CATCHES OF CARCHARHINIDAE SHARKS IN ICCAT FISHERIES

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SUMMARY

*The entire Carcharhinidae shark family has been proposed for listing on CITES Appendix 2. Here we document the catches of these species in ICCAT fisheries. In addition, we do an analysis of correlations in the catches of these species to identify groups of species that tend to be captured together. There are 20 species of the family Carcharhinidae documented in ICCAT's Task 1 data, with mean catches varying annually between less than one ton to up to 50,000 tons for blue shark (Prionace glauca), which represents the overwhelming majority of the catches. While catches of some of the bycatch species are positively correlated (*Carcharhinus leucas *with* C. limbatus, C. signatus *with* C. obscurus, *and* C. obscurus *with* C. falciformis*), catches of main species blue shark are negatively correlated with* C. plumbeus. *This suggests that higher blue shark catches are not associated with higher bycatch of other Carcharhinidae species proposed for this listing.*

RÉSUMÉ

*La totalité de la famille des requins Carcharhinidae a été proposée pour inscription à l'Annexe 2 de la CITES. Nous documentons ici les captures de ces espèces dans les pêcheries de l'ICCAT. En outre, nous analysons les corrélations dans les captures de ces espèces afin d'identifier les groupes d'espèces qui ont tendance à être capturées conjointement. Il y a 20 espèces de la famille des Carcharhinidae documentées dans les données de tâche 1 de l'ICCAT', avec des captures moyennes variant chaque année de moins d'une tonne jusqu'à 50.000 tonnes pour le requin peau bleue (Prionace glauca), représentant la vaste majorité des captures. Même si les captures de certaines espèces de prises accessoires sont positivement corrélées (*Carcharhinus leucas *avec* C. limbatus, C. signatus *avec* C. obscurus, *et* C. obscurus *avec* C. falciformis*), les captures des principales espèces de requin peau bleue sont négativement corrélées avec C. plumbeus. Cela suggère que les captures plus élevées de requin peau bleue ne sont pas associées aux prises accessoires plus élevées d'autres espèces de Carcharhinidae proposées pour cette inscription.*

RESUMEN

*Se ha propuesto la inclusión de toda la familia de tiburones Carcharhinidae en el Apéndice 2 de CITES. Aquí documentamos las capturas de estas especies en las pesquerías de ICCAT. Además, hacemos un análisis de las correlaciones en las capturas de estas especies para identificar los grupos de especies que tienden a ser capturados juntos. Hay 20 especies de la familia Carcharhinidae documentadas en los datos de Tarea 1 de ICCAT, y la media de las capturas varía anualmente entre menos de una tonelada y hasta 50.000 toneladas de tintorera (*Prionace glauca*), que representa la inmensa mayoría de las capturas. Mientras que las capturas de algunas de las especies de captura fortuita están correlacionadas positivamente (*Carcharhinus leucas *con* C. limbatus, C. signatus *con* C. obscurus *y* C. obscurus *con* C. falciformis*), las capturas de la especie principal, la tintorera, están correlacionadas negativamente con* C. plumbeus*. Esto sugiere que el aumento de las capturas de tintorera no está asociado a una mayor captura fortuita de otras especies de Carcharhinidae propuestas para esta inclusión.*

KEYWORDS

Fishery biology, Shark fisheries, Overfishing, Trade, By catch, Fish catch statistics, Depleted stocks

1. Introduction

The entire Carcharhinidae or requiem shark family has been proposed for listing on CITES Appendix 2 (CITES 2022). The grey reef shark (*Carcharhinus amblyrhynchos*), dusky shark (*C. obscurus*) smalltail shark (*C. porosus*), Ganges shark (*Glyphis gangeticus*), sandbar shark (*C. plumbeus*), Borneo shark (*C. borneensis*), Pondicherry shark (*C. hemiodon*), smoothtooth blacktip shark (*C. leiodon*), sharptooth lemon shark (*Negaprion acutidens*), Caribbean reef shark (*C. perezi*), daggernose shark (*Isogomphodon oxyrhynchus*), night shark (*C. signatus*), whitenose shark (*Nasolamia velox*), blacknose shark (*C. acronotus*), whitecheek shark (*C. dussumieri*), lost shark (*C. obsoletus*), Pacific smalltail shark (*C. cerdale*), Borneo broadfin shark (*Lamiopsis tephrodes*), and the broadfin shark (*L. temminckii*) are all assessed as Endangered or Critically Endangered on the IUCN Red List of Threatened Species, as a result of unsustainable fishing mortality driven at least partly by international trade demand for their products. Accordingly, under the CITES criteria listed in Annex 2a, Criterion A and B, these species are candidates for listing on CITES Appendix 2.

The proposal further argues that save two species, every member of the family Carcharhinidae is a visual lookalike for at least one fin position, and that all members of the family are lookalikes for traded meat. CITES Annex 2b, Criterion A criterion states Species may be listed on CITES Appendix 2 if specimens of the species in the form in which they are traded resemble specimens of a species included in Appendix II under the provisions of Article II, paragraph 2 (a), or in Appendix I, so that enforcement officers who encounter specimens of CITES-listed species are unlikely to be able to distinguish between them. Accordingly, the proposal also argues this justifies that the entire Carcharhinidae family should be listed on CITES Appendix 2. The proposal therefore includes: the Genus *Carcharhinus*, the Genus *Isogomphodon*, the Genus *Loxodon*, the Genus *Nasolamia*, the Genus *Lamiopsis*, the Genus *Negaprion*, the Genus *Prionace*, the Genus *Rhizoprionodon*, the Genus *Scoliodon*, and the Genus *Triaenodon*.

ICCAT has three major shark species that are currently or have been target for fisheries. These include shortfin mako shark (*Isurus oxyrinchus*), porbeagle shark (*Lamna nasus*), and blue shark (*Prionace glauca*, BSH). Shortfin mako and porbeagle shark are already listed on CITES Appendix 2. While blue shark is not specifically named in the proposal for listing according to the Annex 2a, Criterion A and B criteria, it is the only species of the Genus *Prionace* that is included. So, if the proposal is successful, all the ICCAT major shark species will be listed on CITES Appendix 2.

ICCAT does not typically document long-term time series of shark catches at the species level for all minor and bycatch species. It does however have some data for these species. These data bear some examination to support responding to the CITES listing proposal for the Carcharhinidae. Here, we document catches of shark species listed in this proposal and examine the patterns of correlation in the catches of species entertained in this proposal.

2. Methods

The data source for this analysis is the Task 1 dataset from ICCAT Data Base. Because of poor species identification and reporting of minor shark species, we considered data only after 2000 and for EU-Spain, EU-Portugal, Japan, and the United States. These CPCs are deemed to have the most reliable Task 1 information for sharks. In addition, we exclude any shark time series from the Mediterranean Sea. We use the final 2021 Task 1data and present time series of total catches.

We do correlation test to determine if there is an association between the catch of each pair of shark species. All species for which there were fewer than 3 observations in the time series were eliminated from consideration. Superficially at least, this might provide some indication of how likely the catch of one species is associated with the other species in ICCAT fisheries. Correlation analyses were performed

3. Results and Discussion

Twenty different shark species that would qualify for the proposed CITES listing were captured and reported in ICCAT fisheries (**Figure 1**, and **Table 1**). With the exception of blue shark, mean annual catches for other Carcharhinidae species tended to be very small with mean values of less than one ton for *C. isodon, C. galapagensis, C. melaopterus, C. albimarginatus*, less than 10 tons for *C. brevipinna, C. altimus, C. obscurus, Negaprion brevirostris* and *C. brachyurus* and less than 500 tons for the remaining species.

The catch series values in some years are suspiciously high for some species. According to Task 1, *C. acronotus*, *C. leucas*, *C. signatus*, *C. altimus*, *and N. brevirostris* all have peak values in their annual catch time series that are more than 10 times the mean of the series. These values could have represented catch of large aggregations of sharks but, and most likely, they could also represent reporting errors. Moreover, some species such as *C. albimarginatus* are not confirmed to be present in the Atlantic ocean.

With catches greater than 50,000 tons since 2007, catches for blue shark in the Atlantic Ocean represent the overwhelming majority of the tonnage of catches of sharks in the family Carcharhinidae (**Figure 1**, **Table 1**, **Figure 2**). At a maximum, catches of species other than blue shark represent less than 1% of the total Carcharhinidae catch.

Correlations between species in the selected Task 1 catch are shown in **Figure 3** and their corresponding correlation coefficients and p values in **Table 3**. Note that it was not possible to correlation analysis for some of the Negaprion, Rhizoprionodon and the other Carcharhinus species in **Table 2** because there were not enough observations overlapping in time to support that analysis. There are 4 species pairs that appear to be correlated at a significance level of $p<0.05$ (**Table 3**). While catches of the bycatch species are positively correlated (*C. leucas* with *C. limbatus*, *C. signatus* with *C. obscurus*, and *C. obscurus* with *C. falciformis*), catches of main species blue shark are negatively correlated with *C. plumbeus*. We dedicate particular attention to the correlations of blue shark and the other shark species because there is a commercial fishery for blue shark. Correlations of blue sharks with other species of the Genus Carcharhinus were not statistically significant. This suggests that higher blue shark catches are not associated with higher bycatch of other Carcharhinidae species proposed for this listing. However, absent other information the ability to interpret correlation analyses as an indicator of co-occurrence in fisheries is limited.

References

CITES. 2022. Nineteenth Meeting of the Conference of the Parties. Consideration of proposals for amendment of Appendices I and II. **sCoP19 Pro**: Xx.

Table 1. Species codes and corresponding species names.

Species	Scientific name
CCP	*Carcharhinus plumbeus*
BSH	*Prionace glauca*
FAL	*Carcharhinus falciformis*
OCS	*Carcharhinus longimanus*
CCL	*Carcharhinus limbatus*
CCS	*Carcharhinus signatus*
CCE	*Carcharhinus leucas*
DUS	*Carcharhinus obscurus*
BRO	*Carcharhinus brachyurus*
CCA	*Carcharhinus altimus*
CCB	*Carcharhinus brevipinna*
RHT	*Rhizoprionodon terraenovae*
CCG	*Carcharhinus galapagensis*
NGB	*Negaprion brevirostris*
CCR	*Carcharhinus porosus*
CCN	*Carcharhinus acronotus*
CCO	*Carcharhinus isodon*
RHA	*Rhizoprionodon acutus*
BLR	*Carcharhinus melanopterus*
ALS	*Carcharhinus albimarginatus*

Table 2. Task 1 catches (in tonnes) by year, for shark species of the Genus *Carcharhinus*, the Genus *Negaprion*, the Genus *Prionace*, and the Genus *Rhizoprionodon*.

Species/Year	Carcharhinus brachyurus	Carcharhinus brevipinna	Carcharhinus falciformis	Carcharhinus leucas	Carcharhinus limbatus	Carcharhinus longimanus	Carcharhinus obscurus	Carcharhinus plumbeus	Carcharhinus porosus	Carcharhinus signatus	Prionace glauca	Rhizoprionodon acutus	Rhizoprionodon terraenovae	Carcharhinus altimus	Negaprion brevirostris	Carcharhinus acronotus	Carcharhinus isodon	Carcharhinus galapagensis	Carcharhinus melanopterus	Carcharhinus albimarginatus
2001	0.82	1.27	42.208	0.37	33.857	543.379	1.12	180.91	114.204	30.225	35219.52	138	NA	NA	NA	NA	NA	NA	NA	NA
2002	NA	0.16	357.787	NA	107.044	205.016	2.438	120.596	306	9.137	32765.07	11	0	NA	NA	NA	NA	NA	NA	NA
2003	NA	0.4	476.006	375.39	53.063	178.799	0.13	120.139	NA	23.594	37982.85	23	NA	0.006	0.182	NA	NA	NA	NA	NA
2004	NA	19.044	316.226	137.569	218.76	188.924	0.036	49.072	NA	0.142	36306.34	1	143.537	42.5	53.071	49.258	0.09	NA	NA	NA
2005	0.773	NA	73.531	0.761	565.052	81.637	NA	60.112	130.437	NA	43072.47	11	NA	NA	NA	NA	NA	NA	NA	NA
2006	1.945	NA	6.622	0.087	42.47	77.572	NA	39.983	10.018	NA	43888.64	16.175	1681.051	NA	0.09	NA	NA	NA	NA	NA
2007	3.222	NA	232.373	0.248	57.676	35.79164	19.372	11.597	NA	12.71	50464.08	5	987.793	0	0.407	NA	NA	0	0.065	NA
2008	8.152	NA	31.069	10.708	62.063	245.6664	2.172	2.451	0.461	41.897	53902.93	0	NA	0.065	0.163	NA	NA	NA	NA	NA
2009	1.34	0.004	70.408	0.35201	48.25	53.956	14.85199	22.292	0.461	35.208	58842.56	68	370.137	0	0.104	NA	NA	1.217	NA	NA
2010	50.765	NA	1.09572	0.156	11.759	132.061	0.142	5.2385	NA	47.412	65253.54	0	383.615	0.21	0.112	NA	NA	0	0.215	0.015
2011	NA	NA	103.8275	8.55501	6.342	6.4519	14.75287	8.385009	NA	12.954	73200.48	6	NA	NA	0.374	NA	NA	NA	NA	0.06
2012	NA	0.3212	62.7397	2.482	5.116	3.6472	7.57441	4.19	NA	33.892	63245.67	3	NA	NA	NA	NA	NA	NA	NA	NA
2013	NA	3.212	122.575	0.09727	69.272	3.66045	5.494	6.217	NA	6605.285	57858.63	NA	NA	NA	0.04325	NA	NA	NA	NA	NA
2014	0	0	37.21572	0	8.801	5.599331	3.676504	0	0	1.261	62961.36	0	0	0	0	0	NA	0	NA	NA
2015	0.053	NA	169.6142	0.134001	0.39	1.3429	0.002984	0	NA	0.117421	62791.33	NA	NA	0	NA	NA	NA	0	NA	NA
2016	NA	NA	149.2774	0.100255	NA	2.604	NA	NA	NA	0.361161	70213.75	NA	0	NA	0.068	NA	NA	NA	0.063	NA
2017	NA	NA	420.5784	0.02006	NA	10.34525	NA	NA	NA	0.16305	68141.54	NA	NA	NA	NA	NA	NA	NA	0.029	NA
2018	0	0.01687	554.3346	0.138141	0	2.080215	0	0	NA	0.306672	68331.36	NA	NA	0	NA	NA	NA	0	NA	NA
2019	0	0.07612	178.037	NA	0	2.190743	0	0	NA	0.175996	62004.68	NA	NA	0	NA	NA	NA	1.91	NA	NA
2020	0	NA	221.1099	0.069171	0	1.399	0	0	NA	0.373455	54722.05	NA	NA	0	NA	NA	NA	1.001	NA	NA

Table 3. Summary of pairwise correlation analysis of Task 1 catch data for Carcharhinidae shark species. Species codes and corresponding species names are listed in **Table 1**.

row	column	cor	p
BSH	CCE	-0.30795	0.501635
BSH	CCL	-0.36265	0.202553
CCE	CCL	0.997543	5.74E-07
BSH	CCP	-0.66171	0.009949
CCE	CCP	-0.1297	0.781666
CCL	CCP	0.075733	0.796936
BSH	CCS	0.206214	0.520214
CCE	CCS	-0.6002	0.284557
CCL	CCS	-0.31836	0.313204
CCP	CCS	0.253391	0.426813
BSH	DUS	-0.04133	0.893349
CCE	DUS	-0.32498	0.593631
CCL	DUS	-0.17954	0.597327
CCP	DUS	0.307011	0.358445
CCS	DUS	0.794737	0.003468
BSH	FAL	0.063536	0.784388
CCE	FAL	-0.28374	0.537457
CCL	FAL	-0.22195	0.445695
CCP	FAL	-0.07372	0.802223
CCS	FAL	0.068047	0.83357
DUS	FAL	0.569419	0.042227
BSH	OCS	0.27197	0.259994
CCE	OCS	-0.22665	0.625027
CCL	OCS	-0.15056	0.60742
CCP	OCS	-0.27992	0.3324
CCS	OCS	0.260626	0.413266
DUS	OCS	0.161693	0.634804
FAL	OCS	0.000686	0.997775

Figure 1. Task 1 catches (in tonnes) for shark species corresponding to the Genus *Carcharhinus*, the Genus *Negaprion*, the Genus *Prionace*, and the Genus *Rhizoprionodon*.

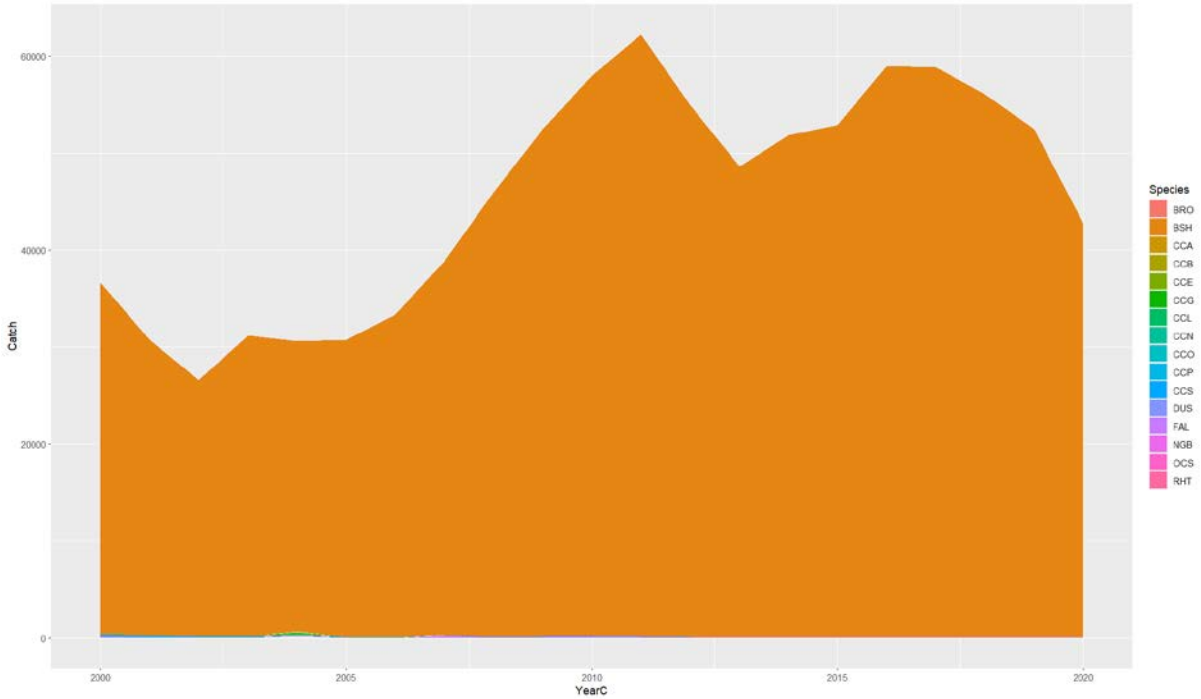

Figure 2. Area plot for Task 1 shark species of the Genus *Carcharhinus*, the Genus *Negaprion*, the Genus *Prionace*, and the Genus *Rhizoprionodon*. Species codes are listed in **Table 1**.

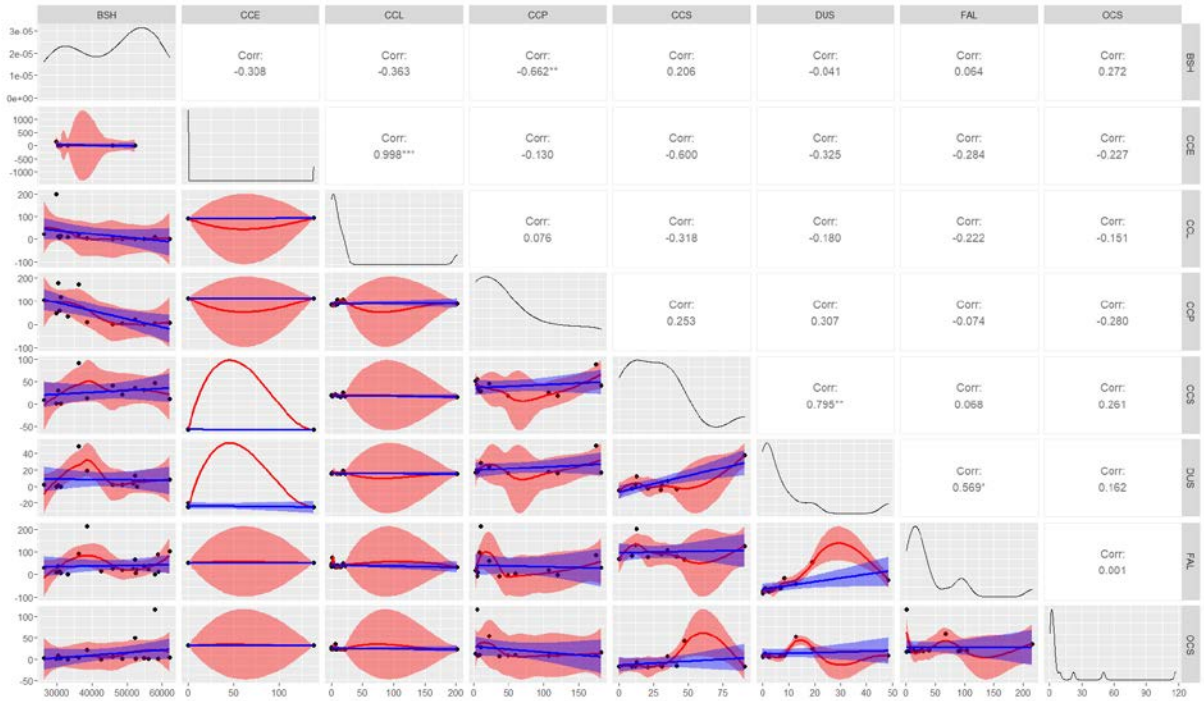

Figure 3. Correlation plot for Task 1 shark species of the Genus *Carcharhinus* and the Genus *Prionace*. Species codes are listed in **Table 1**. The lower left triangle shows plots of Loess smoothed fit in red, and linear fits in blue. The upper right triangle represents the correlation coefficients for each species pair. The statistical significance of the correlations is marked as: *** if the p-value is < 0.001, ** if the p-value is < 0.01, *if the p-value is < 0.05, "." if the p-value is < 0.10.