KEN	NJA_LKA	NJA_MDG	NJA_MDV	NJA_MOZ	NJA_MUS	NJA_MYS	NJA_OMN
AUS	52,107.45 t						3.63 t										
BGD		7,298.96 t															
CHN	28,440.64 t	885.65 t	8,670.32 t		33,015.49 t	60,996.53 t	57,764.19 t	109,674.08 t	9,674.97 t	6,398.51 t	23,956.83 t	98,396.07 t	62,403.27 t	23,054.49 t	130,783.31 t	451.52 t	114,814.68 t
COM			339,975.41 t														
EUR	568.46 t		93,672.68 t		156,162.42 t	106,952.85 t	1,261.90 t	1,940.68 t	6,185.99 t	41,084.42 t	156.53 t	307,205.90 t	9,966.95 t	107,819.61 t	94,049.63 t		4,485.34 t
FRAT			3,955.85 t		5,179.73 t	10,676.41 t				299.64 t		6,833.69 t	81.55 t	4,315.67 t	5,762.61 t		
GBR	6.41 t				28.04 t	47.72 t						775.81 t		172.64 t	108.13 t		
IDN	82,943.91 t	445.46 t				1,356.21 t	3,645,729.54 t	85,169.41 t			12,582.03 t					1,586.81 t	
IND	158.83 t	33.50 t	77.65 t		59.96 t	449.05 t	253.55 t	1,145,113.97 t	188.81 t	182.20 t	4,215.97 t	560.67 t	1,115.14 t	109.50 t	1,527.41 t	1.47 t	2,619.43 t
IRN	0.75 t		1,948.65 t	51,095.15 t	763.98 t	1,656.26 t	23.79 t	464.22 t	674,382.82 t	1,315.35 t	20.47 t	3,019.73 t	1,465.14 t	2,369.28 t	1,494.70 t	0.05 t	155,655.60 t
JPN	113,267.86 t	58.95 t	21,326.01 t	1.23 t	8,902.68 t	41,770.74 t	101,302.12 t	34,920.26 t	2.55 t	4,433.75 t	20,513.54 t	69,808.41 t	43,105.15 t	80,582.67 t	42,015.35 t	90.97 t	878.36 t
KEN	1.90 t	0.97 t	3.83 t		39.90 t	75.22 t	1.40 t	79.27 t		15,988.00 t	22.71 t	76.16 t	86.20 t	4.07 t	245.89 t	0.01 t	0.93 t
KOR	16,212.65 t	27.77 t	8,367.94 t	9.28 t	3,065.35 t	16,365.78 t	20,667.46 t	5,557.87 t	36.17 t	6,908.17 t	5,838.84 t	19,720.04 t	19,539.32 t	11,741.96 t	39,427.30 t	138.89 t	1,202.27 t
LKA	2.20 t	54.35 t				2.29 t	96.04 t	12,989.06 t	0.46 t		2,965,948.79 t		6,581.03 t		10.21 t		13.11 t
MDG	0.24 t	0.06 t	67.68 t		1,542.99 t	2,829.81 t	0.20 t	24.08 t	3.50 t	3.60 t	1.19 t	84,141.14 t	3.56 t	492.44 t	247.96 t		36.72 t

Showing 1 to 15 of 29 entries Previous 1 2 Next

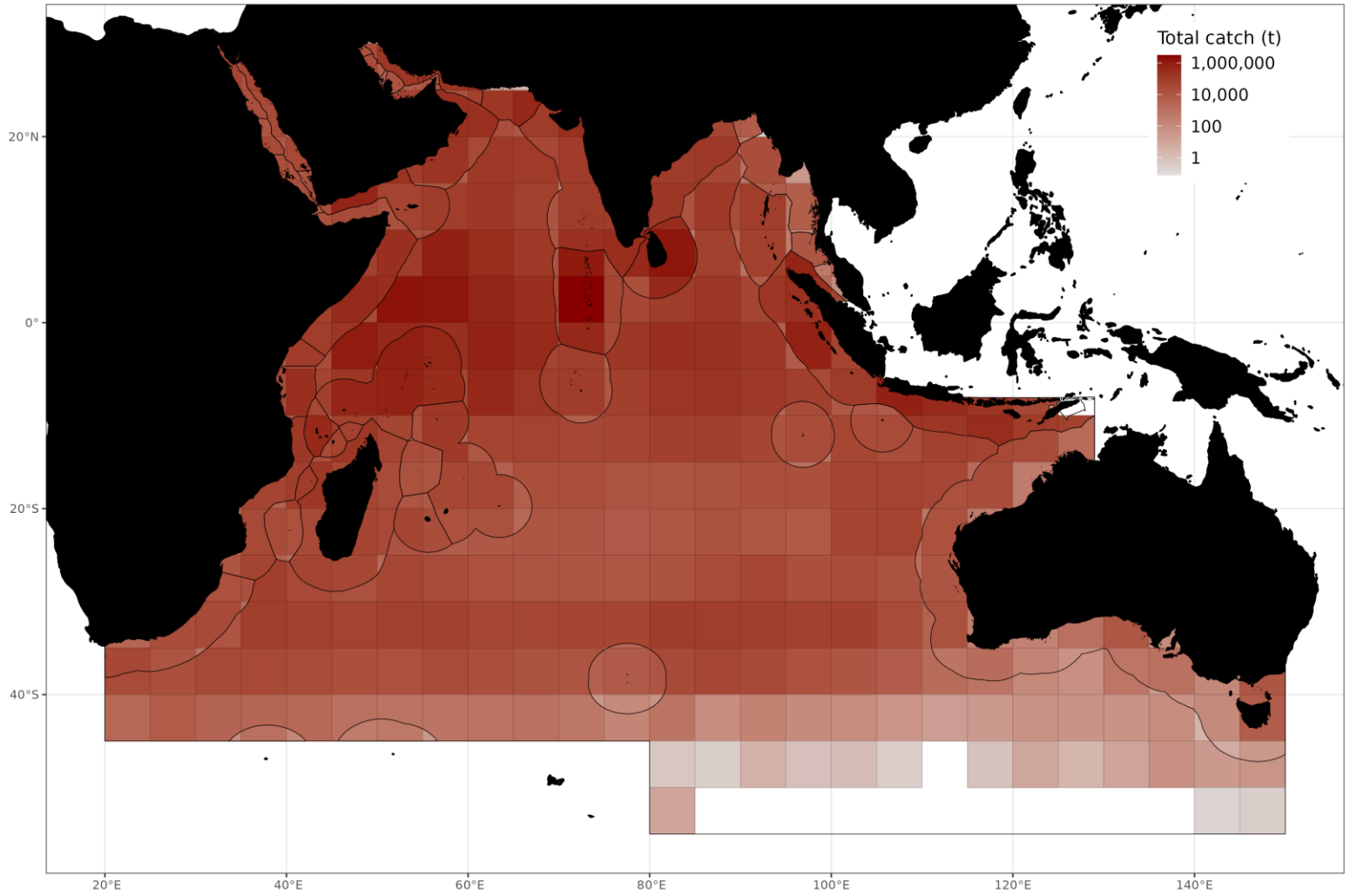
RESULTS - *CATCH ATTRIBUTION BY AREA*



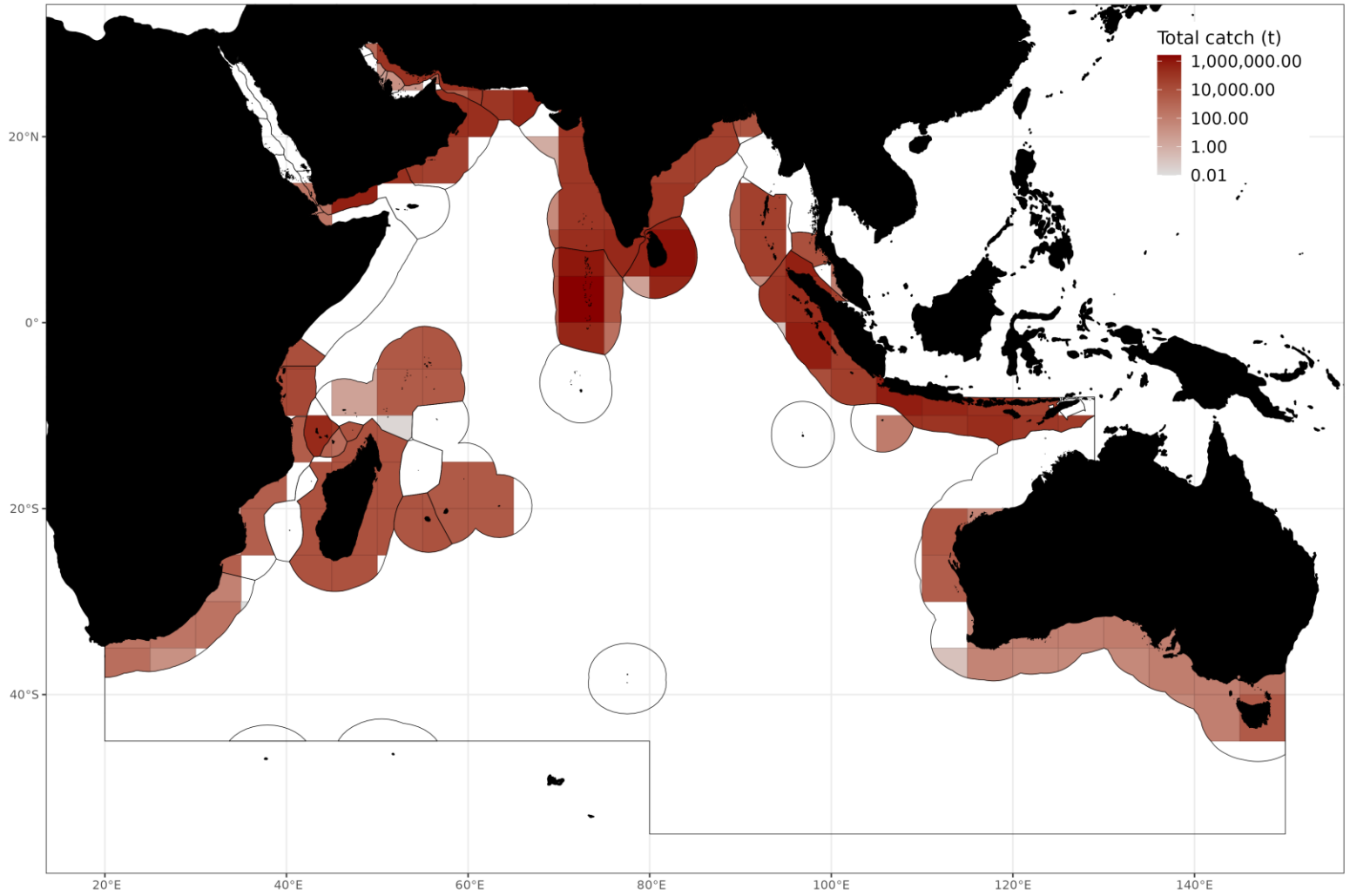
RESULTS - *CATCH ATTRIBUTION BY AREA (DENSITY)*



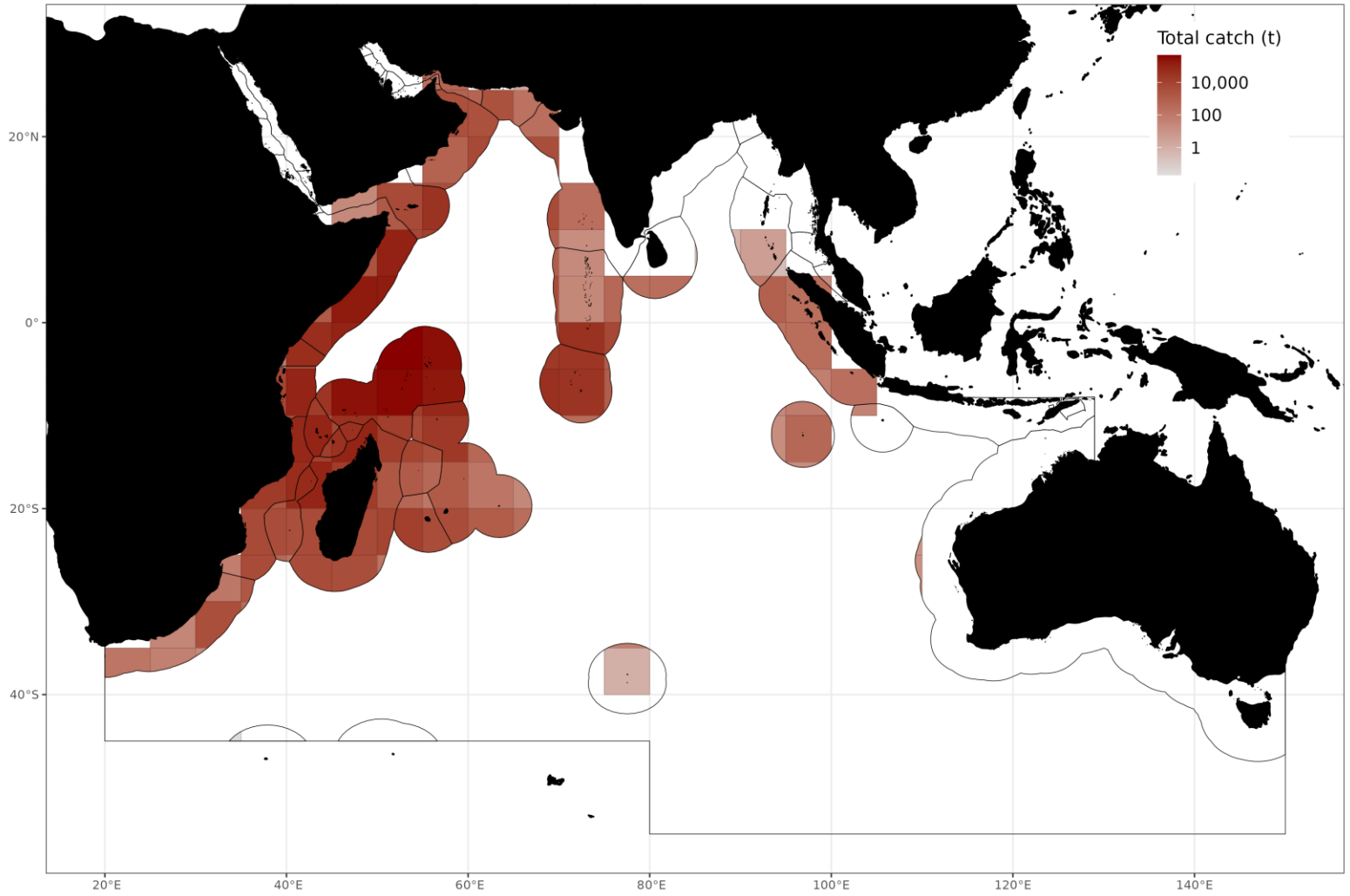
RESULTS - *CATCH ATTRIBUTION BY GRID*



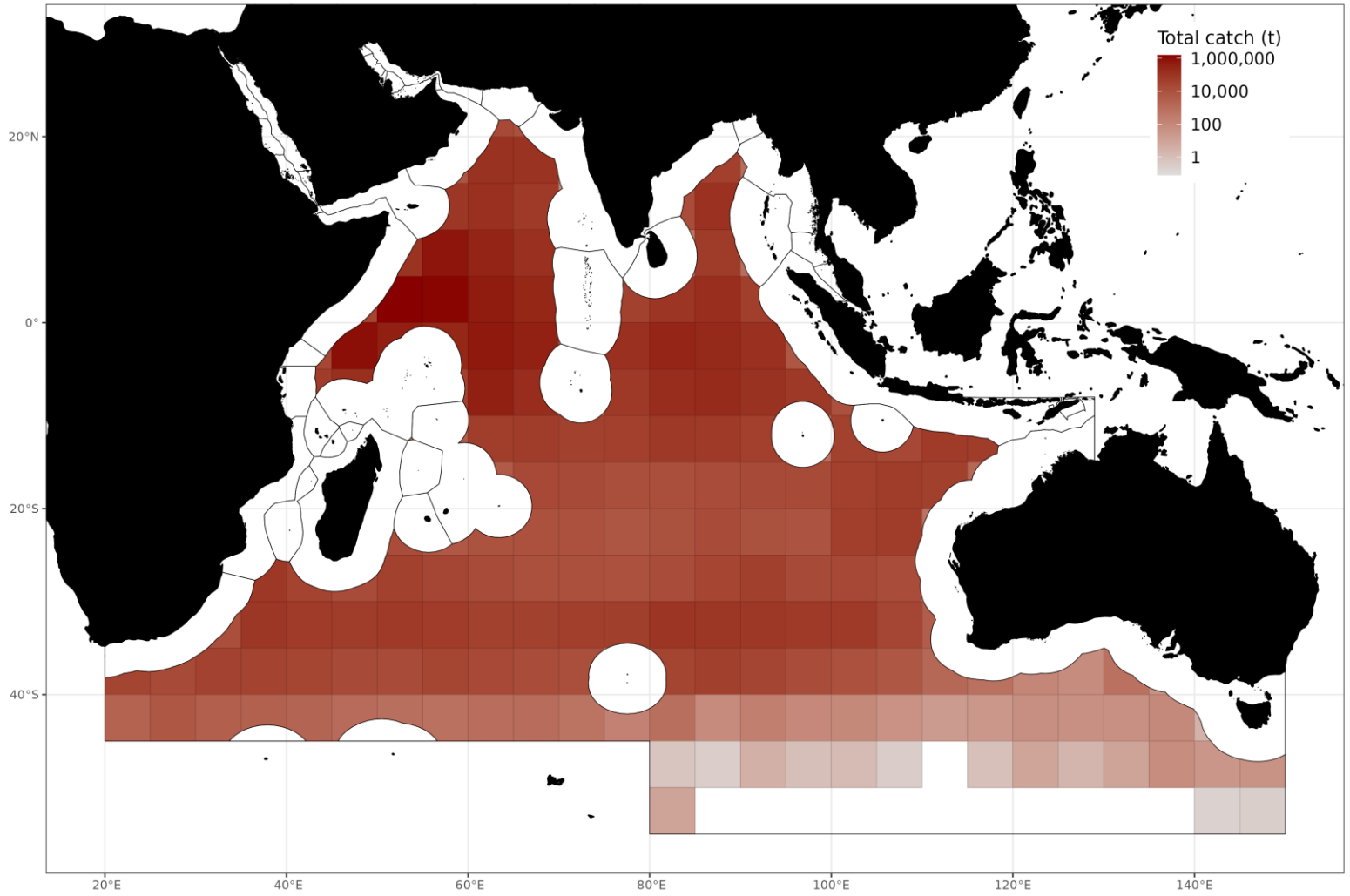
RESULTS - *CATCH ATTRIBUTION BY GRID (ARTISANAL)*



RESULTS - *CATCH ATTRIBUTION BY GRID (INDUSTRIAL)*



RESULTS - *CATCH ATTRIBUTION BY GRID (INDUSTRIAL)*



RESULTS - *CAVEATS*

- The default size of the grids (5°x5°) in the raised catches dataset is such that very few of these fall entirely within a given NJA
- For this reason, several grids that overlap with the high seas might have a significant part of their surface within the NJA of one or more coastal states
  - A side effect is that a given fleet might be estimated as fishing within an NJA of a coastal state, whereas the fleet was instead only fishing in the high seas area of such grids

Reference data | Estimated catches

Selected AUNJs

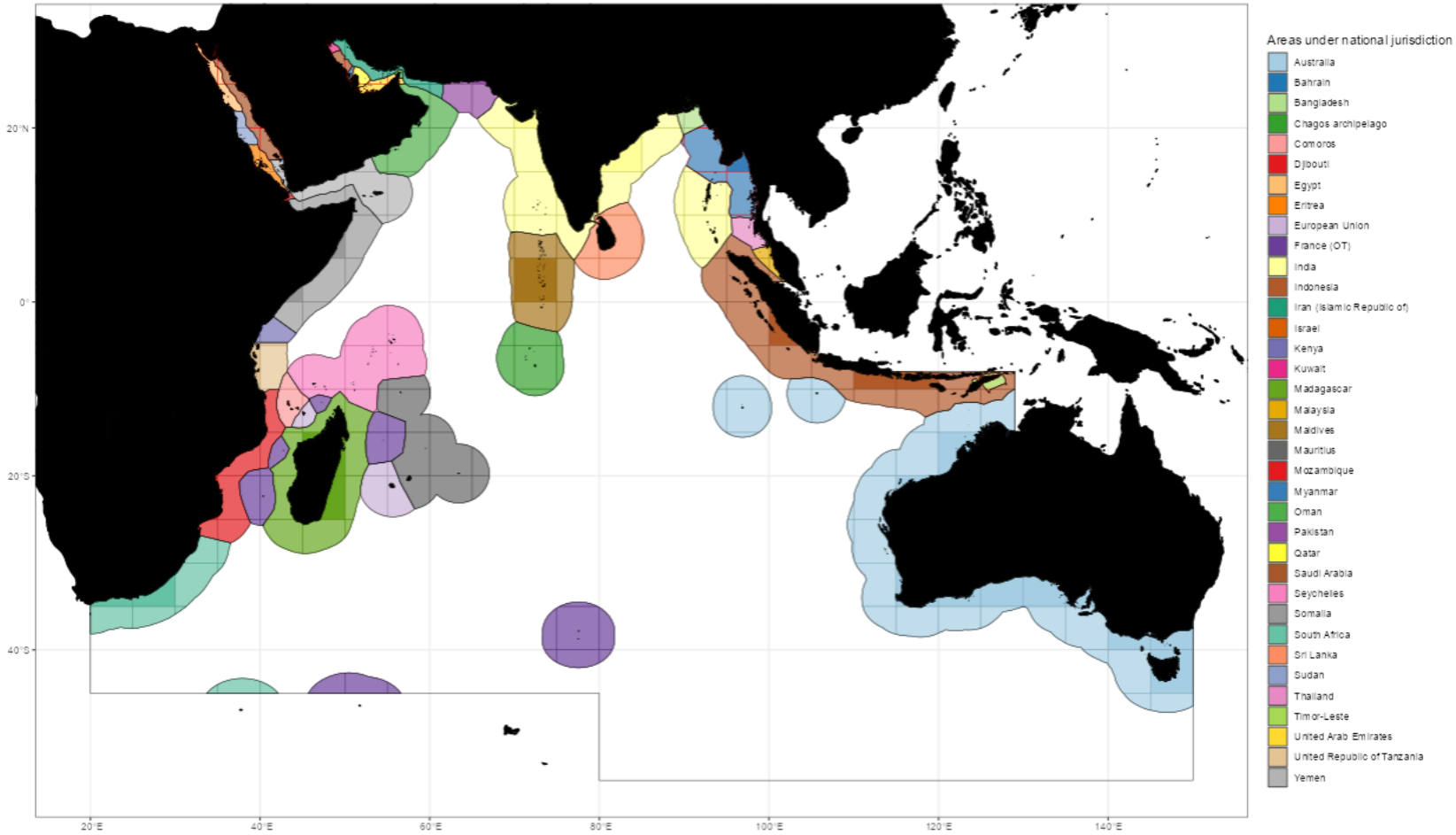
Grid type

5 degrees

Show 10 **entries**

Code	Entity	Status	NJA surface area
ARE	United Arab Emirates	non CPC	54,350 km^2
AUS	Australia	CPC	4,320,208 km^2
BGD	Bangladesh	CPC	77,773 km^2
BHR	Bahrain	non CPC	7,614 km^2
CHAGOS	Chagos archipelago	CPC	638,581 km^2
COM	Comoros	CPC	164,572 km^2
DJI	Djibouti	non CPC	6,916 km^2
EGY	Egypt	non CPC	90,344 km^2
ERI	Eritrea	CPC	78,318 km^2
EUR	European Union	CPC	378,244 km^2

Previous 1 2 3 4 Next



Reference data | Estimated catches

Selected AUNJs

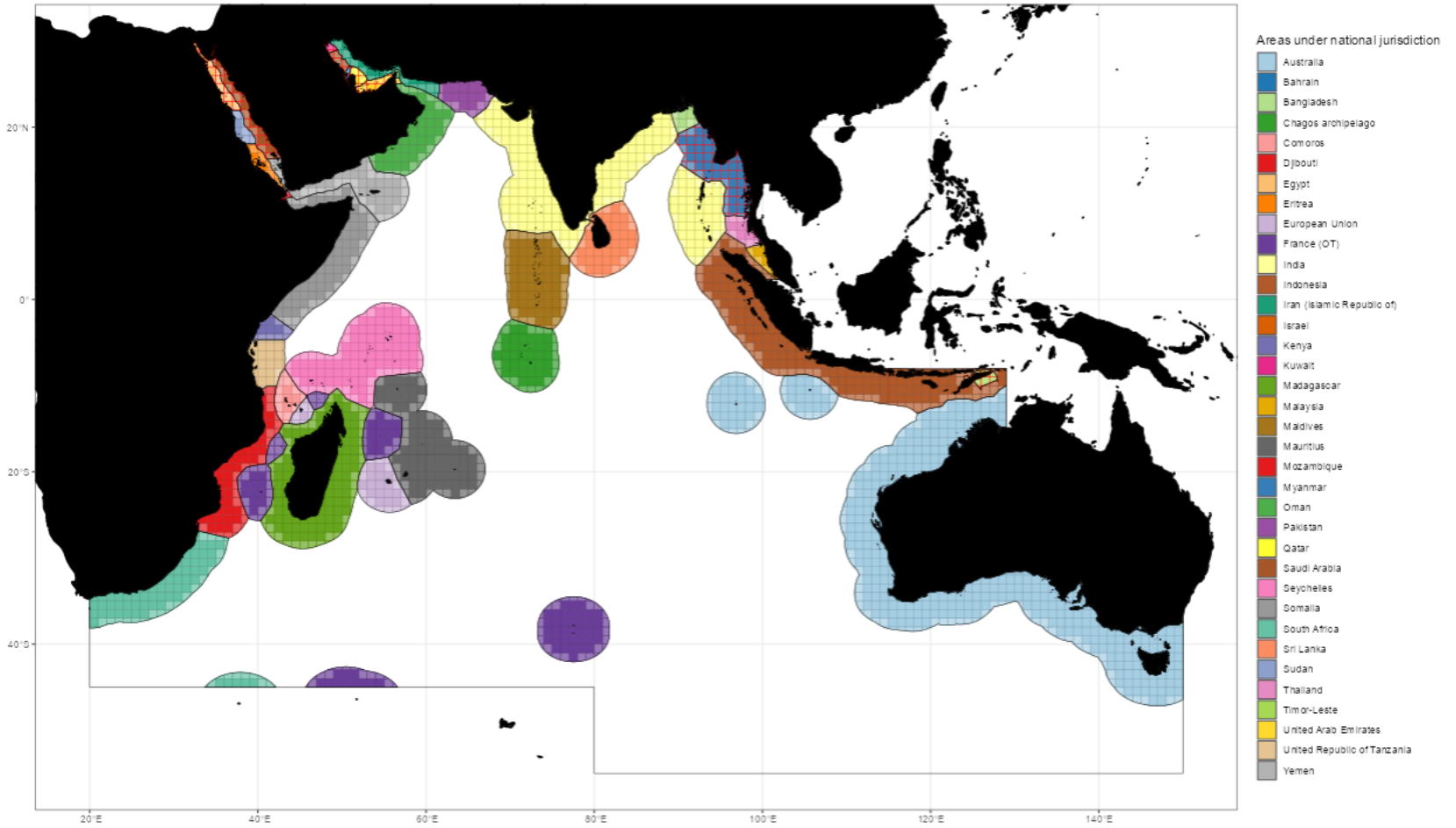
Grid type

1 degree

Show 10 **entries**

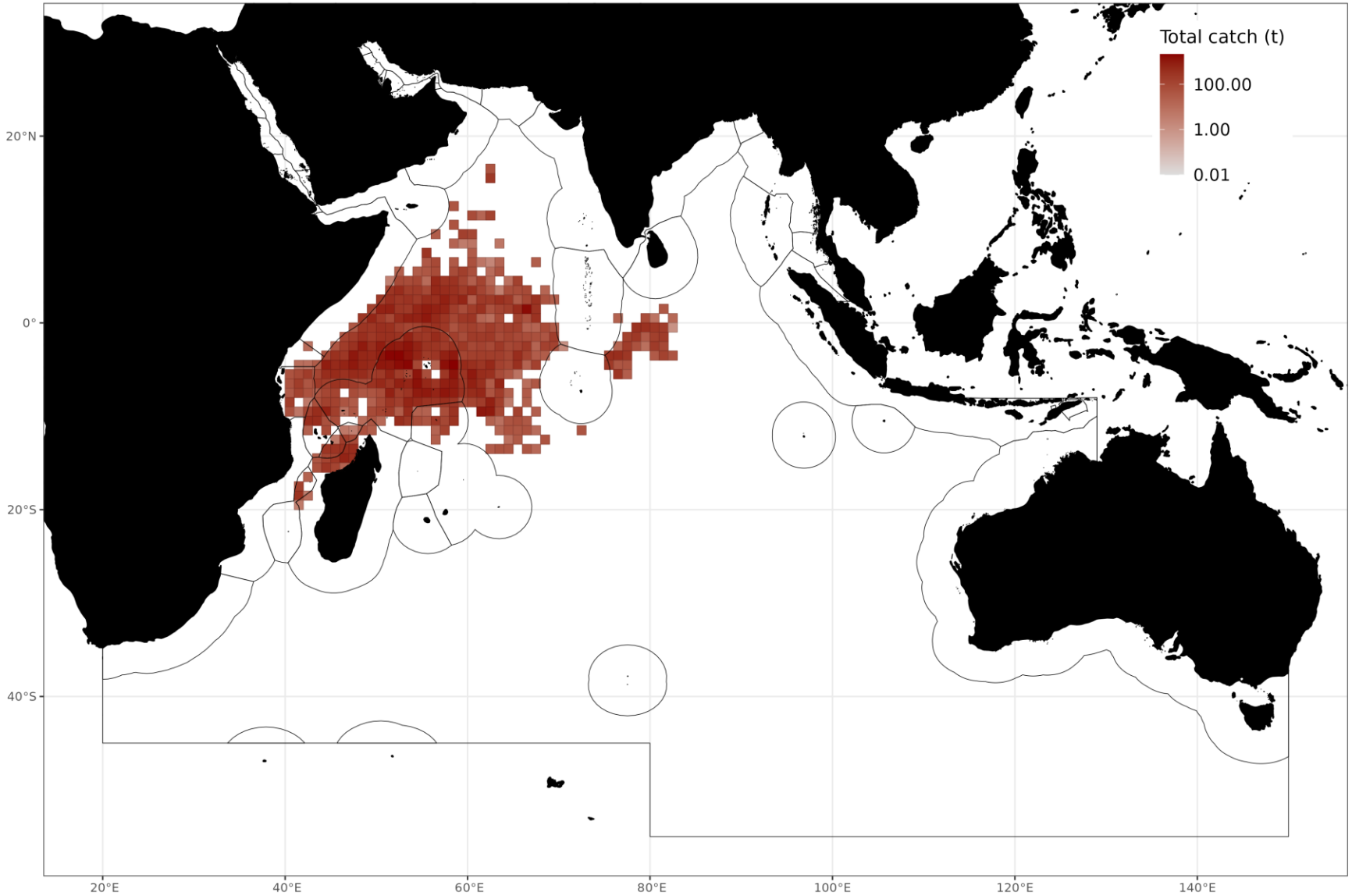
Code	Entity	Status	NJA surface area
ARE	United Arab Emirates	non CPC	54,350 km^2
AUS	Australia	CPC	4,320,208 km^2
BGD	Bangladesh	CPC	77,773 km^2
BHR	Bahrain	non CPC	7,614 km^2
CHAGOS	Chagos archipelago	CPC	638,581 km^2
COM	Comoros	CPC	164,572 km^2
DJI	Djibouti	non CPC	6,916 km^2
EGY	Egypt	non CPC	90,344 km^2
ERI	Eritrea	CPC	78,318 km^2
EUR	European Union	CPC	378,244 km^2

Previous 1 2 3 4 Next



RESULTS - *CAVEATS*

- Spatial catches from industrial *surface* fisheries (as well as other types of industrial fisheries) are available to a higher level of resolution (1°x1°) and already raised to totals
  - In this case, the process keeps the original data to increase the accuracy of the results
- Among all available data there are catches from ***NEI* fleets** (code: **NEI**), as well catches from **fleets not anymore operating** in the IOTC area of competence, or flagged by **non-IOTC coastal states** (code: **OTH**)


Total catch (t)
100.00
1.00
0.01
20°N
0°
20°S
40°S
20°E
40°E
60°E
80°E
100°E
120°E
140°E

REFERENCES

- IOTC-2011-WPTT13-07a
  Preparation of catch-at-size and catch-at-age files for the stock assessments of tropical tunas
- IOTC-2011-WPTT13-07b
  Preparation of data input files for the assessments of Indian Ocean yellowfin tuna stock
- IOTC-2017-SC20-INF05
  Estimation of EEZ catches (also presented at the TCAC04, 2018)
- Publicly available IOTC datasets
  $1RC_{bsf}$, $3CE_{fs}$, $4SF_{fs}$
- IOTC data browser

RESULTS - *DISCLAIMER*

The designations employed and the presentation of data and material in this information product do not imply the expression of any opinion whatsoever on the part of the *Food and Agriculture Organization of the United Nations* (FAO) and the *Indian Ocean Tuna Commission* (IOTC) concerning the legal or development status of any country, territory, city or area of its authorities, or concerning the delimitation of its frontiers or boundaries.

INTERACTIVE TOOL

- https://data.iotc.org/tcac12/

The tool is currently hosted on a testing server, so it might not be always responsive in case too many connections are received at the same time.