

RECENT DATA (2007-2013) FROM THE IRISH BLUE SHARK RECREATIONAL FISHERY

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SUMMARY

Updated results from the blue shark recreational fishery in Ireland are presented spanning the period 2007-2013 for the purposes of the 2015 ICCAT stock assessment. Catch and tagging data from 2007-2013, including CPUE data from the total fishery (i.e. from all reporting skippers), and long-term catch data collected from a subset of reliable angling charter vessel skippers, are presented. CPUE for the total fishery dropped from 1999/2000 onwards, compared to the 1987-1998 period and has remained relatively stable at these reduced levels. Blue shark angling effort has reduced substantially in recent years, arising from decreased numbers of participants in the recreational fishery, as well as lowered catch rates. The tagging programme commenced in 1970 and continues to the present day. Up to 2013, a total of 18,278 blue sharks were tagged, with 895 reported recaptures. This includes 1,431 new tagging events and 83 recaptures since the last report to ICCAT in 2008. Recapture rates were higher than those reported previously. Numbers of blue sharks tagged, however, are much reduced from the numbers tagged in the 1990s.

RÉSUMÉ

Les résultats actualisés de la pêche récréative de requin peau bleue opérant en Irlande sont présentés sur une période s'étendant de 2007 à 2013 aux fins de l'évaluation du stock de 2015 de l'ICCAT. Le document présente les données de capture et de marquage de 2007 à 2013, incluant les données de CPUE de toute la pêche (c-à-d. de tous les capitaines qui ont déclaré) et les données de capture à long terme recueillies par un sous-ensemble de capitaines dignes de confiance opérant des navires de pêche à la ligne de location. La CPUE pour la totalité de la pêche a chuté à partir de 1999/2000 par rapport à la période 1987-1998 et elle est demeurée relativement stable à ces niveaux réduits. Au cours de ces dernières années, l'effort exercé sur le requin peau bleue par les pêcheurs à la ligne s'est considérablement réduit ; cela est dû au fait que le nombre de participants à la pêche récréative a chuté, tout comme les taux de capture. Le programme de marquage a commencé en 1970 et se poursuit encore actuellement. Jusqu'en 2013, au total, 18.278 requins peau bleue ont été marqués et 895 récupérations ont été déclarées. Ces chiffres incluent 1.431 nouveaux cas de marquage et 83 récupérations depuis la dernière déclaration de données à l'ICCAT en 2008. Les taux de récupération étaient supérieurs à ceux déclarés antérieurement. Le nombre de requins peau bleue marqués est toutefois bien inférieur à celui des années 1990.

RESUMEN

Se presentan los resultados actualizados de la pesquería de recreo de tintorera en Irlanda abarcando el periodo 2007-2013 con miras a la evaluación de stock de ICCAT de 2015. Se presentan los datos de captura y marcado de 2007-2013, incluidos los datos de la CPUE de la pesquería total (es decir, de todos los patrones que declararon) y los datos de captura a largo plazo recopilados por un subconjunto de patrones fiables de buques alquilados de pesca con caña. La CPUE para la pesquería total cayó desde 1999/2000 en adelante en comparación con el periodo 1987-1998 y ha permanecido relativamente estable en estos niveles reducidos. El esfuerzo de pesca con caña dirigido a la tintorera se ha reducido sustancialmente en años recientes, con motivo del número cada vez menos de participantes en la pesquería de recreo, y también han descendido las tasas de captura. El programa de marcado comenzó en 1970 y continúa actualmente. Hasta 2013, se marcaron en total 18.278 tintoreras y se declararon 895 recapturas. Esto incluye 1.431 nuevos eventos de marcado y 83 recapturas desde el último informe a ICCAT, de 2008. Las tasas de captura fueron superiores a las declaradas previamente. Sin embargo, el número de tintoreras marcadas es mucho menor que el número de tintoreras marcadas en los 90.

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KEYWORDS

Blue shark, sport fishing, tagging, migrations, catch/effort

1. Introduction

Inland Fisheries Ireland (IFI; formerly the Central Fisheries Board) is the statutory state agency charged with conserving, developing, protecting and promoting inland fisheries and sea angling resources. IFI's Marine Sportfish Tagging Programme which began in 1970, followed a perceived decline in the abundance of certain elasmobranch species (Fitzmaurice and Green (2000)), and has developed into an extensive national programme undertaken largely by selected skippers of angling charter vessels. Since its inception, it has provided a large data set on the movements, migrations, and biology of various species of sharks and rays. The results of these studies (1970-2006), have previously been reported by Fitzmaurice and Green (2000), and were presented to the International Commission for the Conservation of Atlantic Tunas (ICCAT; Fitzmaurice *et al.* 2005a, b; Green *et al.* 2009) for stock assessment purposes. Results from the 2007- 2013 tagging and recapture programme for blue shark (*Prionace glauca*) are presented here, which build on the dataset from 1970-2006 (Green *et al.* 2009), and includes Catch Per Unit Effort (CPUE) data for the recreational fishery based on charter skipper's voluntary angling logbook returns. The long-term dataset commencing in 1970 is also presented for comparative purposes. The 2007-2013 data have been submitted to ICCAT for assessment as recommended in 2004 (Anon., 2005).

The blue shark, a carcharhinid shark, is a large pelagic species which is widespread in temperate and tropical waters. A viviparous species, blue shark can exceed lengths > 300 cm TL and are highly fecund producing average litters of 35 pups. Typically they occur in large aggregations which are often size and sex segregated. Listed as Near Threatened (IUCN, 2009) the blue shark is taken on various gears including longlines, gillnets, handlines, rod and reel, trawls, trolls and harpoons in the North Atlantic but mainly as incidental bycatch. The blue shark is one of Ireland's largest and most valuable marine sport fishes (Fitzmaurice and Green, 2000). They are present in Irish waters usually from June to October when they are taken by recreational anglers on rod and line on a catch-and-release basis.

2. Methods

2.1 Tagging

The majority of the blue shark tagged were caught by anglers on charter boats in the recreational fishery and tagged by charter boat skippers. A limited number were tagged by a small number of reliable individual anglers fishing from their own boats. Fish were principally tagged with Jumbo Rototags (Dalton Lifetime Jumbotag) due to their ease of application and durability. Tagging data were recorded by each skipper in a logbook which captured tag number, species, date, location, length, and general observations. On-board weights (kg) were recorded by a small number of skippers. Recapture data are reported to IFI who issue a nominal reward to the captor, and also supply details of the original tagging event.

Based on tagging logbook returns, the number of skippers tagging blue shark each year has fallen from a peak of 50 in 2000 to 21 in 2013.

2.2 CPUE data

IFI has compiled angling catch statistics from a voluntary logbook scheme taken on by many of the charter-boat skippers in the Irish fleet. This programme was introduced in 1978 to monitor angling effort and species trends. Information recorded included: the number of ground fishing (i.e. not targeting pelagic sharks) or shark angling days per skipper per annum (by boat), the catches (by species and estimated weight range), and the number of anglers per vessel per annum. The availability of these data allowed for computation of a CPUE value for the blue shark fishery. Green *et al.* (2009) previously recognized that the number of boats in the recreational fishery is the best available index for effort as each individual boat acts as a discrete angling unit. The number of voluntary angling catch logbooks being returned by charter skippers has reduced considerably in recent years, from a maximum of 105 in 2005 to 15 in 2013.

To provide consistent CPUE data, Green *et al.* (2009) selected ten reliable skippers from various ports around the country. These were well-established, long-term operators with tagging experience, who had been returning fully completed tagging and angling logbooks. Due to retirements, the economic decline, and changes in vessel ownership, only six (or less as stated in results below) of these skippers have been reporting annually since 2007.

3. Results and discussion

3.1 Tagging and recapture data

Blue sharks account for 45% of all 43,376 fish species tagged since the beginning of this national tagging programme (1970). In total, 19,309 blue sharks were tagged (18,278 with Jumbo tags) between 1970 and 2013 (**Figure 1**). This total (19,309), includes an additional 43 fish tagged between 1970 and 2006, that had not been included in the previous report (Green *et al.* 2009), but were identified following a thorough updating and debugging of the tagging dataset. Between 1970 and 2013, a total of 895 recaptures (Jumbo tags) were recorded (**Figure 2**) giving an overall recapture rate of 4.9%. Recapture rates (percentage of blue shark recaptured relative to the total number tagged) fluctuated over the course of the tagging programme (**Table 1**). Tagging and recaptures peaked in the mid-1990s (**Figures 1 and 2**). The higher recapture rate between 2000 and 2006 (10.8%) is likely to correspond to the large number of blue sharks tagged throughout the 1990s, creating a greater likelihood of recapture within the years to follow (**Figure 1 and 2**). A strong relationship between the number of sharks tagged and the number recaptured is evident, as detailed in Green *et al.* (2009). The reason for the higher rate of recaptures post-1988 is unknown (**Figure 3**), although improvements in telecommunication could play a role. Tagging is carried out between June and September each year as blue sharks appear around the Irish coast during this time when water temperatures increase.

Between 2007 and 2013, a total of 1,431 blue sharks were tagged. On average, 21 skippers per annum tagged blue shark over this period. There were 83 recaptures in that time, giving a recapture rate of 5.8%. The numbers of blue shark tagged since the early 2000s have been consistently low, in part, due to a reduced tagging effort caused by the loss of some taggers from the programme as well as a decline in interest in shark angling generally. Since the commencement of the programme, blue sharks have been tagged at a number of locations around the Irish coast (**Figure 4**), with the majority being tagged off the west and south coasts. Between 2007 and 2013, the most common areas within which blue sharks were tagged, were located along the south coast (**Figure 4**). Only a small number were tagged in the Irish Sea which is probably due to the low occurrence of the species probably because of the lower salinities (DEFRA 2010) which are being less suitable for blue sharks. From 1970 to 2013, the lengths for 8,950 tagged blue sharks (jumbo tags only), ranging in size from 45-273 cm Fork Length (FL) (**Figure 5**). Length measurements reported between 2007-2013 range from 54-221 cm total length (TL) (**Figure 5**).

The majority of blue sharks tagged off the Irish coast to date have been female (**Figures 6 and 7**). The overall sex ratio from 1970 to 2013 is 8.3:1 (F: M). However, this is an upward trend over time with ratios each decade ranging from 1:1 to 14:1 in the 1970's, to 4.2:1 to 25:1 between 2000-2013 (**Figure 8**). In the North Atlantic, female blue sharks are estimated to mature between 230-249 cm Total Length (TL) or, 192.6 – 208.4 cm FL (ICCAT 2014). The new recapture dataset (2007-2013) does not indicate a change in the migration pattern, or sex distribution, of blue shark as compared to historical records (1970-2006) (**Figures 9, 10, 11, 13 and 14**).

Distances travelled to date range from 0 – 6,840 km, with a mean distance of 2,286 km and 82% of all recaptures occurred after two years at liberty (**Figure 12**). Within that time, recapture data demonstrates transatlantic movements west towards the mid- and east-Atlantic, and south towards the coast of West Africa. 53% of all recaptures had moved off shore and travelled more than 500 km within 365 days. 75% of recaptures travelled 500 km or more within 730 days (**Figure 12**). Blue sharks recaptured between 2-7 years post-release, on average, were found 3000-4000 km from the Irish coast (**Table 2**), usually in the upper latitudes of the mid-North Atlantic (**Figure 13 and 14**), a known favourite location for immature female blue sharks (Henderson *et al.* 2001). Within IFI's dataset (1970-2013), the furthest nominal distance travelled by a blue shark before recapture was 6,840 km (**Figure 12**). The furthest distance reported by the Co-operative Shark Tagging Programme run by the US National Marine Fisheries Service between 1962 and 2000 was 6,926 km (Kohler 2002). In 2002, a blue shark tagged as part of IFI's programme was recaptured an estimated 6,840 km from its tagging location off the coast of Accra, Ghana only 247 days after its release (**Figure 13**). New records for the longest time at liberty have been recorded since 2006: one blue shark was recaptured in 2008 after 4,326 days (11 years) and another individual was recaptured in 2009 after 6,502 days (17 years) at liberty (the latter two examples were outliers excluded from **Figure 12** but recapture location can be seen in **Figure 14**). Both sharks had returned to the west coast of Europe, an estimated 560 km and 450 km from their original tagging locations respectively.

Blue sharks were primarily recaptured by commercial fishing vessels using mainly long lines, trawls and seine nets and in recent years baited hook long lines (LLHB) (**Figure 15**). Only 2.4% were recaptured by anglers. In total 8% of recaptures did not report the method of capture. The impact of tuna long lines on the recapture of blue shark is evident from **Figure 16**. In total, 79% of all blue shark recaptures were made using tuna long lines. This is comparable to, though lower than, the findings of Campana *et al.* (2015), who reported that 96% of the reported blue shark catches in the North Atlantic are caught by pelagic long-lines.

3.2 Catch Per Unit Effort (CPUE) data

For six decades, shark angling has been a niche market for charter angling skippers in Ireland but activity has declined since 1997 (**Figure 17**). The CPUE for the entire fishery from 2007 to 2013 has fluctuated between 1-2 sharks per boat per day, a decrease from the high values of the late 1980s and 1990s (**Figure 18** and **Table 3**).

The subset of reliable skippers selected to provide a refined CPUE index has reduced from ten to a pool of six periodically active skippers which may render the dataset somewhat less robust than previously although the subset continues to provide a good index for the national catch dataset (**Figure 19**). The 'reliable skippers' dataset (2007-2013), together with the historical data, are presented in **Figures 20, 21, 22** and **Table 4**. A consistent decline in effort since 1995 is evident (**Figure 20**). Recent catch figures have remained close to the low levels first noted in 2002 (**Figure 21**). Examination of the CPUE for the reliable skippers, suggests a modest improvement in 2011 and 2013 compared to the low values recorded from 1997-2009 (**Figure 22**). This is consistent with the pattern for the entire fishery (**Figure 18**). A poor CPUE in 2012 may reflect the limited fishing opportunities arising from the inclement summer weather patterns observed that year. Similarly, the slightly improved CPUE in 2013 may have been due to the more favourable angling conditions in that year (Met Eireann 2012 and 2013). Overall, the dataset shows a reduction in blue shark fishing effort, a long-term reduction in blue shark catch, and a modest relative improvement in CPUE trend since 2009.

4. Conclusions

The tagging results are consistent with previous data from this programme. The updated and debugged dataset from Irish waters, completed in 2015, will allow for more extensive analysis.

Blue shark abundance (CPUE) in Ireland has declined since the mid-1990s, and in recent years persisted at the low levels first observed in the mid-2000s. Participation in the blue shark sport fishery in Ireland has declined probably reflecting reduced catch opportunities. The status of the species in the Irish recreational fishery remains a concern despite the relative stability in abundance in recent years.

Acknowledgements

This long-term tagging programme and its outputs would not have been feasible without the ongoing support of a large number of sport fishing charter skippers in Ireland who carry out the tagging and data logging on a voluntary basis. Grateful thanks to all and to the anglers who captured the fish. Special thanks to Peter Green, who managed this programme up to 2007, for his dedication and enthusiasm up to his retirement from IFI in 2007. This ongoing research is funded and staffed by Inland Fisheries Ireland.

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Table 1. Recapture rate (percentage recaptured out of total number tagged) for blue shark over time.

Years	Recapture rate (%)
1970-1987	1.03
1988-1999	5.4
2000-2006	10.8
2007-2013	5.8

Table 2. Mean nominal distance (km) travelled by recaptured blue shark.

Years at liberty	< 1		1 - 2		2 - 3		3 - 4		4 - 7		7 - 12		12 - 18	
	Dist. (km)	SD	Dist. (km)	SD	Dist. (km)	SD	Dist. (km)	SD	Dist. (km)	SD	Dist. (km)	SD	Dist. (km)	SD
F	1919	1032	2803	1194	3306	955	3263	1538	1690	*				
M	2310	844	3076	1396	3105	1069	3058	1295	3380	*				
Unsexed	1761	1169	2518	1345	3165	1508	3561	1624	3374	732	560	*	450	*
All blue shark	1853	1113	2676	1306	3219	1281	3398	1531	3187	847	560	*	450	*

*One individual

Table 3. Catch, effort and CPUE data for the entire shark fishery derived from IFI charter skipper voluntary logbook data. Catch= the total annual blue shark catch; effort = total number of days shark fishing per annum.

	Catch	Effort	CPUE
avg. 1978 - 1980	553	211	2.62
1981	169	126	1.34
1982	171	102	1.68
1983	608	163	3.73
1984	386	141	2.74
1985	115	74	1.56
1986	364	140	2.6
1987	275	148	1.86
1988	256	139	1.84
1989	500	238	2.1
1990	907	252	3.6
1991	915	320	2.86
1992	679	277	2.45
1993	1501	359	4.18
1994	1071	339	3.16
1995	1370	498	2.75
1996	1183	337	3.51
1997	1578	411	3.84
1998	749	330	2.27
1999	822	447	1.84
2000	576	362	1.59
2001	832	380	2.19
2002	358	314	1.14
2003	471	284	1.66
2004	128	175	0.73
2005	143	147	0.97
2006	220	140	1.57
2007	190	184	1.03
2008	128	128	1.00
2009	203	102	1.99
2010	140	82	1.71
2011	135	61	2.21
2012	36	37	0.97
2013	130	58	2.24

Table 4. a) Effort (number of days fishing), b) catch (number of blue shark caught) and c) CPUE data for blue sharks from IFI logbook data obtained from 10 ‘reliable skippers’ from 1989- 2006, and 6 ‘reliable skipper from 2007-2013.

a)Effort (number of days fishing)																									
Skipper	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
A	41	32	28	28	19	19	39	25	18	18	17	16	15	6	5	4	10	5	11	6	2	4	8		7
B	16	11	9	5	6	6	6	5	3		10	13	11	7	14	9	8	4							
C			25	8	11	11	16	19	24	20	32	27	18	16	8	15	15								
D			14	5	14	14	11	10	24	8	25	10	16	18	11	18	3	3							
E	26	19	16	17	11	11	17	25	11	13	7	14	11	12	12	14	5	7			5	15	13		
F			9	14	23	23	43	36	35	24	27	15	10	3	11	1	6	4							
G	13		19	14	10	10	16	20	18	12	10	9	14	17	11	8	15	11	2						
H	19	27	25	21	21	21	17	20	17	20	21	14	18	11	14		5	13	9	6	3	3		6	7
I								6	9	10	21	14	13	4	6	5	3	12	21	25	11	16	14	11	17
J	7	11	4	9	9	9	14	13	6	8	15	7	6	6	10	3	3	8	11	11	12	19	10	10	6
Total	122	100	149	121	124	124	179	179	165	133	185	139	132	100	102	77	73	67	54	48	33	57	45	27	37
b) Catch (number of blue shark caught per annum)																									
Skipper	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
A	79	170	76	69	50	50	119	90	75	33	33	31	30	5	6	5	9	9	9	7	6	8	15		4
B	54	44	10	13	25	11	32	27	11		22	24	18	9	31	11	13	6							
C			65	21	18	26	39	73	68	41	60	46	59	16	22	15	16								
D			25	5	93	31	28	24	124	16	86	21	40	21	20	14	1	1							
E	38	39	44	47	97	28	57	70	26	23	16	24	16	9	31	11	4	9			13	60	82		
F			23	36	28	55	148	144	166	61	55	26	24	2	13	1	16	8							
G	51		48	33	38	58	41	75	49	33	10	26	27	30	28	6	21	37	3						
H	35	53	56	44	12	41	51	60	56	52	45	20	42	12	36		8	13	9	0	3	0		8	14
I								21	23	23	19	23	27	1	8	0	5	5	22	16	14	7	8	1	30
J	31	32	9	61	72	52	59	69	14	34	22	29	8	0	11	1	11	16	31	23	26	46	20	19	50
Total	288	338	356	329	433	352	574	653	612	316	368	270	291	105	206	64	104	104	74	46	62	121	125	28	98
c) CPUE for blue shark showing mean and standard deviation (SD)																									
Skipper	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
A	1.9	5.3	2.7	2.5	2.6	2.6	3.1	3.6	4.2	1.8	1.9	1.9	2.0	0.8	1.2	1.3	0.9	1.8	0.8	1.2	3.0	2.0	1.9		0.6
B	3.4	4.0	1.1	2.6	4.2	1.8	5.3	5.4	3.7		2.2	1.8	1.6	1.3	2.2	1.2	1.6	1.5							
C			2.6	2.6	1.6	2.4	2.4	3.8	2.8	2.1	1.9	1.7	3.3	1.0	2.8	1.0	1.1								
D			1.8	1.0	6.6	2.2	2.5	2.4	5.2	2.0	3.4	2.1	2.5	1.2	1.8	0.8	0.3	0.3							
E	1.5	2.1	2.8	2.8	8.8	2.5	3.4	2.8	2.4	1.8	2.3	1.7	1.5	0.8	2.6	0.8	0.8	1.3			2.6	4.0	6.3		
F			2.6	2.6	1.2	2.4	3.4	4.0	4.7	2.5	2.0	1.7	2.4	0.7	1.2	1.0	2.7	2.0							
G	3.9		2.5	2.4	3.8	5.8	2.6	3.8	2.7	2.8	1.0	2.9	1.9	1.8	2.5	0.8	1.4	3.4	1.5						
H	1.8	2.0	2.2	2.1	0.6	2.0	3.0	3.0	3.3	2.6	2.1	1.4	2.3	1.1	2.6		1.6	1.0	1.0	0.0	1.0	0.0		1.3	2.0
I								3.5	2.6	2.3	0.9	1.6	2.1	0.3	1.3	0.0	1.7	0.4	1.0	0.6	1.3	0.4	0.6	0.1	1.8
J	4.4	2.9	2.3	6.8	8.0	5.8	4.2	5.3	2.3	4.3	1.5	4.1	1.3	0.0	1.1	0.3	3.7	2.0	2.8	2.1	2.2	2.4	2.0	1.9	8.3
Mean	2.8	3.3	2.3	2.8	4.2	3.1	3.3	3.8	3.4	2.5	1.9	2.1	2.1	0.9	1.9	0.8	1.6	1.5	1.4	1.0	2.0	1.8	2.7	1.1	3.2
SD	1.2	1.4	0.5	1.6	3.0	1.6	0.9	1.0	1.0	0.8	0.7	0.8	0.6	0.5	0.7	0.4	1.0	0.9	0.8	0.9	0.9	1.6	2.5	0.9	3.5

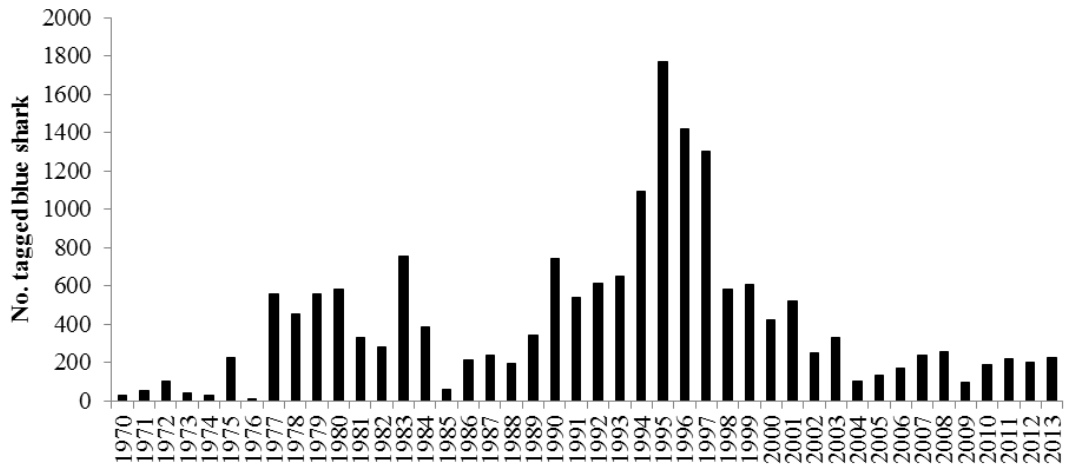


Figure 1. Number of blue shark tagged using jumbo tags per annum (n=18,278).

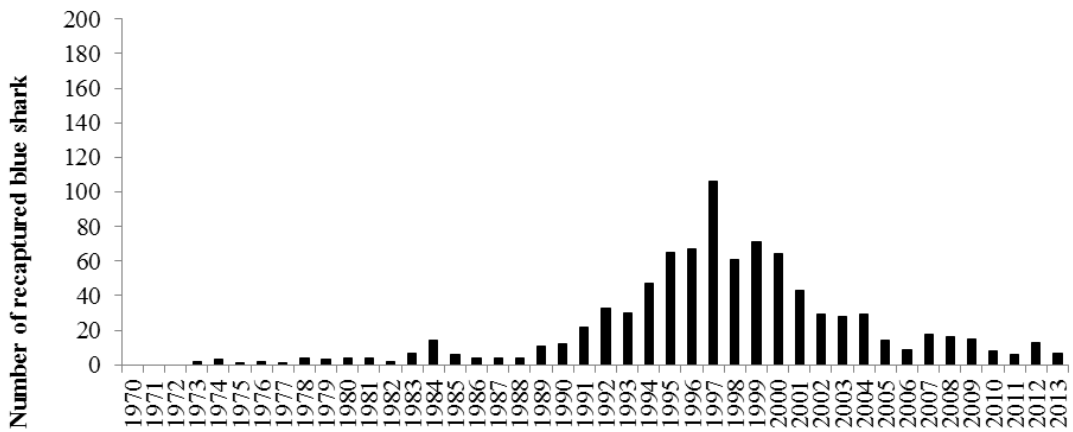


Figure 2. Total number of jumbo tag blue shark recaptures per annum (n=895).

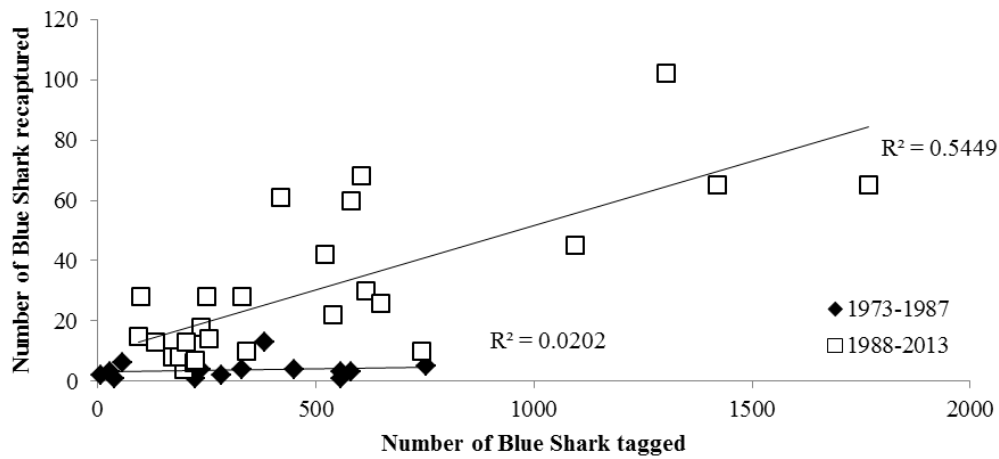


Figure 3. The relationship between taggings and recaptures in 1973-1987 and 1988-2013.

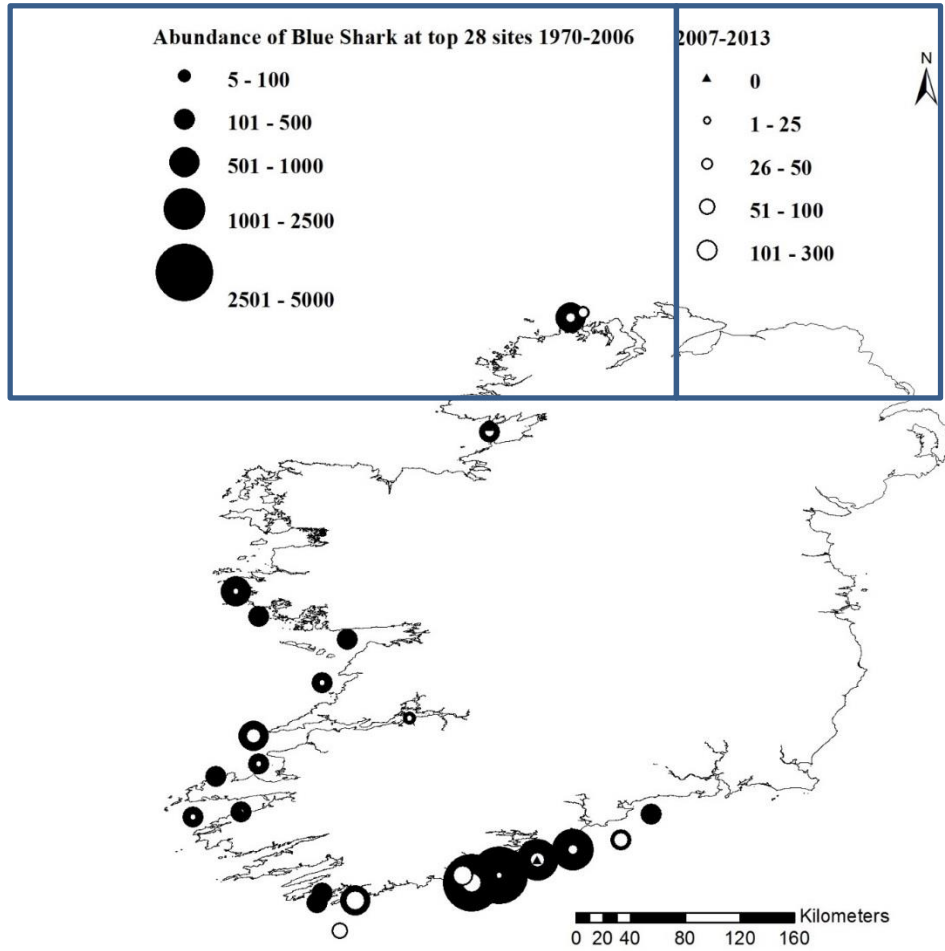


Figure 4. The primary top tagging locations (by port of charter vessel) for blue shark by the Marine Sportsfish Tagging Programme, with abundances of blue shark tagged 1970-2013.

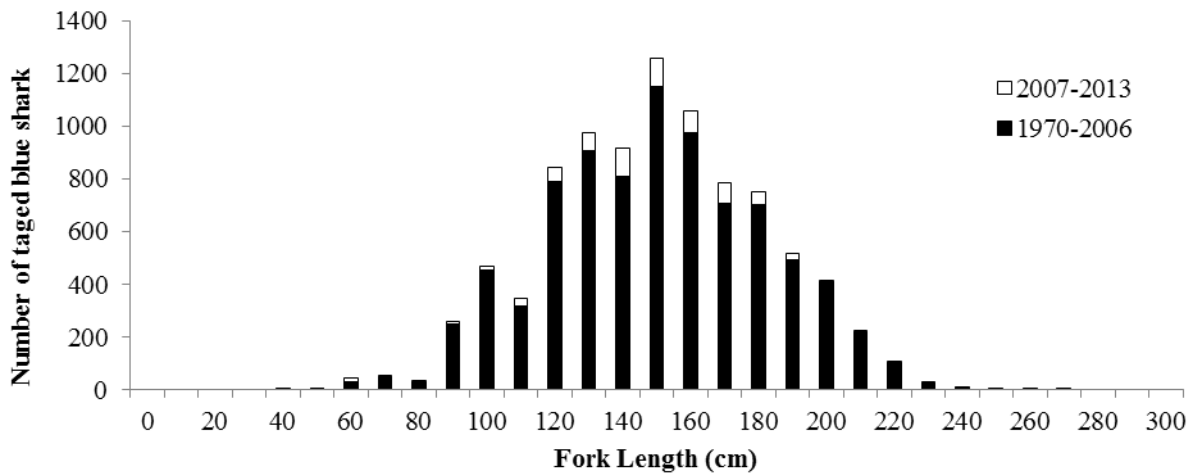


Figure 5. Size distribution of tagged blue shark (n = 8,950).

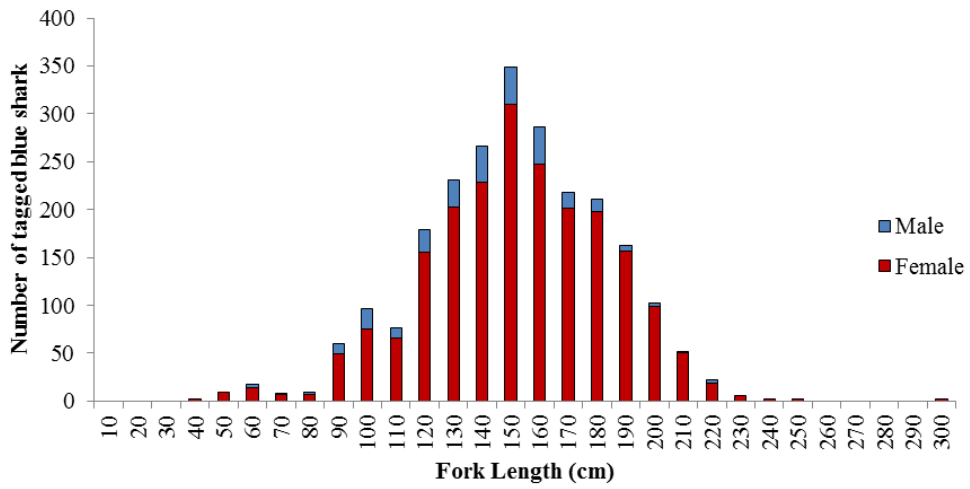


Figure 6. Length frequency distribution of tagged blue sharks (1970-2013).

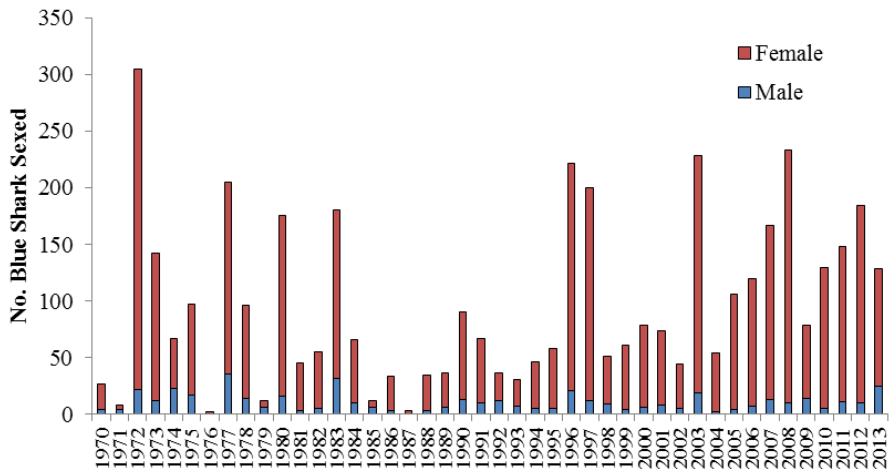


Figure 7. Sex distribution of tagged blue sharks over time.

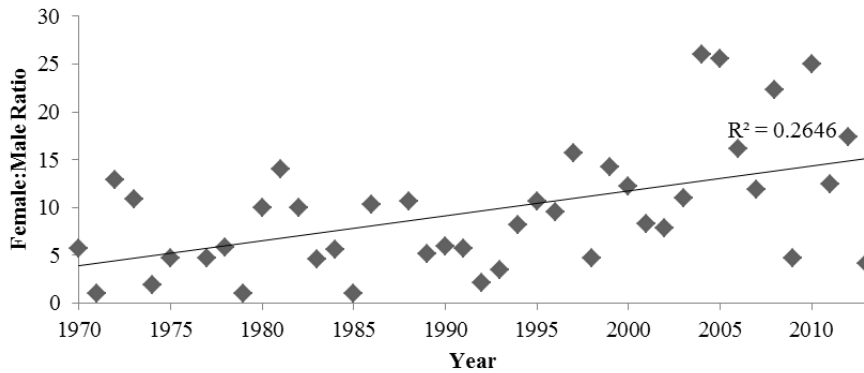


Figure 8. Sex ratio of tagged blue sharks over time.

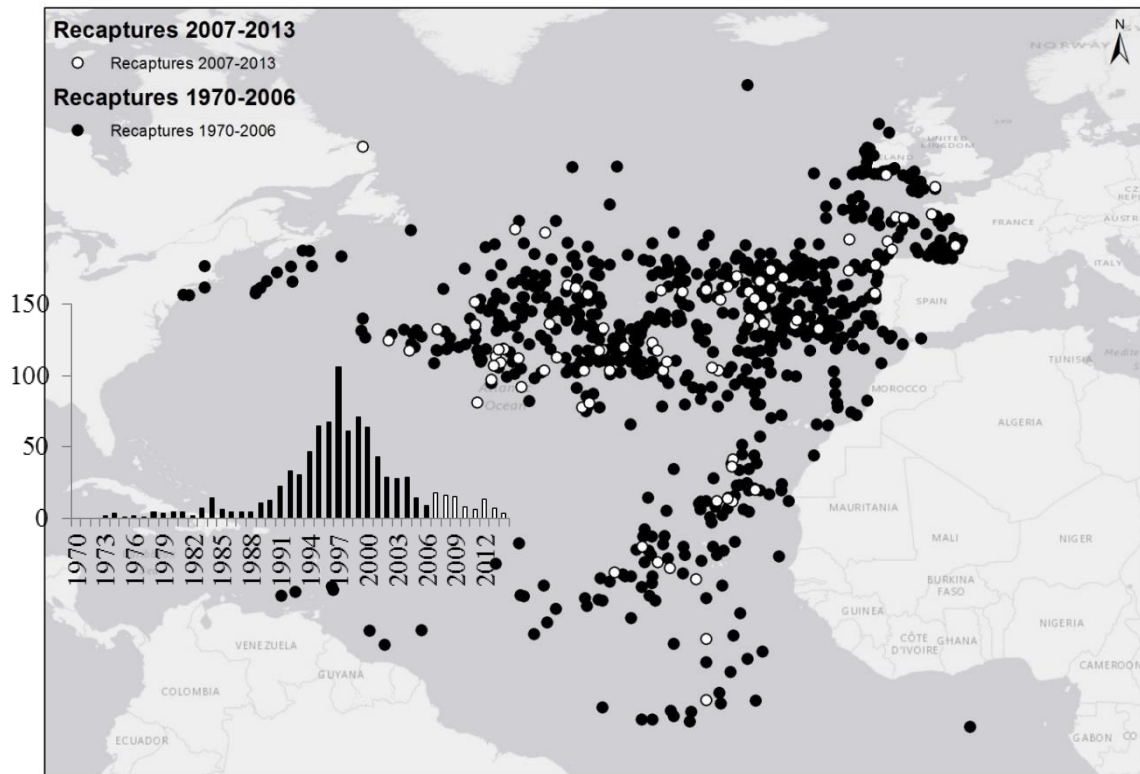


Figure 9. Map of the locations of blue shark recaptures (inset: Number of blue sharks recaptured 1970-2013).

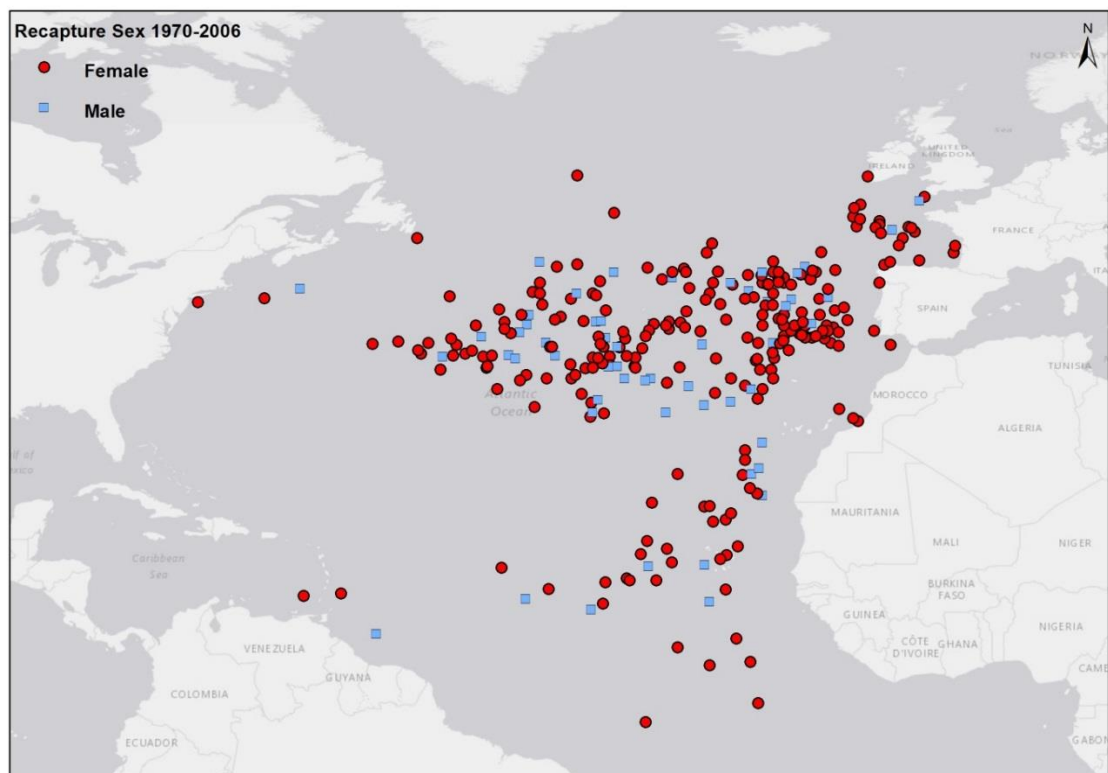


Figure 10. Number and location of male and female blue shark recaptures 1970-2006.

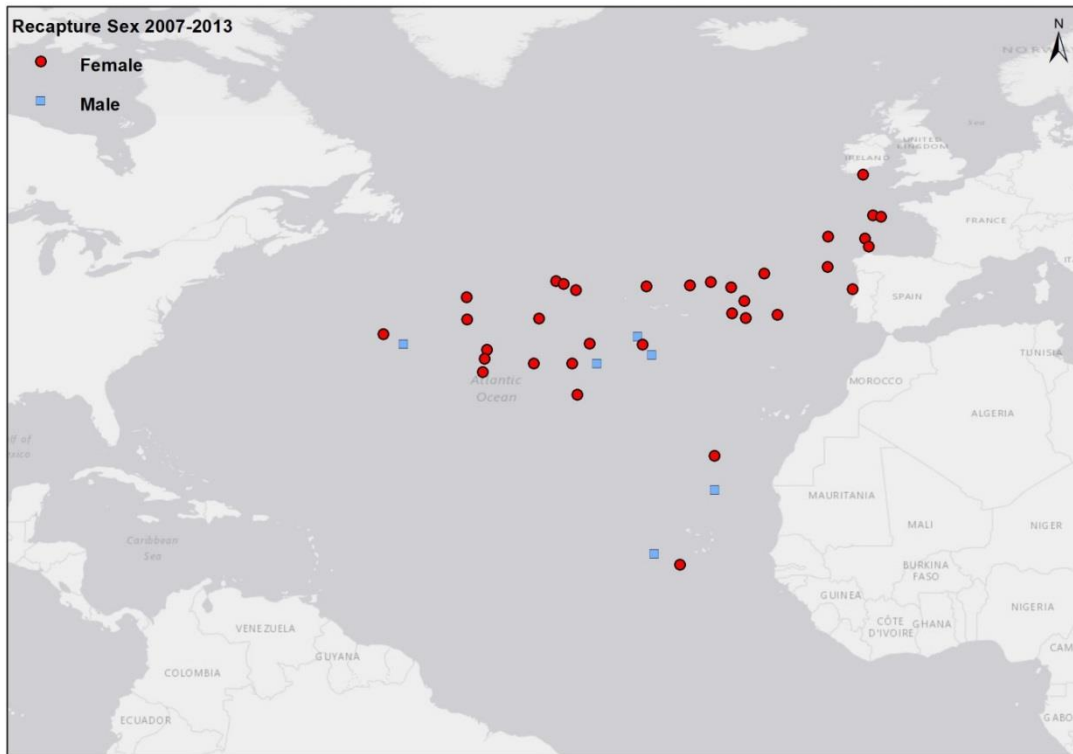


Figure 11. Number and location of male and female blue shark recaptures 2007-2013.

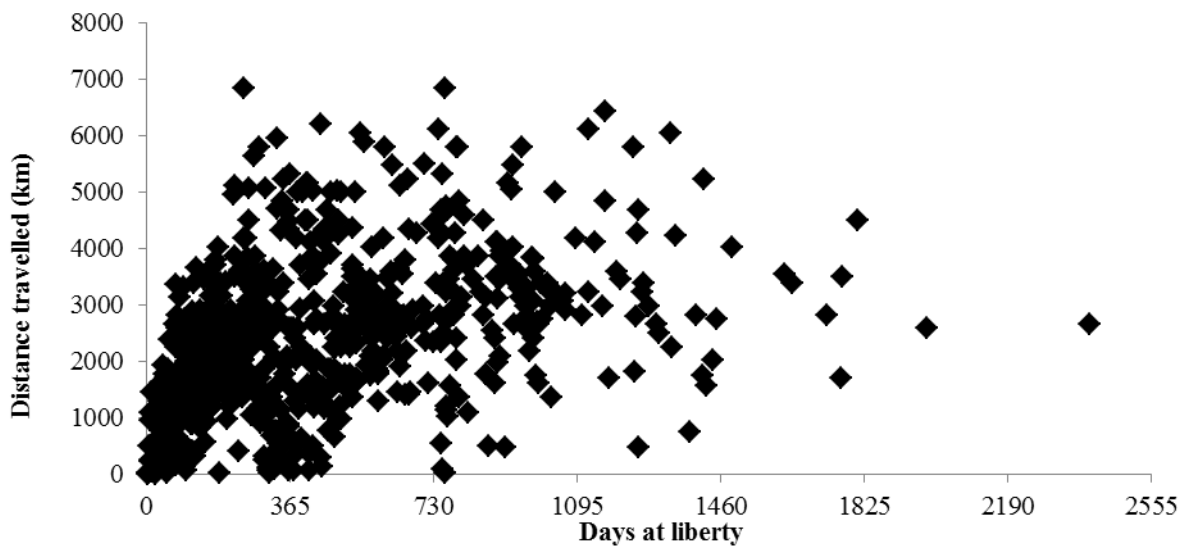


Figure 12. Nominal distance travelled (km) per length of time at liberty (two outliers have been excluded from dataset).

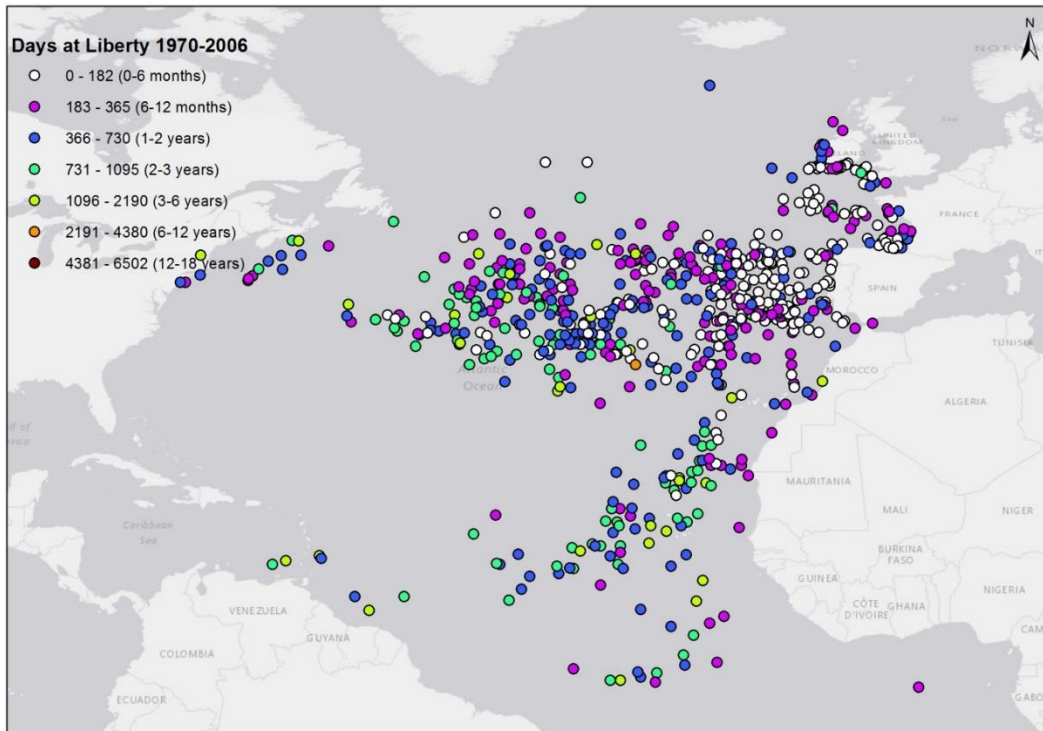


Figure 13. Number of days at liberty for recaptured blue shark 1970-2006.

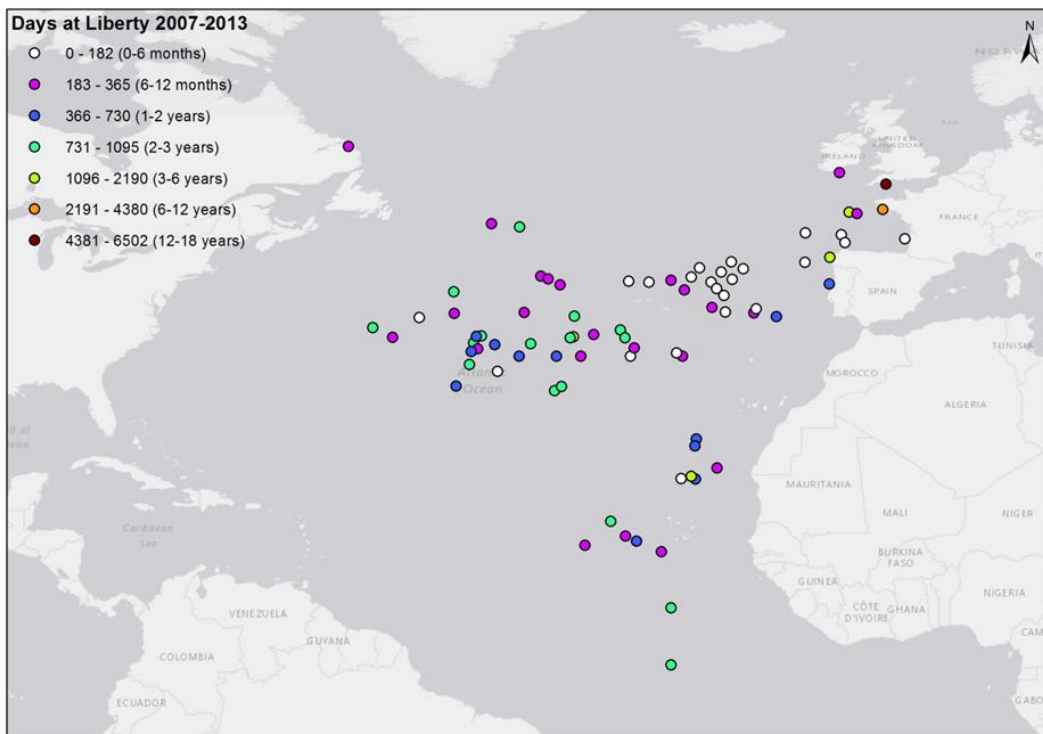


Figure 14. Number of days at liberty for recaptured blue shark 2007-2013.

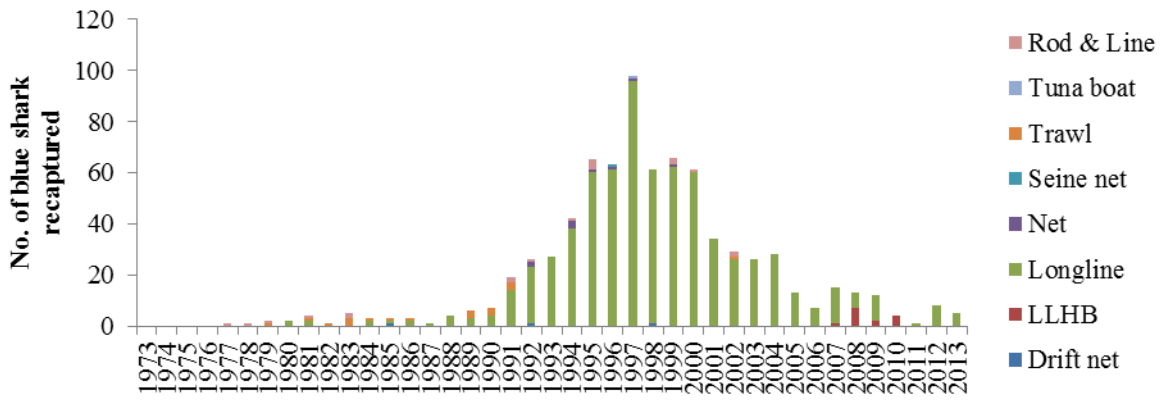


Figure 15. Number of blue shark recaptured per gear type.

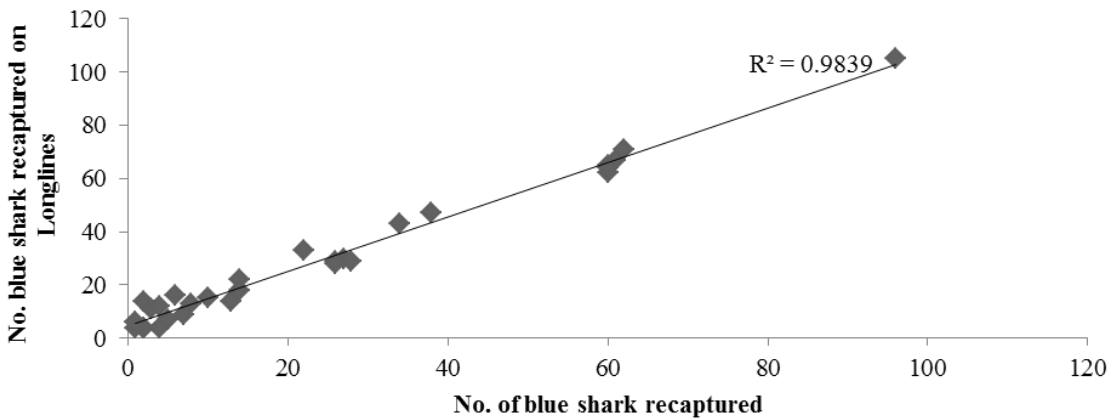


Figure 16. The number of blue shark reported recaptured by long lines plotted against the total number recaptured each year (data available from 1980-2013).

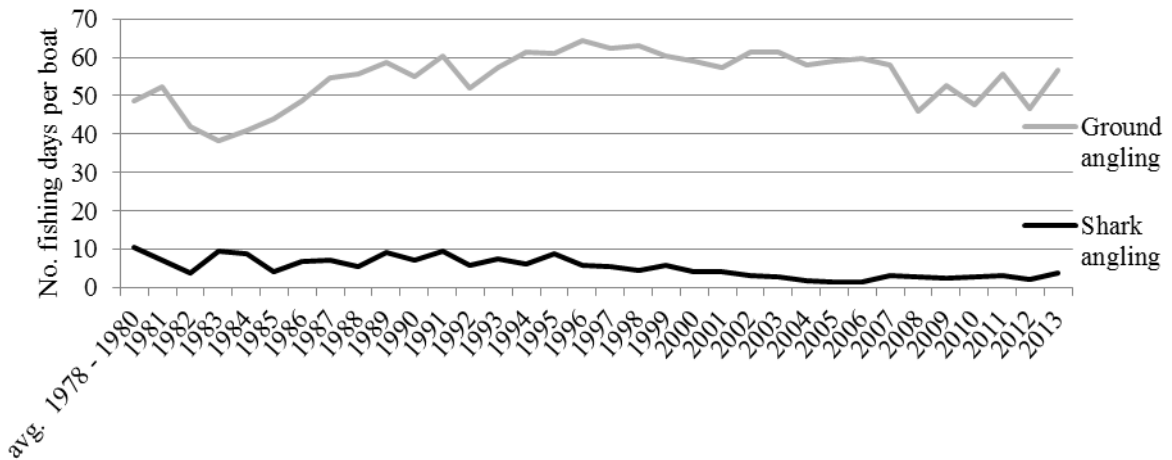


Figure 17. Average number of days per year spent fishing per charter boat.

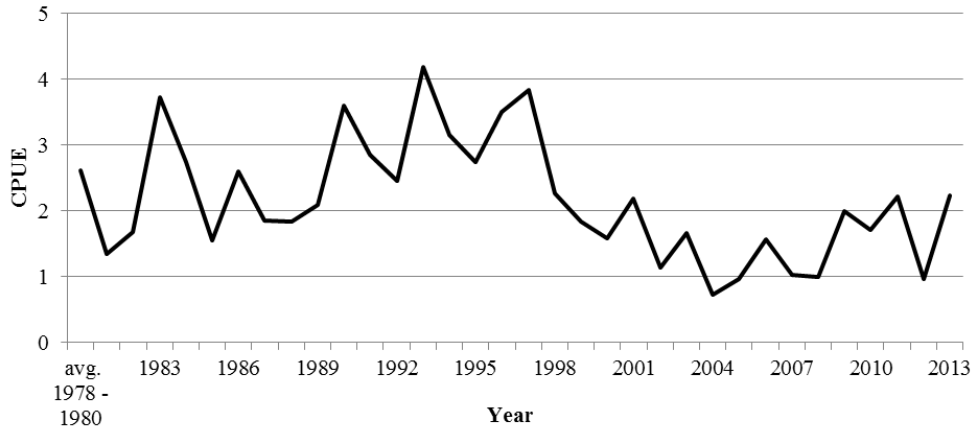


Figure 18. Catch per unit effort (CPUE) of blue shark for all skippers between 1978 and 2013 (from the entire recreational fishery).

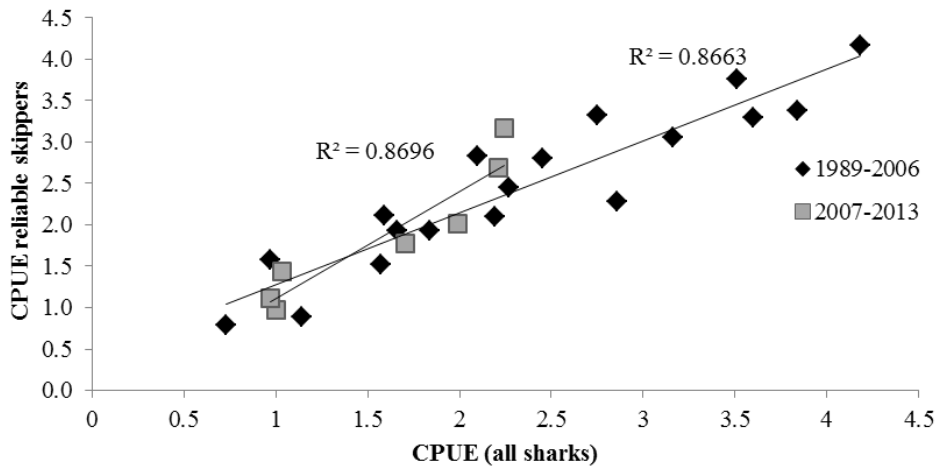


Figure 19. CPUE for the 10 reliable skippers (1989-2006) vs CPUE for 4 reliable skippers (2007-2013).

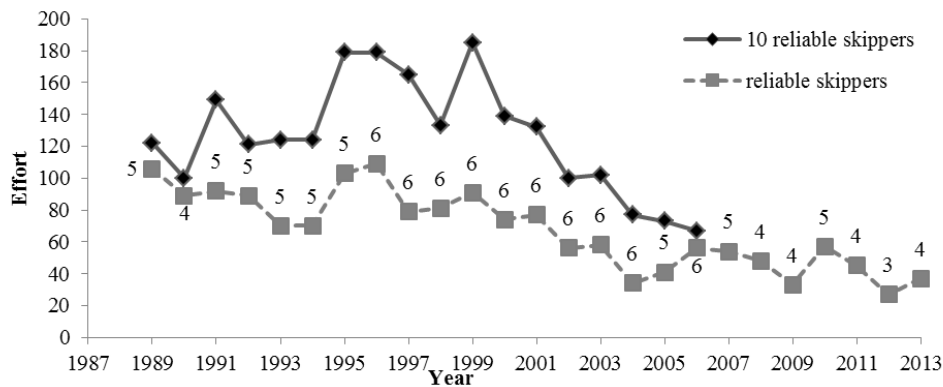


Figure 20. Mean effort (no. of days per annum engaged in shark fishing) between 1989 and 2006 for 10 reliable skippers (solid line) and from 1989 - 2013 (dashed line) for reliable skippers who also provided data after 2006.

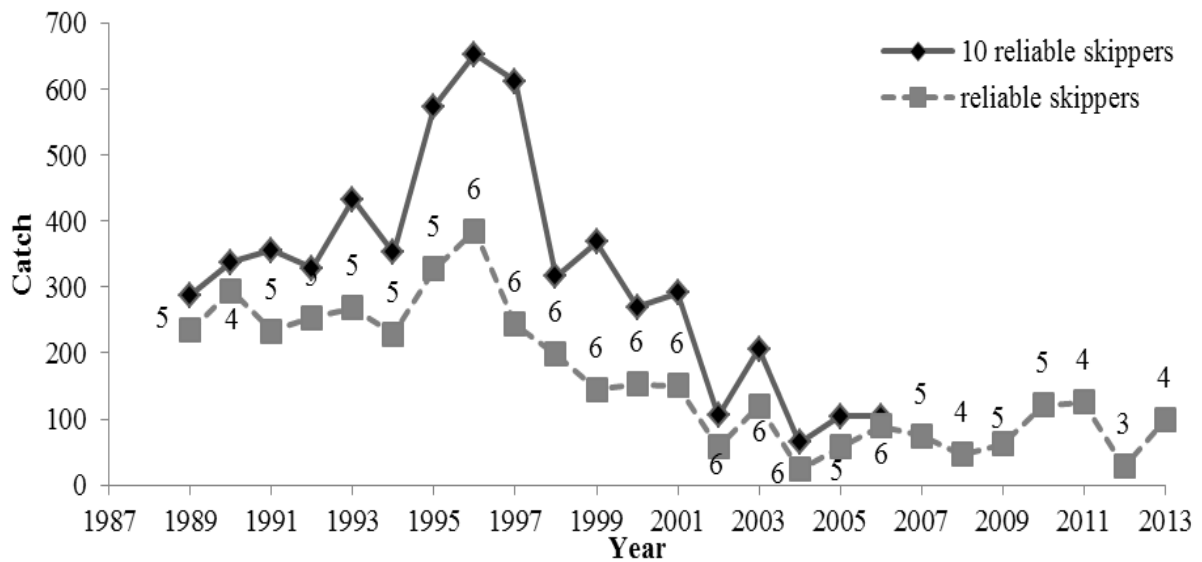


Figure 21. Mean catch (number of blue shark caught per boat) between 1989 and 2006 for 10 reliable skippers and from 1989 - 2013 (dashed line) for reliable skippers who also provided data after 2006.

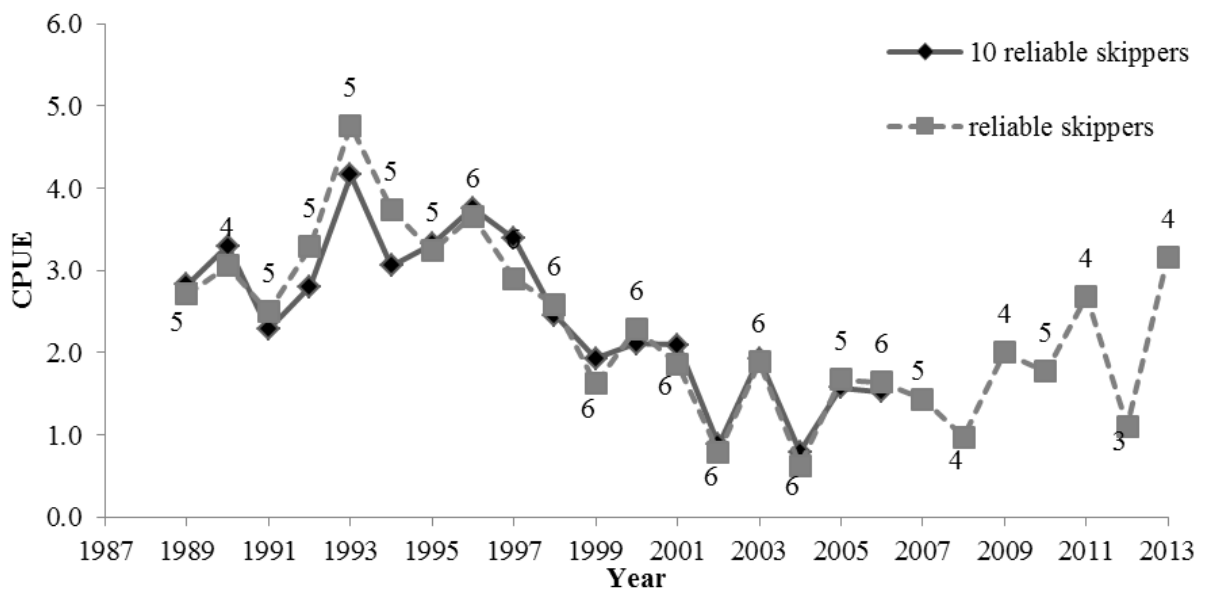


Figure 22. Mean CPUE (number of blue shark caught per boat per day) between 1989 and 2006 for 10 reliable from 1989 - 2013 (dashed line) for reliable skippers who also provided data after 2006.