SUMMARY OF DATA FROM THE SOUTHWEST OF ENGLAND BLUE SHARK FISHERY FROM 1953-2021

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SUMMARY

Results from analysis of the Southwest of England recreational blue shark fishery from 1953-2021 are presented for the purpose of the 2020 ICCAT request for data on the species. During this period 108731 blue sharks were captured for 56650 days fished, giving an overall CPUE of 1.92 fish/trip. CPUE initially peaked during the 1950s between 2.93-4.59 before declining during the 1960s. CPUE reached its lowest value of 0.18 in 2000 with an increasing trend for 2010-2014. CPUE increased markedly from 2.58 in 2014 to 5.33 in 2015 and peaked at 8.85 fish/trip in 2017 before decreasing slightly during 2018-2021. Immature female fish dominated catches throughout, although both male and female mature fish were present during certain periods.

RÉSUMÉ

Les résultats de l'analyse de la pêcherie récréative de requin peau bleue au Sud-Ouest de l'Angleterre de 1953 à -2021 sont présentés en réponse à la demande de données sur cette espèce formulée par l'ICCAT en 2020. Pendant cette période 108.731 requins peau bleue ont été capturés pendant 56.650 jours de pêche, soit une CPUE globale de 1,92 poisson/ sortie. La CPUE a d'abord culminé dans les années 1950, entre 2,93 et 4,59, avant de baisser dans les années 1960. La CPUE a atteint sa valeur la plus basse de 0,18 en 2000, avec une tendance à la hausse pour la période 2010-2014. La CPUE a nettement augmenté, passant de 2,58 en 2014 à 5,33 en 2015 et a atteint un pic de 8,85 poisson/ sortie en 2017 avant de légèrement diminuer au cours de la période 2018-2021. Les poissons femelles immatures ont dominé les captures tout au long de l'année, bien que des poissons mâles et femelles matures aient été présents pendant certaines périodes.

RESUMEN

Se presentan los resultados del análisis de la pesquería de recreo de tiburón azul del suroeste de Inglaterra entre 1953 y 2021 a efectos de la solicitud de datos sobre la especie realizada por ICCAT en 2020. Durante este periodo se capturaron 108.731 ejemplares de tiburón azul en 56.650 días de pesca, lo que arroja una CPUE global de 1,92 peces/marea. La CPUE alcanzó inicialmente un máximo durante la década de 1950, entre 2,93-4,59, antes de descender durante la década de 1960. La CPUE alcanzó su valor más bajo de 0,18 en 2000, con una tendencia al alza entre 2010 y 2014. La CPUE aumentó notablemente de 2,58 en 2014 a 5,33 en 2015 y alcanzó un máximo de 8,85 peces/marea en 2017 antes de disminuir ligeramente durante 2018-2021. Las hembras inmaduras dominaron las capturas en todo momento, aunque tanto hembras como machos maduros estuvieron presentes en algunos periodos.

KEYWORDS

Blue shark, sport fishing, migration, catch/ effort

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Introduction

The Blue Shark (*Prionace glauca)* is a large pelagic shark with a widespread distribution in both tropical and temperate waters. *P. glauca* is a highly migratory species which can travel over 3000 km in a single year (Aires-da-Silva *et al*. 2008) and is a common visitor to the waters of the Southwest of England and Wales during summer months. *P. glauca* exhibits a complex life history with a high degree of temporal and spatial separation by both sex and size (Vandeperre *et al.* 2014). *P. glauca* has been a popular sport fish in the British Isles since the 1950s and since its inception in 1953 the Shark Angling Club of Great Britain (SACGB) has kept detailed records of captures of the species. The current recreational fishery for *P. glauca* in the UK in conducted on a catch and release basis and this factor, along with a low capture-induced mortality (Campana *et al*. 2009), and high degree of motivation by anglers to protect the species, means that the data collected is potentially of a high value to fisheries managers. However, a disconnect exists between anglers and scientists, which has resulted in an under-utilization of this data source. To increase the knowledge on this species in the UK, the SACGB, Sportfishing Club of the British Isles (SCBI) and charter skippers are collaborating through the Pat Smith database to collect catch data for *P. glauca* in UK waters and this document presents the combined data from this ongoing project.

1. Data and methods

1.1 Catch and effort data

Data sources

The data from the port of Looe in the county of Cornwall is from the historical records from the Shark Angling Club of Great Britain (SACGB) and consists of records from 34 different boats that fished for sharks from this port from 1953-2021. The SACGB award a trophy for the skipper with the highest number of fish caught per annum, so all fish caught throughout the club's fleet are recorded. Due to the tidal nature of the port, the effort data is more consistent than for other ports as all boats left Looe harbour at the same time and returned at the same time for each trip. Until 2010 all boat catches were recorded via a unique flag system that the harbor master used to collate catch data as each boat returned through the narrow entrance of the Looe River. The system includes a coded method of differentiating fish under and over 75 inches by flags. While the fleet has transitioned to submitting their data by phone to the designated data gatherer, the flag system remains in place. Boats from other ports report to the Pat Smith Database via email, WhatsApp Messenger or by sharing their logbooks.

From the port of Plymouth, a voluntary shark recording project has operated since 2005 and accurate catch, effort and location information is available for this port. The Sportfishing Club of the British Isles (SCBI) have run a three day catch and release competition from 2014-current from the port and the data collected is included here.

Penzance boats record positions of each fish captured, while the remainder of the non-Looe boats record positions at the start of each drift. Two skippers from the port of Penzance provided detailed logbooks, which cover 2009-2019 for catch, effort, and position data. A further six skippers joined the scheme in 2019 and five more in 2021. The geographical locations of the ports involved in this project are shown in **Figure 1**.

Gear and Vessel Type

Prior to the early 1990s all recreational shark fishing vessels were a similar build and engine type, providing further standardization. Newer boats are flagged within the data. Most boats fished with a standard four rods and four anglers, as trips were booked through a central booking agency. Occasionally vessels will use more rods, up to eight at a time. There is no linear or non-linear relationship between rod numbers and catches up to 20 fish per day (r^2= 0.011, P=0.46, n= 4506). Above 20 fish a day there may be a weak positive linear correlation between rods and catches.

Since 1998 all fish were released upon capture. Tagging returns indicate that survivability may be higher using inline circle hooks which have become the only hooks used in the fishery since 2010. Previously offset and inline "J" shaped hooks were universal before this time.

Sharks are attracted to the boat using chum, which is made from a variety of small pelagic fish, often with the addition of fish oil and bran. The chum is suspended in the water in a mesh bag. Baits, which are normally mackerel (*Scomber scrombus*), are suspended at various depths by a float which are held at varying distances from the boat. The hooks are mounted on 49 strand stainless steel wire (1.5-2 mm) bite traces of around two meters, with an

additional rubbing leader of either 49 strand stainless steel wire (1-2.0 mm) or 2 mm monofilament to protect against damage from the shark's skin. Main lines were monofilament or braided Dyneema of at least 20 kg in breaking strain. Although the design of the rods and reels have changed to more modern components since the 1950s, the basic fishing method has remained constant.

The data used in this analysis is summarised in **Tables 1**-**3** and total catch by year is presented in **Figure 2**.

1.2 Length and sex data

Data sources

Due to the requirement of the capture of a fish >178 cm to join the SACGB, and the awarding of prizes for numbers of fish over this size for individual boats, accurate records of lengths for mature fish are available as well as total captures per boat. In addition, a tagging project for Blue Sharks operated from the port of Looe from 1998-2011 and accurate lengths were obtained for all tagged fish. The data used in this analysis is summarised in **Table 4** and length distribution is presented in **Figures 4**-**7**.

2. Analysis

Nominal Catch Per Unit Effort (CPUE1) was calculated using the following formula:

$$CPUE1 = \sum C / \sum f$$

where *C* is total yearly catch and *f* is fishing effort in hours. Both total yearly or yearly by port catch and effort CPUE are reported.

3. Results and discussions

From 1953-2021, 108731 Blue Sharks were captured from boats involved in this project during 56650 days of effort, resulting in an overall nominal CPUE of 1.92 fish/trips. The number of fish caught annually decreased from 6412 to 2180 between 1961 and 1962 and fluctuated from 1962 and 1976 between 1892 and 4003, before decreasing rapidly and in 2000 only 86 fish were captured. *P. glauca* captures remained relatively stable between 125-248 from 2002-2009 (**Table 1**). A steady increase in shark numbers was observed between 2010 and 2014 before a dramatic increase in 2015 when a total of 2020 fish were caught. This increase in numbers was sustained through 2016-2021 to a peak of 4163 fish during 2021, **(Table 1, Figure 2**). Effort (hours fished) varied from 90 to 2209 trips (**Table 2**) and although there was increased effort between 2015 and 2019 compared to previous years, the nominal CPUE followed the same trend as the shark numbers (**Table 3, Figure 3**). Both captures and numbers of *P. glauca* increased for the ports of Penzance and Plymouth before those of the Looe vessels but this difference is partly explained by the presence of some slower boats in Looe which couldn't venture as far offshore, which skewed the numbers for this port during this period (**Table 1, Table 3**). During 2015-2019 boats from the port of Penzance had the highest CPUE, of up to 20.43 fish/trip during 2017. The maximum number of sharks captured during one day from this port was 100 individuals and captures of over 20 fish per day were common from each port during this period.

The fishery was dominated by immature female fish throughout the 1998-2021 with the percentage of male fish varying between 1.68 % in 2015 to 20.40 in 2005 (**Figure 4, 5**). Increases in fish seen between 2015-2017 was mainly due to an increase in the numbers of immature female fish (**Figures 4, 5**), although during September of 2017 the percentage of immature male fish rose to 44.9%. These findings are similar to those from the Irish Blue Shark recreational fishery (Wogerbauer *et al.* 2016) and previous tagging studies from the Southwest of England fishery (Queiroz *et al*. 2012). The presence of mature male fish in 2018 was notable (**Figure 4),** as was an increase in females displaying bite marks typical of mating behavior.

There was a statistically significant difference in mean length between male and female fish (**Figure 6**, df=1, f=13.37, p=0.0003). The mean size of *P. glauca* captured from Looe 1998-2011 was 190.71 cm (median=193.04 cm) for females and 179.14 cm (median=182.88 cm) for male fish (**Table 4**) with a minimum size of 91.44 cm (Male) and 106.68 cm (female). The length/ frequency distribution of size classes was different for female and male fish for the years 1998-2011 with a higher proportion of male fish represented in the 130-170 cm size range (**Figure 6).** 2001 and 2011 showed an increase in the number of smaller sharks of both sexes (**Figure 7**).

Although situated at the eastern extent of the range of *P. glauca* around the UK coastline, the Southwest of England is home to a large seasonal population of the species, with considerable inter-annual variation (Mitchell *et al.* 2014). The years 2015-2021 saw a huge increase in numbers of the species across the region. Although dominated by immature specimens, the increasing numbers of mature male fish seen during later years of this study combined with the number of female fish with bite marks, reflective of mating behavior (Vandeperre *et al.* 2014), suggests that mating may occur in these waters, at least in some years. There were also a number of captures of very young fish (50-60 cm) during 2018-2021 so it is also possible that birthing occurs in these waters.

It is worth noting the considerable differences between recreationally derived data on shark captures with those of the commercial longline fleets. For example, standardizing CPUE of the former by hook number may not be relevant as the sharks are attracted to the boats rather than relying on a wide spread of hooks. Sharks tend to arrive in small groups which are captured as they arrive prior to a waiting period before another group arrives, thus number of hooks plays little role in catches, at least when captures don't exceed 20 fish a day. Factors that control the spread of the chum slick may be more relevant, such as the juxtaposition of wind and tide and these will be fully explored in future publications.

Whether the increase in CPUE seen since 2015 is indicative of stock recovery or changes in migration patterns is unknown, but it appears that the Southwest of the UK represents a seasonal global hotspot for *P. glauca.*

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Table 1. Blue Shark captures by port from the Southwest of England for 1953 to 2021.

Year	*Dartmouth*	*Falmouth*	*Looe*	*Lyme Regis*	*Penzance*	*Plymouth*	*St. Mary's*	*Torquay*	*Sub Total*
1953			360						360
1954			500						500
1955			1200						1200
1956			1650						1650
1957			4171						4171
1958			5711						5711
1959			5213						5213
1960			5934						5934
1961			6412						6412
1962			2180						2180
1963			1862						1862
1964			2828						2828
1965			2027						2027
1966			2582						2582
1967			3351						3351
1968			2547						2547
1969			3274						3274
1970			3356						3356
1971			4003						4003
1972			3200						3200
1973			1800						1800
1974			2400						2400
1975			2900						2900
1976			2400						2400
1977			900						900
1978			700						700
1979			120						120
1980			230						230
1981			150						150
1982			300						300
1983			310						310
1984			240						240
1985			176						176
1986			122						122
1987			380						380
1988			250						250
1989			319						319
1990			385						385
1991			616						616
1992			530						530
1993			398						398
1994			534						534
1995			208						208

Table 1 continued. Blue Shark captures by port from the Southwest of England for 1953 to 2021.

Year	*Dartmouth*	*Falmouth*	*Looe*	*Lyme Regis*	*Penzance*	*Plymouth*	*St. Mary's*	*Torquay*	*Sub Total*
1996			526						**526**
1997			302						**302**
1998			385						**385**
1999			278						**278**
2000			86						**86**
2001			357						**357**
2002			125						**125**
2003			165						**165**
2004			271						**271**
2005			152			1			**153**
2006			127			2			**129**
2007			138			17			**155**
2008			148			28			**177**
2009			149		45	54			**248**
2010			352		20	125			**496**
2011			615		115	150			**880**
2012			468		82	161			**711**
2013			599		268	327			**1194**
2014			506		170	298			**974**
2015			768		715	537			**2020**
2016			1747		858	893			**3498**
2017			2060		1186	836			**4082**
2018	20		1764		1119	915			**3818**
2019	12	20	1175	0	658	235	3	10	**2093**
2020	21	351	1291		2287	180	21	12	**4163**
2021	33	390	1228		854	167	22	14	**2708**
Total									**108731**

Table 2. Blue Shark fishing effort in trips by port for 1998-2019.

	Dartmouth	*Falmouth*	*Looe*	*Lyme Regis*	*Penzance*	*Plymouth*	*St. Mary's*	*Torquay*	*Sub Total*
1953			90						90
1954			150						150
1955			410						410
1956			425						425
1957			1100						1100
1958			1244						1244
1959			1483						1483
1960			1534						1534
1961			1719						1719
1962			1600						1600
1963			1539						1539
1964			1595						1595
1965			1581						1581
1966			1584						1584
1967			1742						1742
1968			1683						1683
1969			2209						2209
1970			1872						1872
1971			1803						1803
1972			1600						1600
1973			1614						1614
1974			1682						1682
1975			1489						1489
1976			1619						1619
1977			800						800
1978			810						810
1979			459						459
1980			521						521
1981			440						440
1982			520						520
1983			501						501
1984			411						411
1985			397						397
1986			432						432
1987			431						431
1988			397						397
1989			411						411
1990			420						420
1991			410						410
1992			619						619
1993			449						449
1994			620						620
1995			573						573

Table 2 continued. Blue Shark fishing effort in trips by port for 1998-2019.

	Dartmouth	*Falmouth*	*Looe*	*Lyme Regis*	*Penzance*	*Plymouth*	*St. Mary's*	*Torquay*	*Sub Total*
1996			522						522
1997			433						433
1998			485						485
1999			536						536
2000			473						473
2001			416						416
2002			770						770
2003			697						697
2004			739						739
2005			639			1			640
2006			346			27			373
2007			309			23			332
2008			251			22			273
2009			233		18	21			272
2010			237		12	27			276
2011			279		29	25			333
2012			263		20	26			309
2013			293		40	35			368
2014			311		29	37			377
2015			291		42	46			379
2016			300		42	55			397
2017			351		48	62			461
2018	16.5		429		136	69			650.5
2019	5	11	418	36	103	45	4.5	11	633.5
2020	8	36	423		100	23	7	4	601
2021	11	43	378		55	28	9	8	532
Total									**56650**

Table 3. Nominal Catch Per Unit Effort (CPUE) for Blue Shark from 1953-2021.

	Dartmouth	*Falmouth*	*Looe*	*Lyme Regis*	*Penzance*	*Plymouth*	*St. Mary's*	*Torquay*	*Sub Total*
1953			4.00						4.00
1954			3.33						3.33
1955			2.93						2.93
1956			3.88						3.88
1957			3.79						3.79
1958			4.59						4.59
1959			3.52						3.52
1960			3.87						3.87
1961			3.73						3.73
1962			1.36						1.36
1963			1.21						1.21
1964			1.77						1.77
1965			1.28						1.28
1966			1.63						1.63
1967			1.92						1.92
1968			1.51						1.51
1969			1.48						1.48
1970			1.79						1.79
1971			2.22						2.22
1972			2.00						2.00
1973			1.12						1.12
1974			1.43						1.43
1975			1.95						1.95
1976			1.48						1.48
1977			1.13						1.13
1978			0.86						0.86
1979			0.26						0.26
1980			0.44						0.44
1981			0.34						0.34
1982			0.58						0.58
1983			0.62						0.62
1984			0.58						0.58
1985			0.44						0.44
1986			0.28						0.28
1987			0.88						0.88
1988			0.63						0.63
1989			0.78						0.78
1990			0.92						0.92
1991			1.50						1.50
1992			0.85						0.85
1993			0.88						0.88
1994			0.86						0.86
1995			0.35						0.35

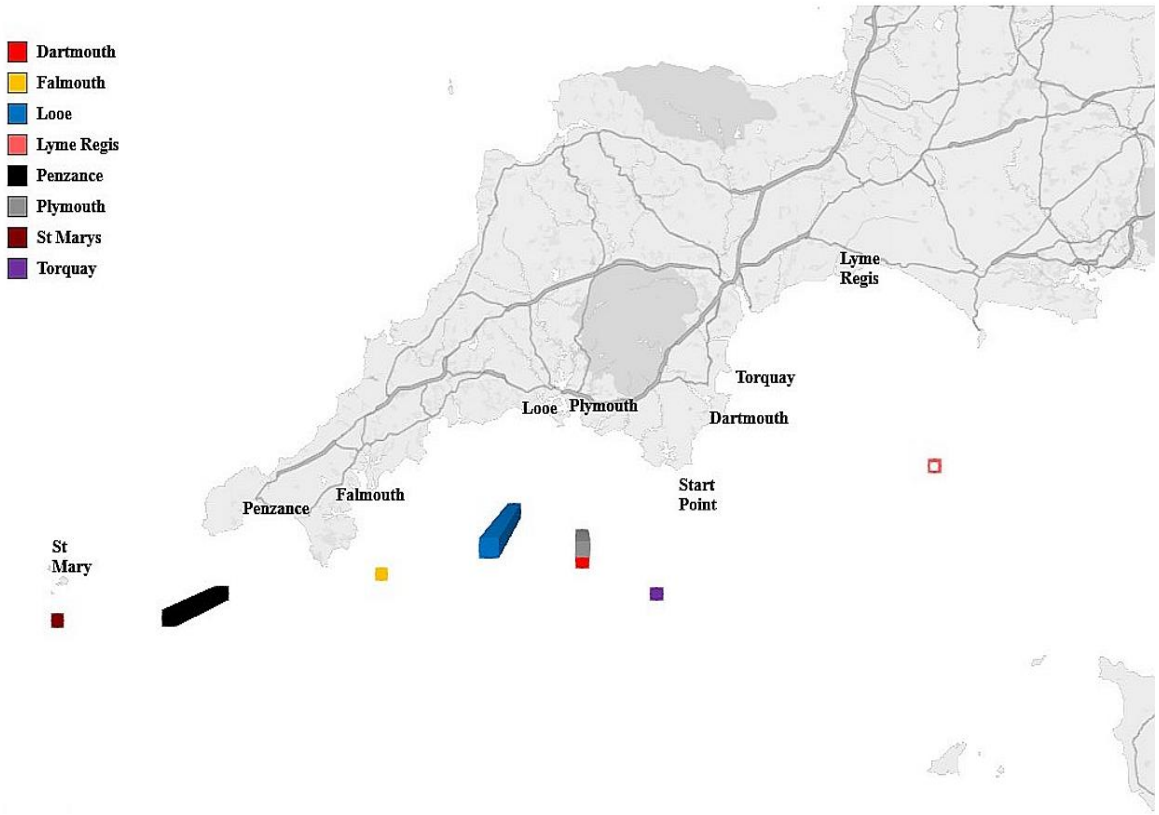
Table 3 continued. Nominal Catch Per Unit Effort (CPUE) for Blue Shark from 1953-2021.

	Dartmouth	*Falmouth*	*Looe*	*Lyme Regis*	*Penzance*	*Plymouth*	*St. Mary's*	*Torquay*	*Sub Total*
1996			1.01						1.01
1997			0.69						0.69
1998			0.79						0.79
1999			0.52						0.52
2000			0.12						0.18
2001			0.86						0.86
2002			0.16						0.16
2003			0.24						0.24
2004			0.37						0.37
2005			0.24			1.00			0.24
2006			0.37			0.07			0.35
2007			0.45			0.74			0.47
2008			0.59			1.27			0.65
2009			0.64		2.50	2.57			0.91
2010			1.49		1.67	4.63			1.80
2011			2.20		3.97	6.00			2.64
2012			1.78		4.10	6.19			2.30
2013			2.04		6.70	9.34			3.24
2014			1.63		5.86	8.05			2.58
2015			2.64		17.02	11.67			5.33
2016			5.82		20.43	16.24			8.81
2017			5.87		24.71	13.48			8.85
2018	1.21		4.11		8.23	13.26			5.87
2019	2.40	1.82	2.81	0.00	6.39	5.22	0.67	0.91	3.30
2020	2.63	9.75	3.05		22.87	7.83	3.00	3.00	6.93
2021	3.00	9.07	3.25		15.53	5.96	2.44	1.75	5.09
Mean									1.92

Table 4. Summary of length frequency analysis by sex for Blue Sharks captured from Looe for 1998-2011.

	Male	*Female*
Mean	179.14	190.71
Median	182.88	193.04
Standard deviation	30.91	27.09
Standard error	3.26	0.85
Max size (cm)	241.3	271.78
Min size (cm)	91.44	106.68
n	90	1007

Figure 1. Map of recreational Blue Shark total captures from the Southwest of England from 1998-2021. Lines indicate positions as mean latitude and longitudes fished from each port. Size of bars denotes total numbers from each port. N= 29160.



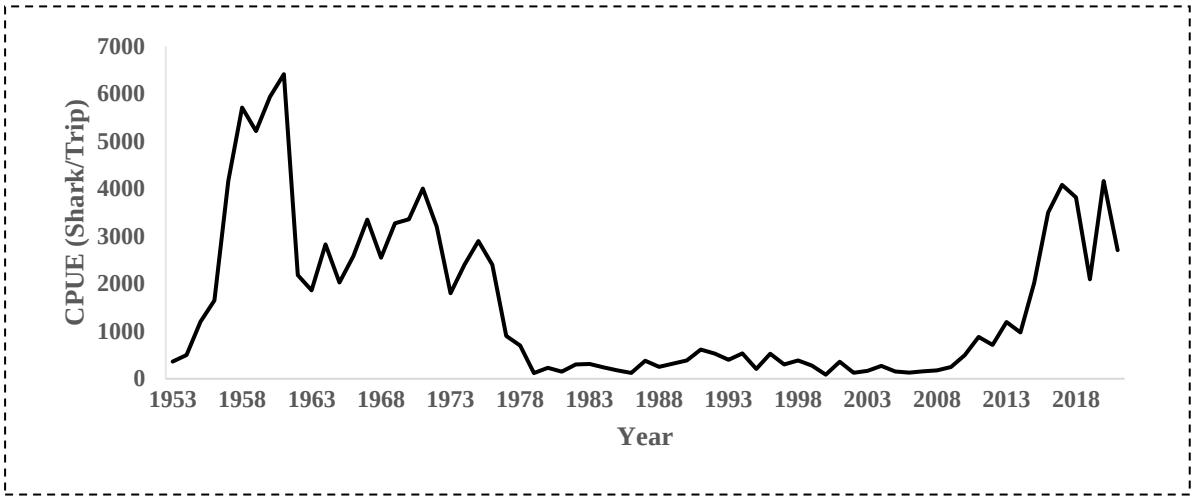


Figure 2. Recreationally captured Blue Shark captures from the Southwest of England from 1953-2021.

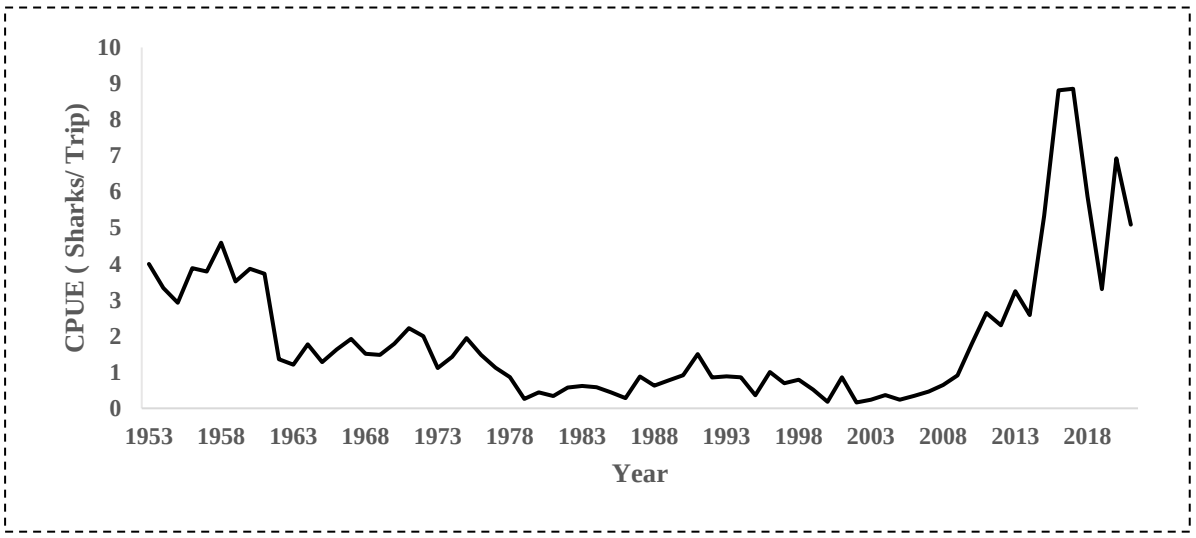


Figure 3. The yearly mean nominal Catch Per Unit Effort (CPUE) for Recreationally captured Blue Shark from the Southwest of England for 1953-2021.

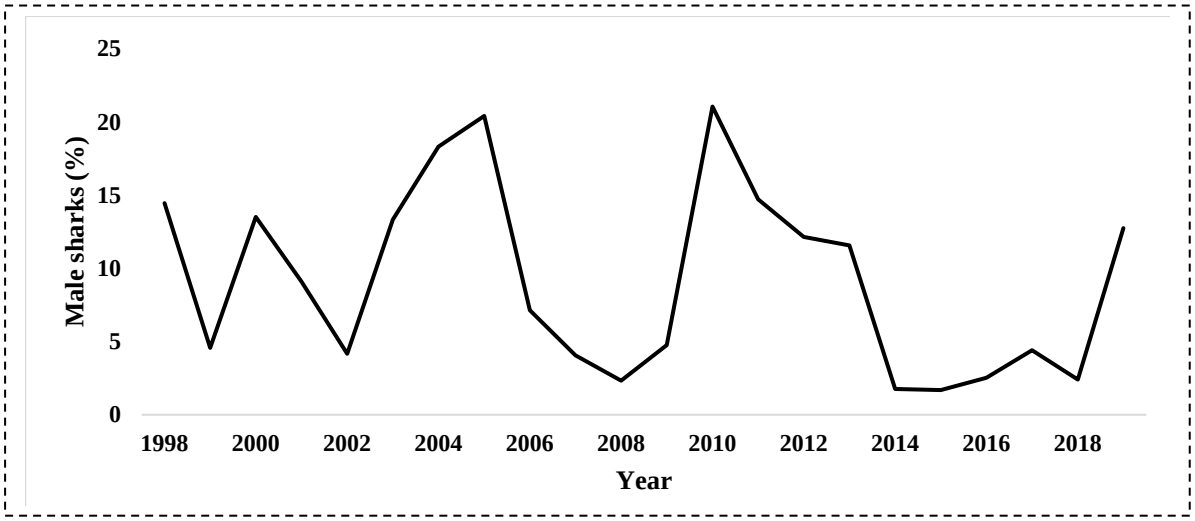


Figure 4. Percentage of male Blue Sharks captured from the Southwest of England from 1998-2019. N=11001.

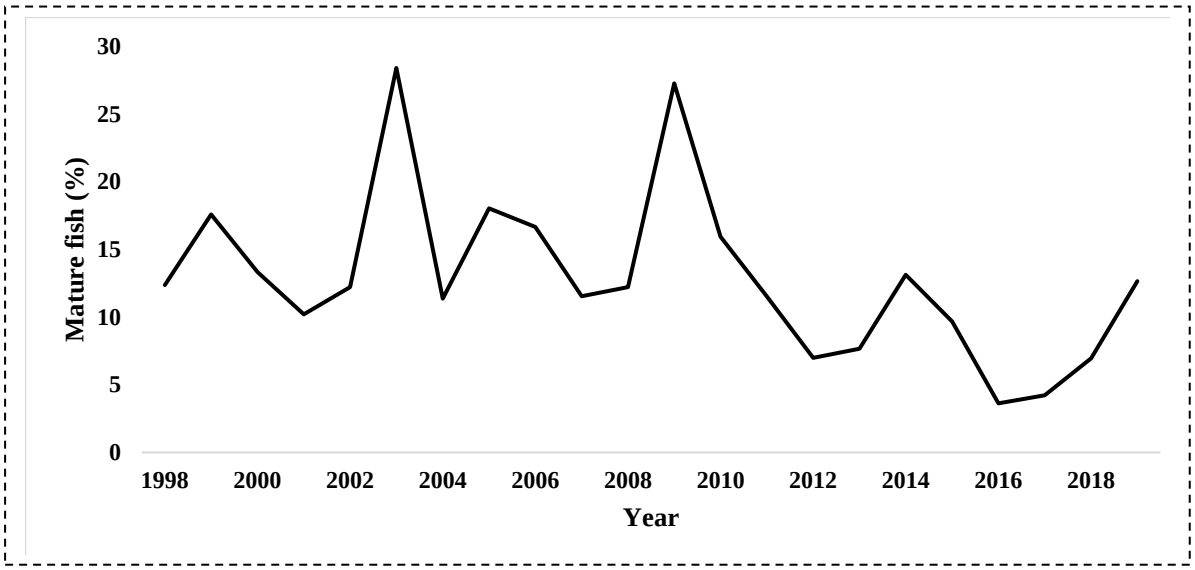


Figure 5. Percentage of mature (>215 cm) blue sharks captured from the Southwest of England from 1998-2024. Data from the SACGB subset. N=14948.

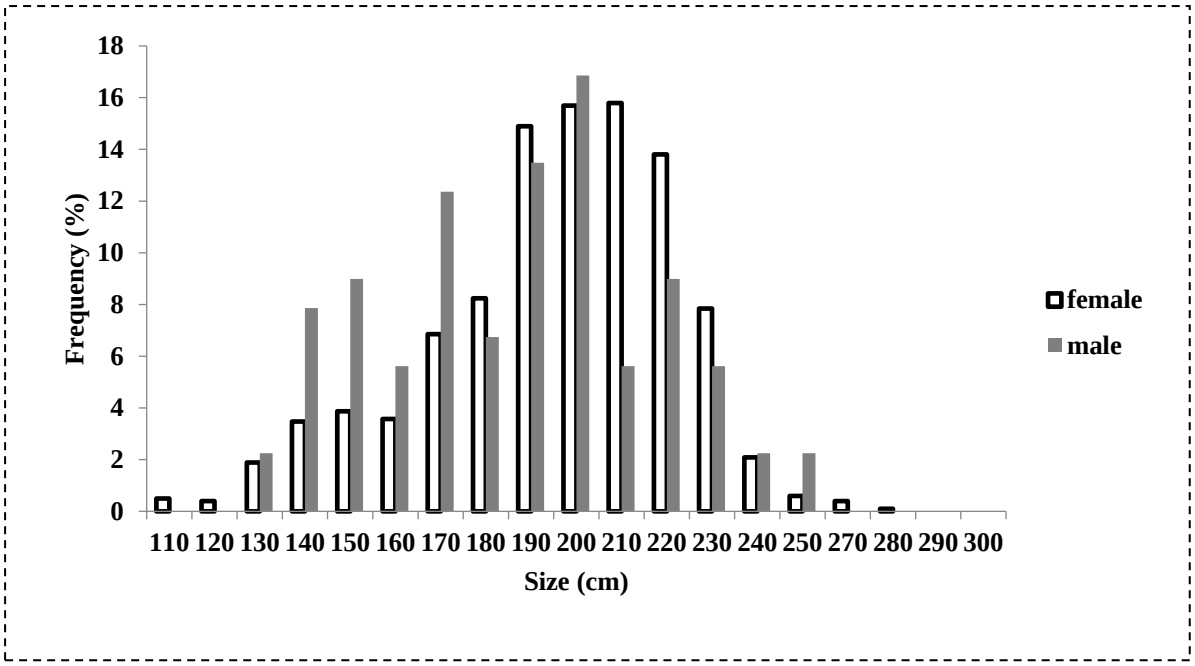


Figure 6. Length (Fork length) frequency of Blue Sharks captures by sex from the port of Looe from 1998-2011. N= 1097.

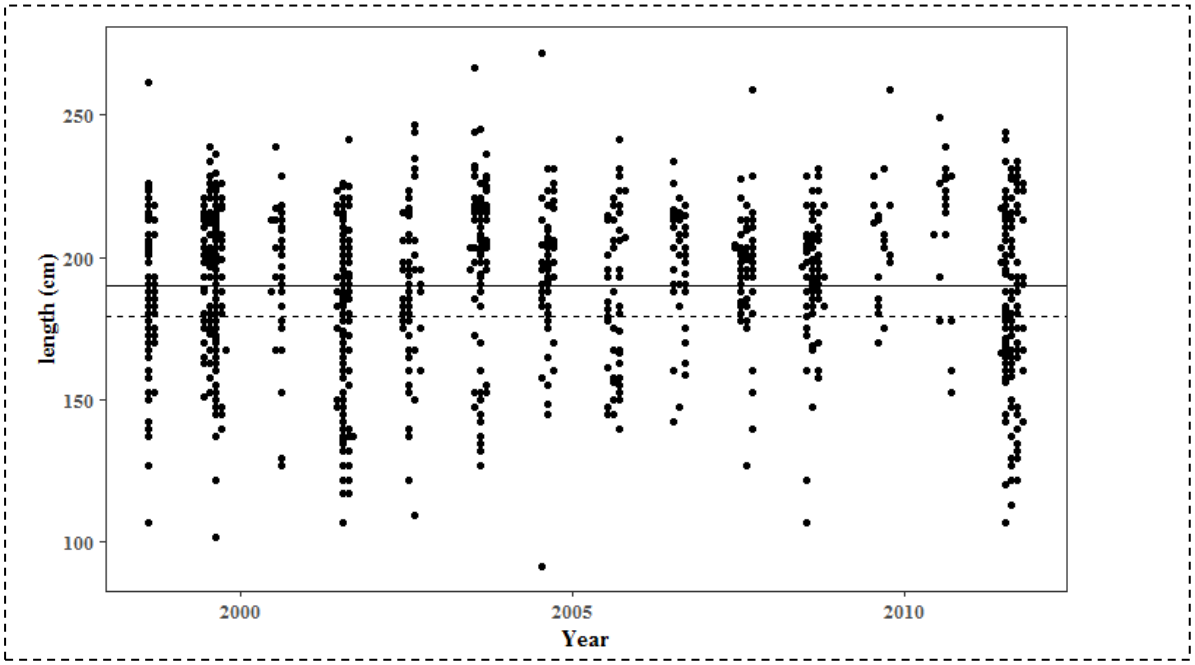


Figure 7. Fork lengths of Blue Sharks captures from the port of Looe from 1998-2011. N= 1097. Dashed line is mean size of male fish and unbroken line female fish, per the period 1998-2011.