



# The Isle of Man Shark Tagging Programme

End of Year Report 2023



Written for:

The Department of Environment, Food and Agriculture (DEFA)

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## Introduction

The Small Shark Tagging Programme in the Isle of Man has been operating since May 2013, with Manx Wildlife Trust (MWT) working in partnership with the Department of Environment, Food and Agriculture (DEFA) to collect data. Sharks, rays and skates are currently subject to multiple threats from fisheries and harvest, including small-scale subsistence fishing, large scale harvesting and unintentional bycatch. These species are therefore protected in many jurisdictions. However, little is known about the distribution, movement or population sizes of these cryptic species in Manx waters. The Small Shark Tagging Programme aims to work with local anglers to tag small sharks and rays with identification tags or streamers, on a catch and release basis. It is hoped the data will provide much needed information on the distribution and numbers of these small shark populations. Going forward, this fundamental understanding is crucial in providing effective and evidence-based data for the future management of these species and the best ways to protect them. The present report is a continuation of this programme, summarising the findings of the tenth year.

Since the Small Shark Tagging Programme's inception, 573 individual elasmobranchs, made up of four species, have been caught and tagged in Manx waters. These species include bull huss (*Scyliorhinus stellaris*), spurdog (*Squalus acanthias*), thornback ray (*Raja clavata*) and tope (*Galeorhinus galeus*). A key success of the programme is the recapture of six tagged tope, highlighting the mobile nature of these sharks and the need for international cooperation on their protection.

The Scottish Shark Tagging Programme greatly contributed to the inception of this programme and showed what can be achieved through citizen science. Although the Scottish Shark Tagging Programme disbanded in 2018, the programme was a great source of knowledge and resources to MWT programme. This included the deployment of two officers who trained Manx local anglers in 2013 (funded by DEFA), design of a project logo, and the annual provision of tags/tagging equipment. Then again in 2017, an officer joined MWT for further training and support. In addition, they also increased public awareness highlighting the need for shark protection, the importance of sea angler's conservation efforts, and contributed to over 26 species of sharks, skates and rays being protected in Scottish waters.

Due to the COVID-19 pandemic, the Small Shark Tagging Programme was unable to tag any small sharks or complete further training during 2020. The project resumed in 2021 and was one of the most successful years for shark tagging for the project. This has continued into 2023 with further training provided. To date the project has trained 95 anglers in how to tag small sharks.

### Project Aims:

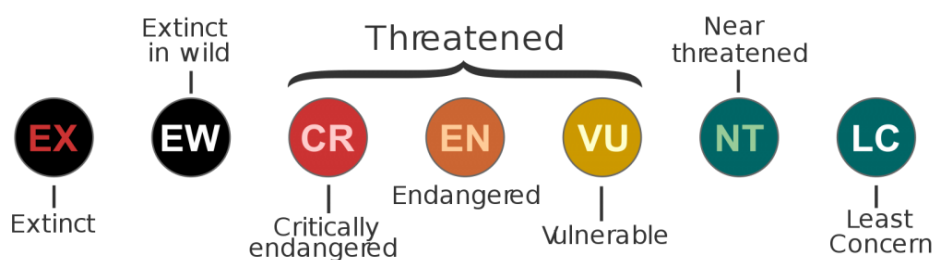
- Promote public awareness on the importance of small shark species and the need for their protection.
- Engage with local anglers to undertake tagging and record subsequent recaptures.
- Utilise the data collected to determine the abundance and distribution of Manx small shark populations.
- Examine local threats to small shark species to inform management plans and conservation activities.

## Species Overview

### *Bull huss*

Bull huss is globally classified as 'Vulnerable' but listed as 'Near Threatened' in Europe by the IUCN Red List, with an overall decreasing population trend (Figure 1; Ellis *et al.*, 2015a; Finucci, Derrick and Pacoureau, 2021). Falling population trends are due to continuously declining numbers of mature individuals and severely fragmented populations (Finucci, Derrick and Pacoureau, 2021). Bull huss experience a high level of exploitation across the species known range, with an overall population reduction of 30% - 49% over the last 48 years (Sherley *et al.*, 2020, Winker *et al.*, 2020). Contrary to this, standardised catch-per-unit-effort (CPUE) data in the Irish Sea and Bristol Channel showed an annual rate of increase of 4.7%. Bull huss is thereby considered locally abundant with a regionally increasing population around the British Isles (ICES-WGEF, 2019).

Females lay eggs two at a time between March and October, taking between 7-12 months to hatch. Sexual maturity is attained for males at 77 cm total length (TL), and females at 79 cm TL, corresponding to an age of four years if hatchling growth rates remain constant (Capapé *et al.*, 2006). This species has a lifespan of approximately 17 - 19 years (Rodríguez-Cabello *et al.*, 2005).



**Figure 1.** The IUCN Red List of Threatened Species categories.

### *Spurdog*

Spurdog is classified as 'Vulnerable' globally by the IUCN Red List (Figure 1; Fordham *et al.*, 2016; Walker *et al.*, 2006), but 'Endangered' in Europe (Ellis *et al.*, 2015b). This assessment is based on a continuing decline in the number of mature individuals and severely fragmented populations. Population genetics has revealed little to no genetic mixing between Northern and Southern Hemisphere populations, even where stocks have overlapping geographic range mixing remains limited (Veríssimo *et al.*, 2010). Within European waters, it is suspected there are three distinct subpopulations (Northeast Atlantic, Mediterranean Sea, Black Sea; Veríssimo *et al.*, 2010). Spurdog are highly migratory, travelling in large, dense aggregations, segregated by size and sex. This aggregating behaviour makes CPUE data an unreliable indicator of population status, as a high CPUE may be maintained even when populations are severely depleted (Ellis *et al.*, 2015b).

Spurdog breed every other year (Holden and Meadows, 1962; Sosinski, 1978; Fahy, 1989), likely mating offshore in winter (Castro, 1983; Compagno, 1984), between October and February (Jones and Ugland, 2001). The central Irish Sea has been suggested as a possible mating site (Dureuil, 2013). Females sexually mature at 74 - 92.5 cm TL and males mature at 57.5 - 64 cm TL (Henderson *et al.*, 2002). The maximum age is at least 40 years (Fahy, 1989), and fecundity increases with size (Ellis and Keable, 2008). The central Irish Sea has been suggested as one of the key mating sites (Dureuil, 2013).

### *Thornback ray*

Thornback ray is classified as 'Near Threatened', with population numbers considered stable in European waters (Ellis, 2016; Ellis *et al.*, 2016). Thornback ray is widespread and one of the more abundant elasmobranchs in the inner continental shelf seas of Europe. Scientific trawl surveys in northern European waters show that relative abundance has been stable or increasing in recent years, following long-term historical declines (McHugh *et al.*, 2011). However, catch analysis from 2000 to 2006 in the North Sea showed 38% of thornback ray were caught prior to reaching sexual maturity (64 cm/~ five years of age; Wiegand *et al.*, 2011). If current fishing patterns continue, it could result in a projected population decline of 90% within 30 years. Therefore, although research indicates that catch rates have increased in core parts of the geographic distribution, this is a recent increase following a longer-term decline.

Kadri *et al.*, (2014) found average age to be at least 15 years. The estimated size at 50% maturity for females have been estimated at 45 cm disc width (DW) and 77 cm TL (eight years), and for males at 42 cm DW and 66.6 cm TL (seven years; Walker, 1998; McCully *et al.*, 2012). This species first spawns in its fifth year (Ryland and Ajayi 1984). The fecundity in British waters has been estimated at between 100 - 140 eggs per year (Holden, 1975; Ryland and Ajayi, 1984). It may not be a continuous spawner and release around 35 eggs over four clutch episodes (Serra-Pereira *et al.*, 2011). The nursery areas used are coastal areas (e.g., the Wash and Thames estuary in the UK).

### *Tope*

Tope is classified as 'Critically Endangered' globally but listed as 'Vulnerable' in Europe by the IUCN Red List, with an overall decreasing population trend (Figure 1; Walker *et al.*, 2020; McCully, Dureuil and Farrell, 2015). Declining population trends have been accredited to severely fragmented populations and a continuing decline of mature individuals (McCully, Dureuil and Farrell, 2015). There is believed to be a single stock of tope in the Northeast Atlantic, extending from southern Norway and Scotland, southwards to the coast of northwest Africa and the Mediterranean Sea (ICES, 2012). Tope landings throughout the Northeast Atlantic region have decreased by 83% in the past twenty years (ICES, 2011). Landings off west Scotland, the Celtic Seas and the English Channel are relatively high, but highly variable (ICES, 2012). Greater abundances of mature individuals have also been found off the northern Irish coast, the southern Irish Sea and the east coast of England (Dureuil, 2013).

This species typically occurs in schools, partially segregated by size and sex (Walker *et al.*, 2008). There is regional variation in size at maturity, in the Northeast Atlantic males mature at 121 cm TL and females mature at 155 cm TL (Dureuil, 2013). Female age-at-maturity varies from 10 - 15 years (average 12.5 years) and maximum age is estimated as 40 years (tag returns suggest a possible maximum age of 60 years; Olsen, 1954; Francis and Mulligan, 1998; Walker, 1999). Tope reproductive cycles vary regionally from annual to triennial, although studies with intensive sampling indicate triennial cycles (Walker *et al.*, 2006; Ebert, Fowler and Compagno, 2013). Average litter sizes are between 20 to 35 pups, with litter sizes increasing in larger females (Ebert, 2003). Shallow, protected bays and estuaries serve as pupping and nursery area where young remain for up to two years (Walker *et al.*, 2006; Bovcon, 2018; McMillan *et al.*, 2018).

## Methodology

The project is advertised locally and interested anglers targeting small sharks are invited to partake in the programme. In 2023, 2 anglers were trained to administer tags. Since the beginning of the programme, 95 anglers have been received small shark tagging training.

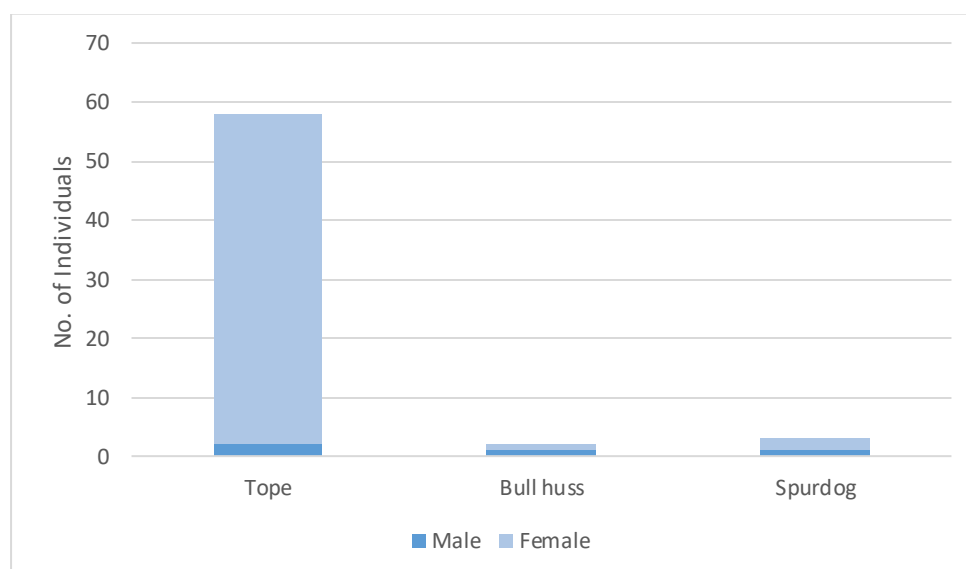
All trained anglers were given a minimum landing size crib sheet, recording cards and tagging equipment (Appendix 1 and 2). Prior to tag application, the condition of each shark was visually assessed to ensure normal appearance and minimum landing size. Any injured or otherwise abnormally appearing sharks, or those below the minimum landing size, would have been rejected from the tagging pool. Next, information was recorded on the species, location, date, length, girth, sex and condition. The tagging equipment consisted of a micro gun with ten micro-tags for tagging smaller sharks. Tag equipment was replaced in small quantities when required, depending on angler's likelihood of being able to fish. One external tag with imprinted unique identification numbers was applied to each fish, which was recorded on the recording card.

The micro-tags were inserted at a 45° angle, then the trigger was pushed to insert the tag. The needle was then removed, and the tag lightly tugged to set the dart. Following tagging, all sharks were released and monitored to ensure normal post capture behaviour. Currently, the data is stored with MWT. Previously data had also been stored with the SSTP. Anglers are able to email tagging information directly to MWT.

## Results

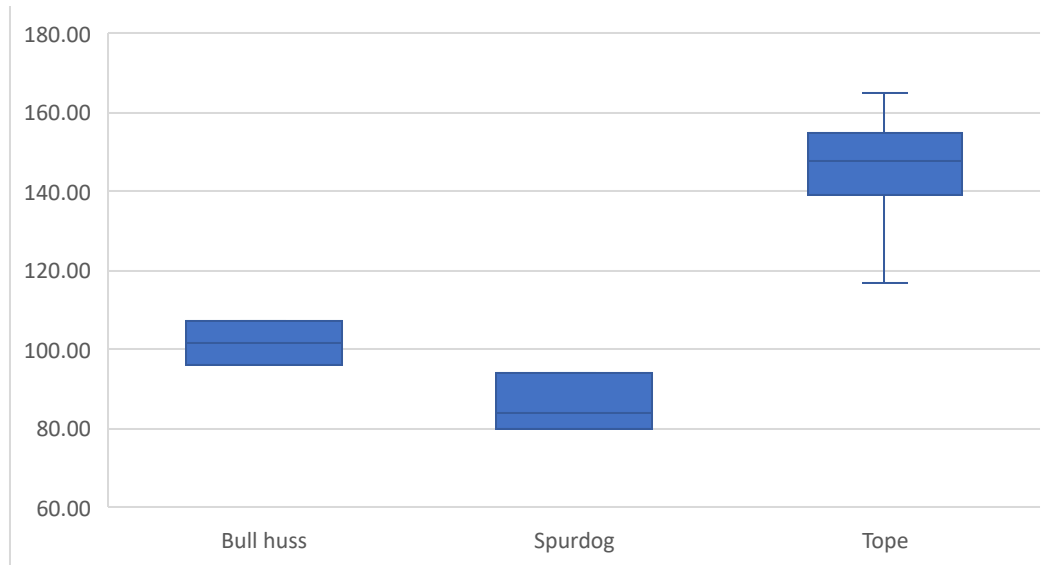
### *Sharks tagged in 2023*

Unfortunately, no boat trips were undertaken in 2023 due to the weather. However, 63 individuals were tagged, including two bull huss, three spurdog and 58 tope (Figure 2). An additional female spurdog and tope were caught and reported but were not tagged. Most individuals caught and tagged were female, as shown in Figure 2. Bull huss was tagged for the second consecutive year since 2014.



**Figure 2.** The number and sex of small sharks tagged in Manx waters during 2023.

The range in length of bull huss was 96.00 – 107.00 cm, with an average length of 101.50 cm ( $\pm 7.78$  cm). Of the three spurdog tagged, the average length was 86.00 cm ( $\pm 7.21$  cm), with a range of 80.00 – 94.00 cm. Tope ranged in length from 105.50 cm to 165.10 cm, with an average length of 145.13 cm ( $\pm 13.90$  cm). Figure 3 shows the range and average length of tagged small sharks from 2023 (Appendix 3).



**Figure 3.** Box plot showing the medium length, and interquartile range (i.e., the range in values of the central 50% of the data) of tagged small sharks in 2023. Whiskers indicate the minimum and maximum lengths recorded.

### *Distribution of sharks tagged in 2023*

Sharks were tagged towards the south, southeast and west of the Island during the 2023 tagging season. This may not reflect an accurate species distribution as anglers tend to fish in areas where certain species are known to be found. Nevertheless, in combination with data obtained in subsequent tagging years, this data may contribute to the identification of hotspots, sex aggregations or nursery areas.

### *Recaptures*

Two Manx recaptures were reported in 2023. All tope, all tagged in 2022, initially tagged off Dalby. They were recaptured off South Portugal and Cadiz, Sapin and landed for market. Two additional tagged sharks were recorded, a tope from Tenerife and a blue shark off Spain, likely from the Scottish tagging programme.

Since 2013 this brings our known recaptures, both local and non-local, to 8. Recaptures provide interesting data, suggesting tope inhabiting Manx waters are migratory across European waters. These recaptures are substantiated by research findings, which consider there to be a single stock of tope throughout European waters (ICES, 2012).

### Comparison of sharks tagged 2013-2023

In total, 573 small sharks have been tagged since 2013 (Table 1). Numbers of tagged individuals have increased over the last three years in comparison to previous years, which were predominantly tope. Whilst numbers in 2023 were down on the successful year previously, they are still an improvement of the numbers seen 2021 and prior. Such high tagging success is in part thanks to the continued support of several anglers and angling charters, Casey J and Gemini.

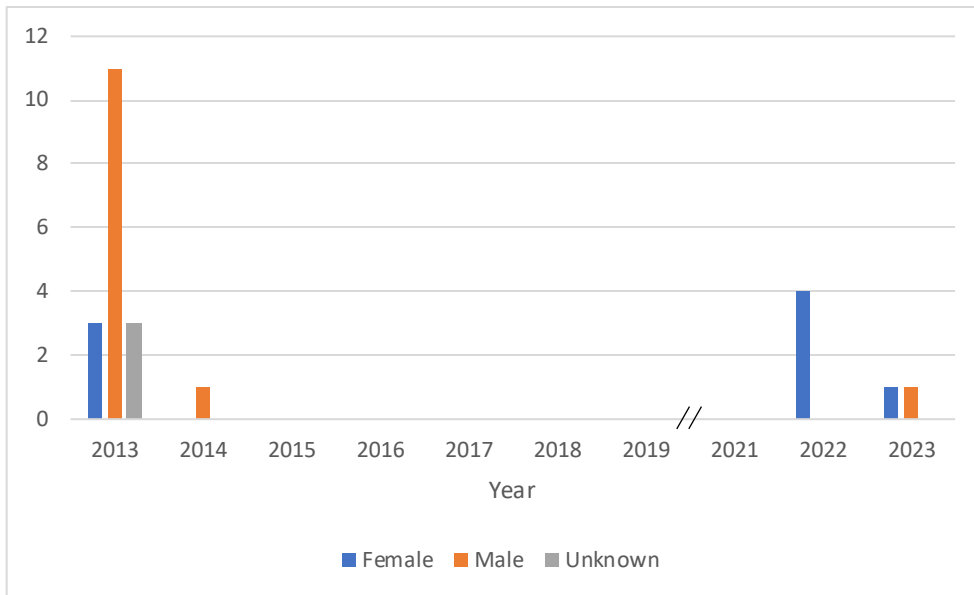
**Table 1.** The number of small sharks per species tagged between 2013 – 2023.

| Species       | Year      |           |           |           |            |           |           |           |            |           |
|---------------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|------------|-----------|
|               | 2013      | 2014      | 2015      | 2016      | 2017       | 2018      | 2019      | 2021      | 2022       | 2023      |
| Bull huss     | 16        | 1         | 0         | 0         | 0          | 0         | 0         | 0         | 4          | 2         |
| Spurdog       | 6         | 1         | 1         | 4         | 90         | 14        | 8         | 31        | 12         | 3         |
| Thornback ray | 0         | 0         | 0         | 0         | 0          | 0         | 0         | 0         | 7          | 0         |
| Tope          | 28        | 22        | 20        | 12        | 40         | 30        | 10        | 22        | 131        | 58        |
| <b>Total</b>  | <b>50</b> | <b>24</b> | <b>21</b> | <b>16</b> | <b>130</b> | <b>44</b> | <b>18</b> | <b>53</b> | <b>154</b> | <b>63</b> |

#### Bull huss

For a second year running bull huss was successfully tagged as part of the programme (Figure 4). Prior to the 2022 and 2023 tagging effort, bull huss had only been tagged in 2013 and 2014 (Table 1). In 2023, a single male and female bull huss were tagged towards the south of the Island off the Chasms and the Sound, compared to the spatial distribution in the 2022 where bull huss were caught off Maughold and the Point of Ayre. In previous survey years, bull huss have exclusively been found off the northwest coast however this new data proves their presence in the water south of the island. It is unclear as to why more bull huss have not been tagged throughout the programme, as research suggests bull huss are locally abundant in the Irish Sea and populations are slowly increasing (ICES-WGEF, 2019).

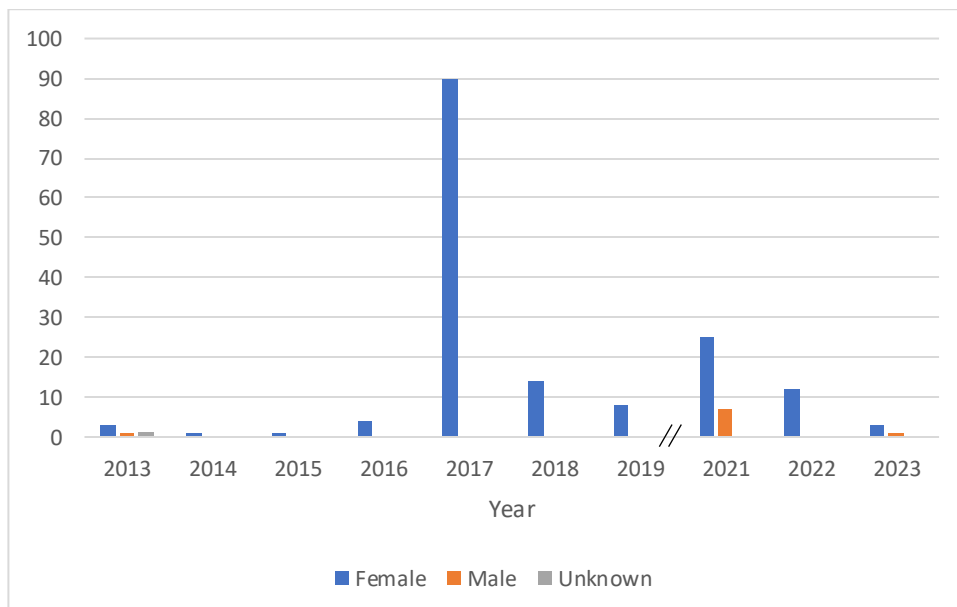
The average length of bull huss caught and tagged is 101.50cm (Appendix 3 – Table 1). Sexual maturity for males and females is reached at 77cm and 79cm respectively, corresponding to an age of four years if growth rates remain constant (Capapé *et al.*, 2006). Both individuals caught during the 2023 season were over the minimum length of maturity. Throughout this project, 78.26% have been over the minimum length of maturity.



**Figure 4.** The number of individual bull huss females (blue) and males (orange), as well as the unidentified individuals (grey) between 2013 – 2023.

### Spurdog

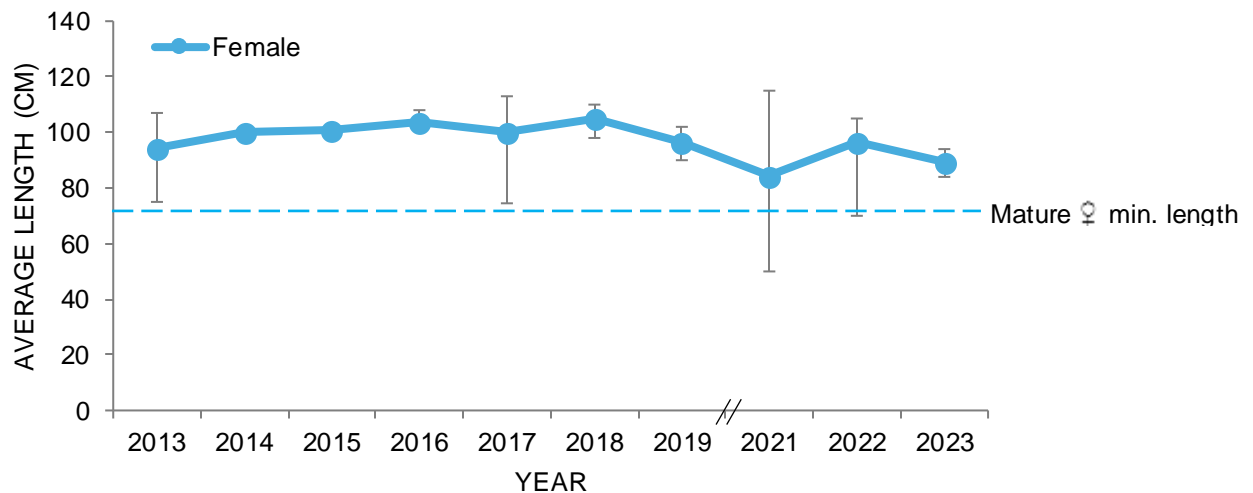
Three female and one male spurdog were tagged during the 2023 tagging effort. Females have been more frequently tagged than males across the entire programme, as shown in Figure 5. The 2023 distribution of spurdog shows they were tagged in waters around the south of the Island. Spurdog travel in large, dense aggregations, segregated by size and sex (Henderson *et al.*, 2002). This makes it unsurprising that females have been primarily tagged but highlights that Manx waters may be crucial migratory routes or pupping grounds for female spurdog.



**Figure 5.** The number of individual spurdog females (blue) and males (orange), as well as the unidentified individuals (grey) between 2013 – 2023.



Figure 6 illustrates the average length of female spurdog between 2013 to 2022 (Appendix 3). The data shows the average to be consistent between 2013 and 2018 before decreasing over the period between 2018 and 2021. In 2022 showed a positive increase in the average length of tagged spurdog continuing into the 2023 season (Figure 6). It is also important to take the spatial distribution and number of spurdog caught and tagged into account when interpreting this data. The minimum total length for females at sexual maturity (50 % certainty) is 74cm (Henderson *et al.*, 2002). Throughout the programme, the majority of tagged females were above this threshold and therefore likely to be sexually mature, indicating that Manx waters may provide nursery grounds for this species.



**Figure 6.** The minimum and maximum length (cm) of tagged female spurdog (whiskers) and average length between 2013 – 2023. Dashed line indicates minimum length of maturity (74 cm). One individual was tagged in 2014, 2015 and 2022 respectively, therefore data was modelled for these years to generate an average length.

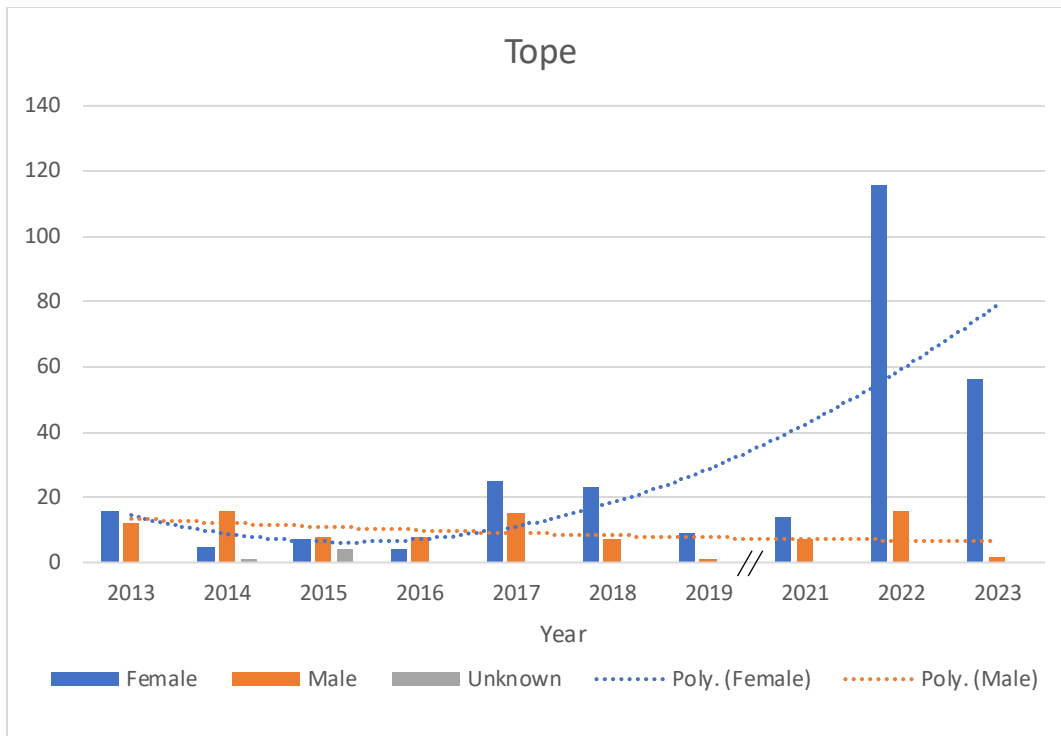
### Thornback ray

No thornback rays were caught this season.

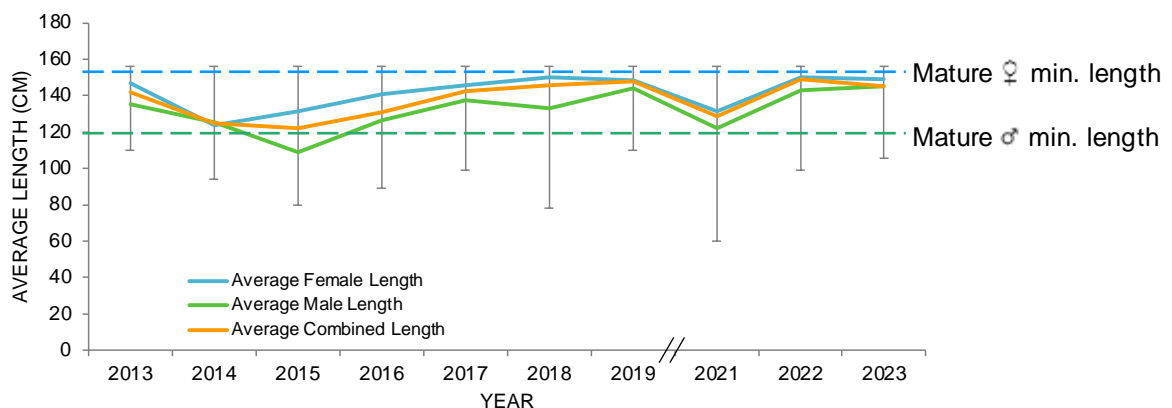
### Tope

Whilst the sex ratio of tagged tope shows annual variation, females have been more frequently tagged than males over the last six years, as shown in Figure 7. The total number of females caught and tagged has increased in the past two years compared to previous years however the numbers in 2023 were less than half that of the prior 2022 season, the number of males caught is both lower and varies annually. The proportion of females to males could be interpreted to suggest that Manx waters may predominantly be used by females, perhaps utilising the area as a small shark nursery ground. However, this is deemed unlikely as the majority of tagged female tope do not meet the 50% certainty of maturity threshold of 155cm TL (Figure 8; Dureuil, 2013). Although male tope have been consistently above the equivalent threshold of 121cm TL (Figure 8; Dureuil, 2013). This may be due to this species typically being partially segregated by size and sex (Walker *et al.*, 2008).

In terms of the distribution of tope during the 2023 survey period, individuals were caught around most of the south particularly around the Calf and the Stack they were also caught up the west coast of the Island and southeast near Derbyhaven.



**Figure 7.** The number of individual tope females (blue) and males (orange), as well as the unidentified individuals (grey) between 2013 – 2023. The curved dotted line indicates average number of males and females over time.



**Figure 8.** The minimum and maximum range in tagged tope length (whiskers); average length (cm) of total tagged topes (orange); average length (cm) of female tagged topes (blue); average length (cm) of male tagged topes (green); and average length for sexually mature females (155 cm, dashed blue) and males (121 cm, dashed green) between 2013 – 2023.

### Overview of Programme

The numbers of tagged individuals for the 2023 survey period continue with the trend of increasing on past year's numbers despite being lower than 2022. In 2023, tope were the species caught and tagged the most. Most individuals caught and tagged were female, as shown in Figure 2. Bull huss was tagged for the second year running since 2014, unfortunately the thornback ray was not tagged again after the previous year where seven rays were tagged for the first time in the programme (Table 1). It is worth noting that the number of all species

tagged in 2023 was over 50% less than the year prior, although still an increase from previous years, and this may be in part due to the lack of organised boat trips.

The average length of tope and spurdog slightly decreased in 2023, whereas bull huss saw an increase in their average length. Average size of small sharks tagged remains variable over the years across both species. Tagging a wider range of shark sizes may provide the programme with more insight into whether Manx waters are important for part of their reproductive cycles, such as for breeding or as a nursery for young.

The south of the island remains a key hotspot for small shark species. Small sharks have also consistently been tagged near Douglas and off Niarbyl, which may highlight these are other key areas important for these species. Effort was made in the 2022 survey season to tag small sharks towards the more northerly parts of the Island, to gain an understanding of the gender and size ratios of species in this area. These efforts to maintain a better coverage of the island is important as it helps to remove the bias of fishing only in certain areas.

## **Conclusions and Recommendations**

In total, 573 small sharks have been tagged since 2013. An additional 13 small sharks were tagged prior to the formal commencement of the Small Shark Tagging Project in 2013. Increased tagging effort in 2022 and 2023 saw the tagging of bull huss, which had not been recorded as caught or tagged since 2014. For the first time in the programme the thornback ray was also tagged in 2022 after an effort was made to fish in more northern waters surrounding the island. Unfortunately, the thornback ray remained elusive for the 2023 season however this could be due to a number of reasons including reduced fishing trips, fishing trips taking place in a less diverse range of locations as well as other environmental factors. Gaining more data on a greater variety of small shark species is hugely beneficial in furthering our understanding of where and how these species use Manx waters. This knowledge can help us to further maintain and protect our fisheries surrounding the island.

The project has recorded four recaptures this year, two of which have occurred from sharks originally tagged on the Island and two recapture from Scotland. To help to increase the probability of successful recapture it is proposed that the continuation of tagging workshops will be key to increase the number of sharks tagged in our waters. Whilst this method is invasive for the species involved it is a good way to minimise the disruption to the sharks and rays as the fishers are able to perform the research whilst they are already fishing. In the same way it helps to reduce the monetary and environmental cost of tagging programmes. Involving fishers and educating them is also an imperative part to achieving healthier waters around our island. Overall, it is too soon to determine whether small sharks are utilising Manx waters for migrations, feed grounds or as part of their reproductive cycles. Continued tagging and recapture of previously tagged individuals are crucial to obtain useful information about the distribution and population structure of small sharks in Manx waters.

Currently, small sharks have been tagged in several Marine Nature Reserves (MNRs) including West Coast, Calf and Wart Bank, Baie ny Carrickey, Langness, Little Ness and Ramsey Bay. These sites only cover up to the 3nm boundary of Manx waters and are not formally designated to protect small shark species. This is in part due to small shark species not receiving formal protection in the Isle of Man currently. However, small sharks will benefit from these MNRs due to restrictions against damaging fishing methods.

Based on our current understanding of the tagged shark species, we recommend greater protection in the form of restrictions or reserve formation/extension into the 3-12 nm zone of

the Calf and Wart Bank, Langness and West Coast MNRs. Extending protection into the wider 3-12nm zone around the Island is crucial to protect these areas from damaging marine developments and fishing.

Manx Wildlife Trust is grateful for the support of this programme from the angling community, including the charter boats Casey J and Gemini, and is optimistic for future data collection.

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## Appendices

### Appendix 1. Tagging guidance crib sheet.

**SSTP Micro-Tag Guidelines**





Micro-tags are inserted using a tagging gun. When not in use we recommend that you use the needle guard to prevent injury!

1. Fit a strip of micro-tags into the tagging gun
2. Insert the needle at an angle of 45°
3. Push the trigger to insert a single tag into the fish
4. Remove the needle and give the tag a short tug to set the barb

Submit your data to Eleanor – [eleanor@manxwt.org.uk](mailto:eleanor@manxwt.org.uk) or drop in at 7-8 Market Place, Peel, IM5 1XF or online at: [www.tagsharks.com](http://www.tagsharks.com)

These tagging guidelines are for tagging guns and micro-tags **ONLY**. SSTP minimum sizes are set to protect fish, if for any reason you are unsure about tagging please **do not tag the fish!**

| SSTP Micro-Tag Minimum Sizes |              |
|------------------------------|--------------|
| Common Skate (wingspan)      | Canula       |
| Tope                         | 65cm (2.8lb) |
| Spurdog                      | 65cm (2.3lb) |
| Smooth-hound                 | 70cm (2.2lb) |
| Bull Huss                    | 65cm (2.5lb) |
| Rays (wingspan)              | 35cm (2.1lb) |

### Appendix 2. Record card.

Please send details to Eleanor by email: [eleanor@manxwt.org.uk](mailto:eleanor@manxwt.org.uk)  
Or drop in/post to: 7-8 Market Place, Peel, IM5 1XF


Name/s: \_\_\_\_\_

Email address: \_\_\_\_\_




Date: \_\_\_\_\_ Time start: \_\_\_\_\_ Time end: \_\_\_\_\_

Location (please circle): NE NW SW SE

Lat/Long (this will NOT be made public):  
\_\_\_\_\_ N \_\_\_\_\_ W



In association with:

| Tag No. | Species | Sex | Length (cm) | Girth (cm) | Condition |
|---------|---------|-----|-------------|------------|-----------|
|         |         |     |             |            |           |
|         |         |     |             |            |           |
|         |         |     |             |            |           |
|         |         |     |             |            |           |
|         |         |     |             |            |           |
|         |         |     |             |            |           |
|         |         |     |             |            |           |
|         |         |     |             |            |           |

**Appendix 3.** The range and average length (cm) of tagged sharks between 2013 – 2023.

**Table 1.** The range and average length (cm) of tagged bull huss for 2022. N.B.: averages for 2014 were not able to be calculated as only one individual was tagged.

| Year | Length range (cm) |         | Average length (cm) | Standard deviation (±) |
|------|-------------------|---------|---------------------|------------------------|
|      | Minimum           | Maximum |                     |                        |
| 2013 | 63.00             | 110.00  | 91.06               | 13.71                  |
| 2014 | 89.00             |         | -                   | -                      |
| 2022 | 74.00             | 100.00  | 86.00               | 9.90                   |
| 2023 | 96.00             | 107.00  | 101.50              | 7.78                   |

**Table 2.** The range and average length (cm) of tagged spurdog between 2013 – 2023. N.B.: averages for 2014, 2015 and 2022 were not able to be calculated as only one individual was tagged in each of these years respectively.

| Year | Length range (cm) |         | Average length (cm) | Standard deviation (±) |
|------|-------------------|---------|---------------------|------------------------|
|      | Minimum           | Maximum |                     |                        |
| 2013 | 75.00             | 107.00  | 94.17               | 11.92                  |
| 2014 | 100.00            |         | -                   | -                      |
| 2015 | 101.00            |         | -                   | -                      |
| 2016 | 101.00            | 108.00  | 104.00              | 3.16                   |
| 2017 | 74.50             | 113.00  | 100.49              | 6.76                   |
| 2018 | 98.00             | 110.00  | 104.93              | 3.67                   |
| 2019 | 90.00             | 102.00  | 96.75               | 3.83                   |
| 2021 | 50.00             | 115.00  | 84.48               | 19.02                  |
| 2022 | 70.00             | 105.00  | 96.83               | 9.43                   |
| 2023 | 80.00             | 94.00   | 86.00               | 7.21                   |

**Table 3.** The range and average length (cm) of tagged thornback ray for 2022.

| Year | Length range (cm) |         | Average length (cm) | Standard deviation (±) |
|------|-------------------|---------|---------------------|------------------------|
|      | Minimum           | Maximum |                     |                        |
| 2022 | 60.00             | 145.00  | 103.14              | 36.14                  |

**Table 4.** The range and average length (cm) of tagged tope between 2013 – 2023.

| Year | Length range (cm) |         | Average length (cm) | Standard deviation (±) |
|------|-------------------|---------|---------------------|------------------------|
|      | Minimum           | Maximum |                     |                        |
| 2013 | 110.00            | 156.00  | 141.71              | 12.32                  |
| 2014 | 94.00             | 145.00  | 124.95              | 14.95                  |
| 2015 | 80.00             | 153.00  | 122.00              | 24.10                  |
| 2016 | 89.00             | 157.00  | 130.70              | 24.07                  |
| 2017 | 99.00             | 168.00  | 142.38              | 14.51                  |
| 2018 | 78.00             | 171.00  | 145.93              | 21.97                  |
| 2019 | 110.00            | 167.00  | 148.10              | 17.88                  |
| 2021 | 60.00             | 168.00  | 127.91              | 26.54                  |
| 2022 | 99.00             | 173.00  | 149.24              | 14.03                  |
| 2023 | 105.50            | 165.10  | 145.13              | 13.90                  |