



Individual migratory patterns of starry smooth-hound, tope shark and common stingray tagged in the southern North Sea

Literature overview and data-report of tagging with miniPATs

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Wageningen Marine Research

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Summary

In the North Sea region, many sharks and rays species have declined due to their vulnerability to fishing, pollution and changes in essential habitats. The role of the North Sea and Dutch coastal waters for rays and sharks remain relatively unknown. In this brief report, we focus on Starry Smooth-hound *Mustelus asterias*, Tope Shark *Galeorhinus galeus*, and Common Stingray *Dasyatis pastinaca* and the use of electronic tags to study their behaviour. This study is part of a larger project "Bridging knowledge gaps for sharks and rays" funded by the European Maritime and Fisheries Fund (EMFF).

An overview of the limited literature that is available on migratory patterns based on tagging of Starry Smooth-hound *Mustelus asterias*, Tope Shark *Galeorhinus galeus*, and Common Stingray *Dasyatis pastinaca* in the North Sea region is given.

Furthermore, to gain more insight in the movement ecology of these elasmobranch species and what the role of Dutch coastal waters is during the completion of their life-cycle, 15 Starry Smooth-hound, 3 Tope Sharks and 5 Common Stingrays were caught, tagged with miniPAT pop-off satellite archival tags and released in the Oosterschelde during 2019-2022. The data of these tagged sharks and stingrays that was or will be transmitted via the ARGOS-satellites will become available for future analyses. Here the deployment data is provided.

1 Introduction

Elasmobranchs (i.e. sharks and rays) play an important role as predators in the marine ecosystem are long-lived, slow growing, reach sexual maturity at relatively old age, and produce a small number of offspring per year. These properties make elasmobranchs vulnerable to fishing, pollution and changes in essential habitats, especially spawning and nursery areas. Elasmobranch populations have declined sharply worldwide and a third of the species are threatened in their survival (Dulvy et al., 2021). The decline of ray and shark populations in the North Sea, especially in the last century, is generally attributed to long-term intensive fishing, as well as large-scale coastal infrastructure and pollution (Heessen, 2010, Sguotti et al. 2016). However, data from the scientific sampling programs show an increase in populations for a number of species since 2010 (ICES, 2022).

This study is part of a larger project “Bridging knowledge gaps for sharks and rays” funded by the European Maritime and Fisheries Fund (EMFF). The role of the North Sea and Dutch coastal waters for rays and sharks remain relatively unknown. In this report, we focus on three species for which relatively little is known on their migratory ecology, i.e. Starry Smooth-hound *Mustelus asterias*, Tope Shark *Galeorhinus galeus*, and Common Stingray *Dasyatis pastinaca* and the use of electronic tags to study their behaviour.

First, we give an overview of the current literature that is available on the migratory patterns of Starry Smooth-hound *Mustelus asterias*, Tope Shark *Galeorhinus galeus*, and Common Stingray *Dasyatis pastinaca* in the North Sea region.

Second, during 2019-2022, Starry Smooth-hounds, Tope Shark and Common Stingrays were caught, tagged with miniPAT pop-off satellite archival tags and released in the Oosterschelde. Here the deployment data will be provided. These electronic tags will yield data that will be available for analyses in follow-up projects on migratory patterns and the role that Dutch coastal waters play for these species.

2 Literature overview

In this chapter we give an overview of the few studies that are available in literature on movement patterns of the Starry Smooth-hound *Mustelus asterias* and Tope Shark *Galeorhinus galeus*, and Common Stingray *Dasyatis pastinaca*, that were tagged in the southern North Sea.

2.1 Starry smooth-hound *Mustelus asterias*

There are only a few studies reported on movement patterns of tagged Starry Smooth-Hounds in the North Sea region (Breve et al. 2016, Breve et al. 2020, Griffiths et al. 2020). Breve et al. (2016; 2020) found that Starry smooth-Hounds that were tagged with Rototags (see photo below) in the Oosterschelde and the adjacent coastal waters were present in the southern North Sea during the summer half year. In the winter half year there was a difference in the patterns between the sexes. Females moved to the English Channel and Bay of Biscay but rarely to the northern North Sea, whereas males moved to either the Northern North Sea or English Channel but rarely to the Bay of Biscay (Fig. 1).



Photo: Starry Smooth-hound with Rototag as used in Breve et al. (2016;2020) studies: Niels Breve.

Griffiths et al. (2020) studied movement patterns of Starry Smooth-hounds using CEFAS-Data Storage Tags, which are biologgers that continuously store water temperature and depth. These DST-tags need to be recaptured or found to read out the data. Movement patterns of Starry Smooth-hounds that were tagged around southern England comprised the southern North Sea and English Channel (Fig. 2 and Fig 3.).

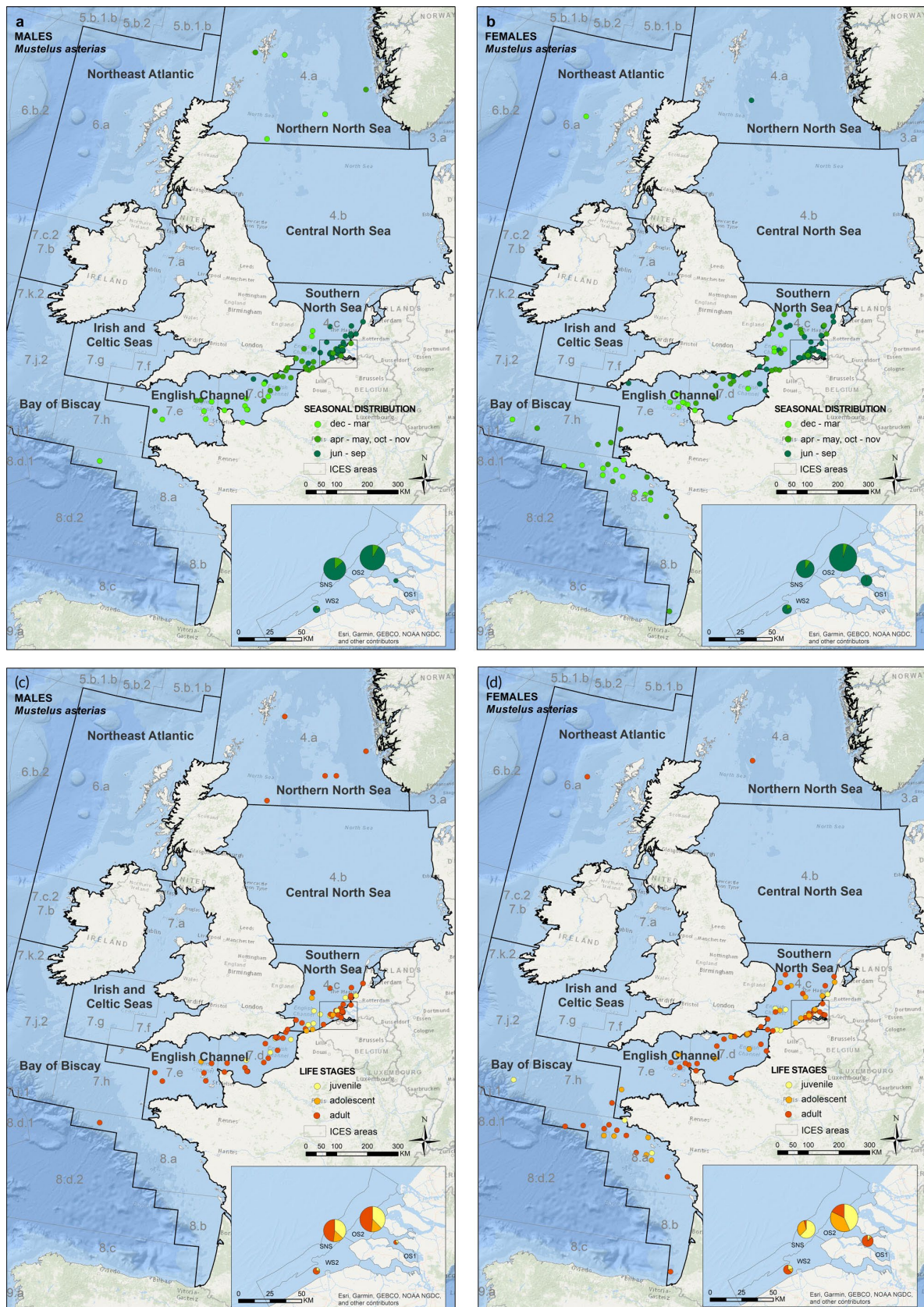


Figure 1 Distribution of Starry Smooth-Hound tagged Oosterschelde and coastal waters of the Netherlands from Breve et al (2020), figure 1: Seasonal distribution of (a) male and (b) female *M. asterias*, and distribution of immature life stages (juveniles, adolescents) and adults for (c) males and (d) females. Fish were captured and tagged in the Netherlands between April and October in 2011–2019 (small inset panels). Total length data in centimeters was obtained from McCully Phillips and Ellis (2015) to identify life stages, with L50 for a division between pups (<33 cm), males: juveniles (33–65 cm), adolescents (65 ≤ 70.4 cm), adults (>70.4 cm), and females: juveniles (33–69 cm), adolescents (69 ≤ 81.9 cm) and adults >81.9 cm).

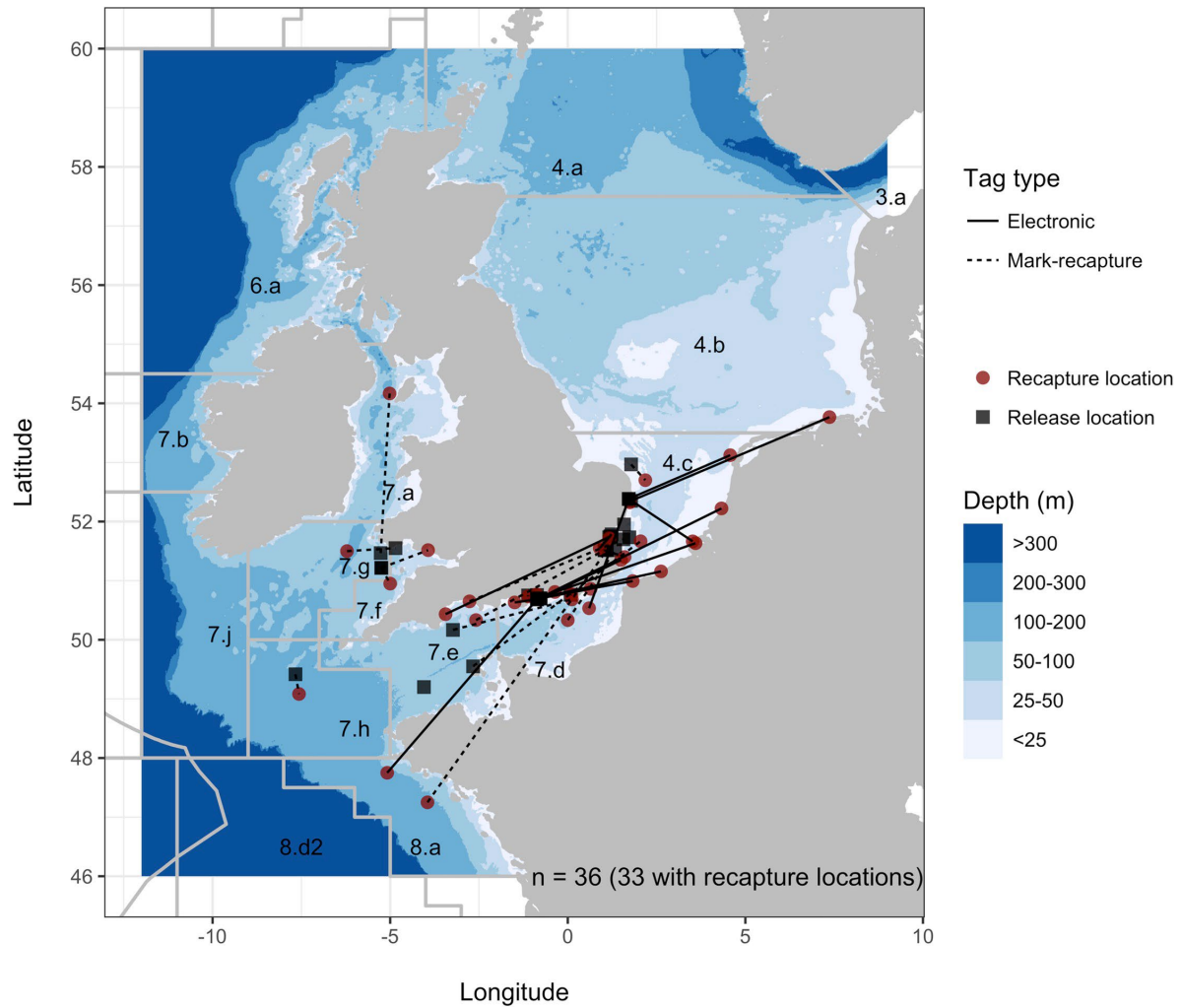


Figure 2 Distribution of release and recaptures of Starry Smooth-hound tagged in waters around southern England, from Griffiths et al.(2020), figure 2: Release and recapture locations of tagged *M. asterias*. Release (black squares) and recapture (red circles) locations of *M. asterias* by tag type (mark-recapture, $n = 18$; electronic, $n = 18$; S4 and S5 Tables). Lines by tag type represent a straight-line between release and recapture locations and are designed to illustrate migration and dispersal.

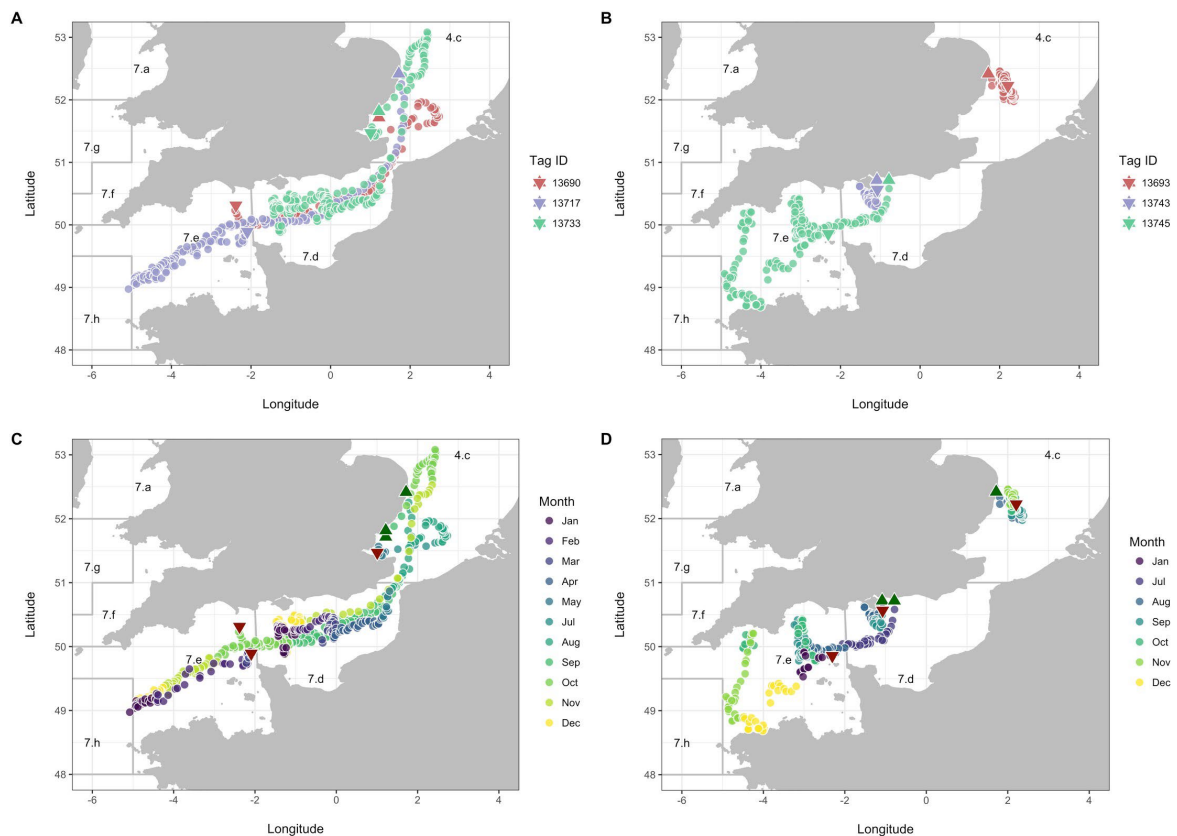


Figure 3 Distribution of release and recaptures of Starry Smooth-hound tagged in waters around southern England, from Griffiths et al.(2020), figure 3: Movements of *M. asterias* tagged with electronic tags ($n = 6$). Daily locations in space and time have been coloured by Tag ID (A and B) and month (C and D; where data are recorded) to illustrate individual variation and seasonality, respectively. Individuals have been split based on movement pattern (migration, A and C; resident, B and D) for illustrative purposes. Release and recapture locations of *M. asterias* are plotted as triangles and inverted triangles, respectively. Each location represents an estimated geographical position per day (24 hours).

2.2 Tope shark *Galeorhinus galeus*

The only reported telemetry study on Tope Shark carried out in the North Sea was Schaber et al. (2022). They found that four Tope Sharks caught and tagged with miniPAT pop-off satellite archival tags (PSAT, Wildlife Computers Inc) around Helgoland in the south-eastern North Sea moved over large distances to Atlantic waters off France, Portugal, Spain (Strait of Gibraltar) and Canary Islands (Fig. 4). Large scale migrations were also found for two tope sharks tagged between Scotland and Ireland, that even moved to Sicily in the Mediterranean Sea (Colloca et al. 2019).

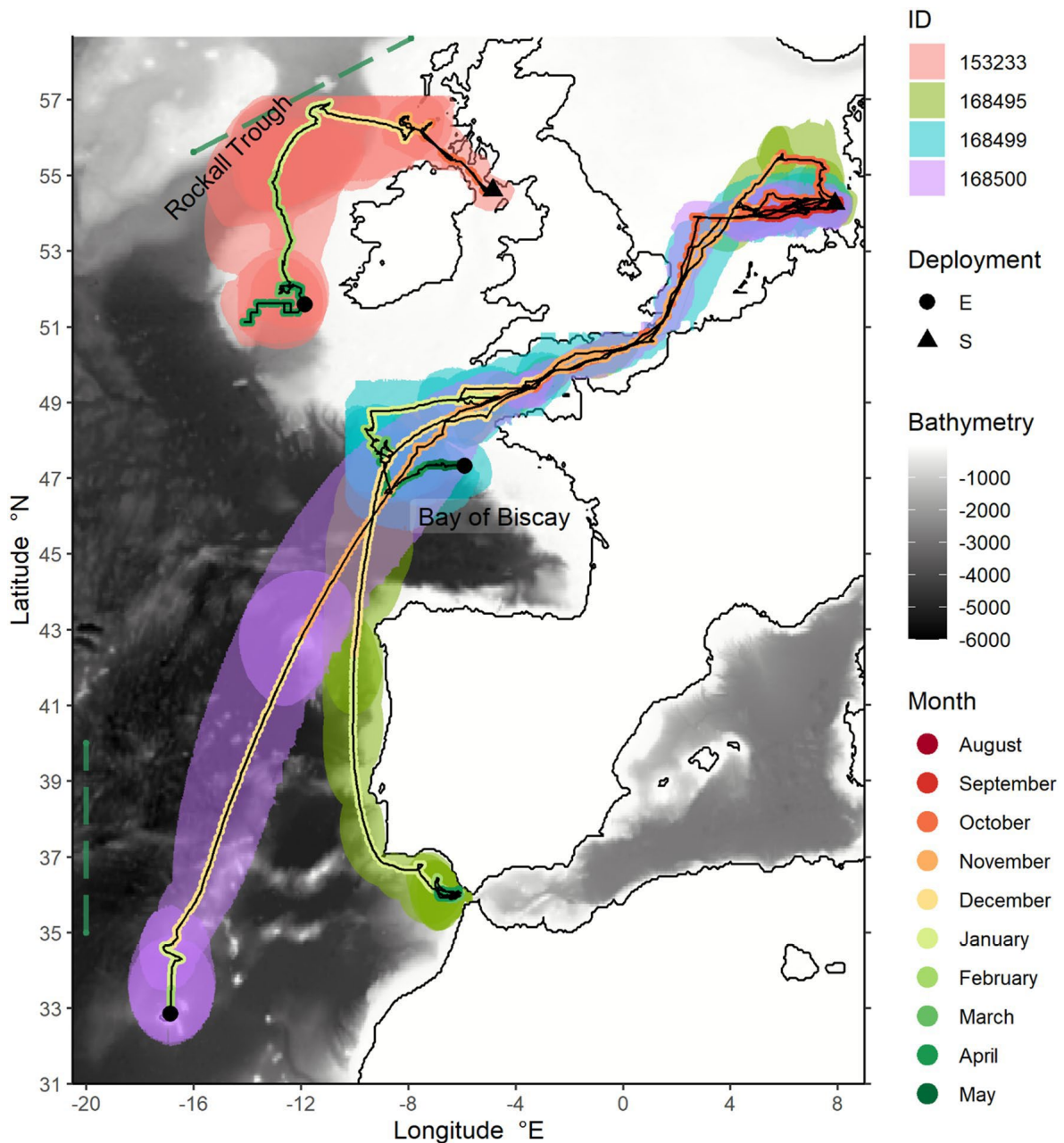


Figure 4 Movement patterns from tope tagged with miniPATs from Schaber et al (2022), figure 1: Temporal progression and routes of most likely migrations of four tope (*Galeorhinus galeus*) after deployment of pop-up satellite archival tags in the German Bight of the North Sea ($n = 3$, 2018 and 2020) and Luce Bay, West Scotland ($n = 1$, 2015). Most likely trajectories-geolocation from GPE3 state-space model connect deployment start and end locations (black paths), temporal progression of the tracks colour coded as per the legend. Shaded zones around the most likely tracks colour coded according to tag ID/Ptt indicating 95% location probabilities. Hydroacoustic data used in this study sampled on transects shown as blue-green dashed lines (IBWSS, north, March/April 2016; BATHYPELAGIC, south, June 2018). Bathymetry/Satellite Image data from NOAA/ETOPO170.

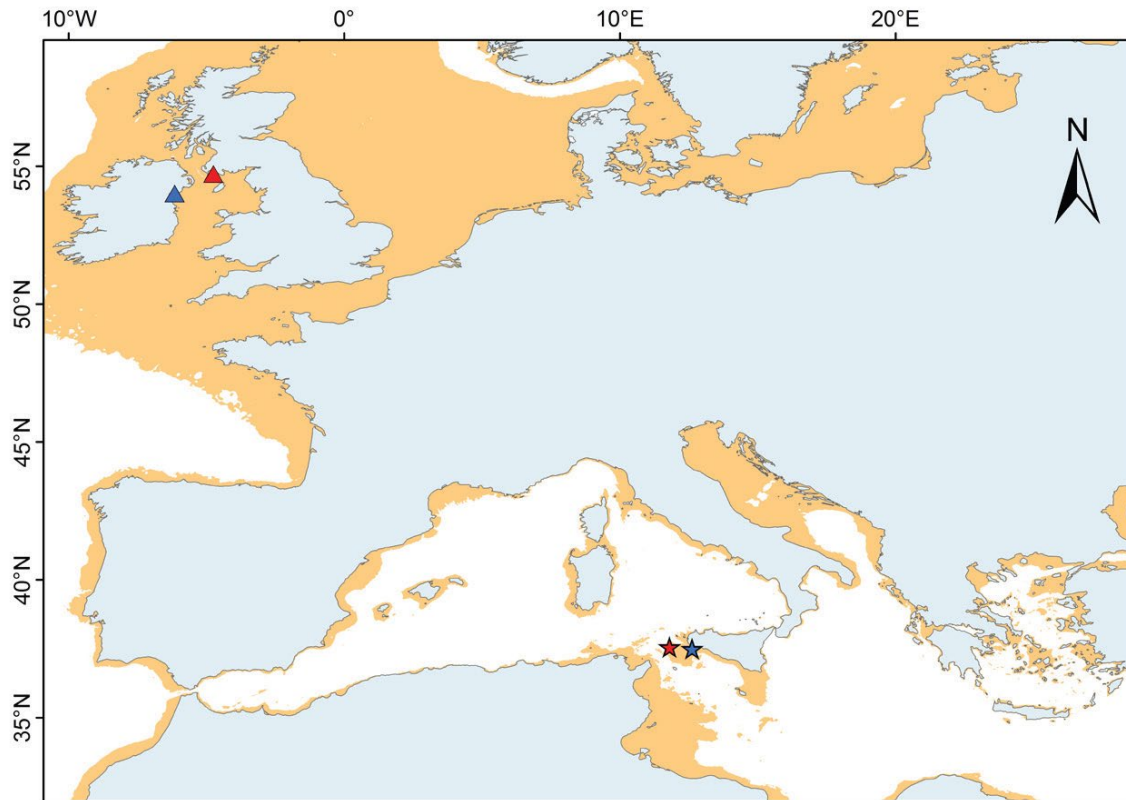


Figure 5 Release and recaptures of two topes tagged in waters between Ireland and Scotland, from Griffiths et al.(2020), figure 2: Map showing the tagging sites (specimen tagged in Scotland, red triangle; specimen tagged in Ireland, blue triangle) and recapture sites (specimen tagged in Scotland, red star; specimen tagged in Ireland, blue star). The orange background represents the continental shelf area (0-200 m depth).

2.3 Common stingray *Dasyatis pastinaca*

To our knowledge, there has only one tagging study has reported on Common Stingray in the North Sea (Breve et al. 2016). In this study, in total 54 Common Stingrays were tagged during 2011-2014, but none of these tagged individuals were reported to be recaptured. Furthermore, no telemetry studies were reported for the North Sea area, nor in the rest of its distribution area (Europe and Northern Africa). The scale and timing of movements of Common Stingrays are therefore still unknown, not only in the North Sea regions but in their entire distribution area.

3 Telemetry materials and methods

During 2019-2022, a tagging study was carried out in the Oosterschelde, in Southern Netherlands targeting Starry Smooth-hound, Tope Shark and Common Stingray, using pop-off satellite archival tags. The deployment of the tags was carried out under permit of the Dutch Animal Welfare Act (permit reference numbers AVD401002016613 and AVD40100202114609.). The tagging procedures were performed in accordance with guidelines and regulations on animal experiments as stated in the corresponding permits.

Starry Smooth-hounds, Tope Shark and Common Stingrays were caught by angling from recreational fishing boats using individual baited rod and line. Angling and tagging took place in the Oosterschelde, in the southern Netherlands, during the summer months of 2019, 2020, 2021 and 2022. In addition to angling, Common Stingrays were also obtained from a commercial Weir Fishery on anchovies in the eastern part of the Oosterschelde (<https://www.behoudweervisserij.nl>). Caught specimens were brought on board for tagging. Total length (TL), weight and sex were recorded. All specimens were fitted with MiniPAT pop-off satellite archival tags (PSAT, Wildlife Computers Inc) into the dorsal base of the first dorsal fin in Starry Smooth-hound and Tope Sharks and into the base of the tail in Common Stingrays (see photo's below). All tags were marked with contact details. All sharks and stingrays were released close to their capture site.

The tags were programmed to record time series of depth, temperature and ambient light. The tags deployed were pre-programmed to release after 365 days of deployment. After detaching from the sharks, the tags surface and transmit the time series and message data via the ARGOS satellite.



Photo: MiniPAT popup satellite tags deployed on sharks (left) and stingrays (right). Niels Breve.

4 Results: overview of the sharks and stingrays tagged in the Oosterschelde

During 2019-2022, in total 23 (15 Starry Smooth-hound, 5 Common Stingrays and 3 Tope sharks) were tagged with miniPATs in the Oosterschelde. The 2021-2022 sharks and stingrays were tagged within project 4311400041. There are still 5 miniPATs available that will be used for deployment on Tope Sharks and/or Common Stingrays caught and released during 2023.

Table 1 Overview of the Starry Smooth-hounds, Tope Sharks and Common Stingrays that were tagged with miniPATs in the Oosterschelde during 2019-2022.

Species	Length (cm)	Wingspan (cm)	Weight (kg)	Sex	Catch method	Tag-number	Date tagged	Location tagged & released
Starry Smoothhound	98		3.8	Female	Rod & line	183007_19P0150	7/12/2019	51°36'36.6"N 3°42'49.8"E
Starry Smoothhound	98		4.1	Female	Rod & line	183005_19P0112	8/24/2019	51°36'56.4"N 3°39'53.4"E
Starry smoothhound	95		3.4	Female	Rod & line	183006_19P0114	8/24/2019	51°36'56.4"N 3°39'53.4"E
Starry Smoothhound	102		4.4	Female	Rod & line	183008_19P0151	8/24/2019	51°36'56.4"N 3°39'53.4"E
Starry Smoothhound	93		3	Female	Rod & line	183009_18P1902	8/24/2019	51°36'56.4"N 3°39'53.4"E
Starry Smoothhound	97		3.5	Female	Rod & line	183011_19P0162	8/24/2019	51°36'56.4"N 3°39'53.4"E
Starry Smoothhound	107		5.3	Female	Rod & line	203431_20P1144	8/20/2020	51°39'27.9"N 3°46'00.0"E
Common stingray	NA	43	5.2	Female	Rod & line	203420_20P1033	9/4/2020	51°40'20.1"N 3°46'17.0"E
Common stingray	NA	54	6.5	Male	Rod & line	203426_20P1098	9/4/2020	51°40'35.5"N 3°47'20.7"E
Common stingray	NA	NA	8.0	Female	Rod & line	183004_20P1167	9/11/2020	51°40'20.1"N 3°46'17.0"E
Common stingray	86	50.3	4.7	Male	Weir fishery	183010_20P1168	6/25/2021	51°30'30.3"N 4°09'39.0"E
Common stingray	79	51.5	5.7	Male	Weir fishery	203421_20P1040	6/25/2021	51°30'30.3"N 4°09'39.0"E
Starry Smoothhound	118		7.8	Female	Rod & line	183003_20P1166	7/22/2021	51°30'24.8"N 4°08'01.3"E
Starry Smoothhound	109		5.4	Female	Rod & line	203422_20P1069	8/3/2021	51°30'24.8"N 4°08'01.3"E
Starry Smoothhound	110		5.3	Female	Rod & line	203424_20P1071	8/3/2021	51°29'28.0"N 4°08'07.6"E
Starry Smoothhound	108		6	Female	Rod & line	203430_20P1143	8/3/2021	51°29'28.0"N 4°08'07.6"E
Starry Smoothhound	119		8.4	Female	Rod & line	203432_20P1215	8/3/2021	51°30'24.8"N 4°08'01.3"E
Starry Smoothhound	114		8	Female	Rod & line	203433_20P1216	8/3/2021	51°30'24.8"N 4°08'01.3"E
Starry Smoothhound	111		6.2	Female	Rod & line	203434_20P1218	8/3/2021	51°30'24.8"N 4°08'01.3"E
Starry Smoothhound	121		7.2	Female	Rod & line	203435_20P1220	8/3/2021	51°29'28.0"N 4°08'07.6"E
Tope Shark	152		NA	Female	Rod & line	232936_21P1984	6/15/2022	51°39'45.0"N 3°44'36.2"E
Tope Shark	149		NA	Female	Rod & line	233774_21P1925	6/15/2022	51°39'45.0"N 3°44'36.2"E
Tope Shark	140		NA	Male	Rod & line	233776_21P1960	6/15/2022	51°39'45.0"N 3°44'36.2"E

The data of these tagged sharks and stingrays that was/will be transmitted from the ARGO-satellites will become available for analyses in follow-up projects.

5 Conclusions and recommendations

Earlier studies with mark-recapture data of Starry smooth-hounds in Dutch coastal waters show that they perform long distance movements to the English Channel, Bay of Biscay and northern North Sea (Breve et al. 2016, 2020). For Tope Shark and Common Stingray no reported studies of migratory behaviour in Dutch waters are available, however, studies from Tope Shark in adjacent waters, i.e. around Helgoland in the German Bight, indicate that Tope Sharks from the Southern North Sea perform large scale migrations to offshore Atlantic waters. For Common Stingray no studies on migratory behaviour are present in the North Sea, nor in their entire distribution area.

Therefore, we expect that the data that will come available from the sharks and stingrays that we tagged with miniPATs in the Oosterschelde will contribute considerably to our knowledge on what role the Dutch coastal waters play for these species, and on what scales they use surrounding seas.

The 5 remaining miniPATs that could not be deployed, will be used this summer for Tope Shark and/or Common Stingray, depending on catch success. We strive to publish the telemetry data in future scientific publications. And they will be made available for future projects concerning these shark and stingray species.

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6 Quality Assurance

Wageningen Marine Research utilises an ISO 9001:2015 certified quality management system. The organisation has been certified since 27 February 2001. The certification was issued by DNV.

References

- Breve NWP, Winter HV, van Overzee HMJ, Farrell ED, Walker PA. (2016). Seasonal migration of the starry smooth-hound shark *Mustelus asterias* between the southern North Sea and the Bay of Biscay, as revealed from tag-recapture data of an angler led tagging programme in the Netherlands. *Journal of Fish Biology* 89 (2): 1158-77.
- Breve NWP, Winter HV, Wijmans PADM, Greenway ESI, Nagelkerke LAJ (2020). Sex differentiation in seasonal distribution of the starry smooth-hound *Mustelus asterias*. *J. Fish Biol.* 97(6): 1870-1875.
- Colloca F, Scannella D, Geraci ML, Falsone F, Battista G, Vitale S, Di Lorenzo M, Bono G (2019). British sharks in Sicily: records of long distance migration of tope shark (*Galeorhinus galeus*) from Northeastern Atlantic to Mediterranean Sea. *Mediterranean Marine Science*, 20(2), 309–313.
- Dulvy NK, Pacoureau N, Rigby CL, Pollom RA, Jabado RW, Ebert DA, Finucci B, Pollock CM, Cheok J, Derrick DH, Herman KB, Sherman CS, Van der Wright WJ, Lawson JM, Walls RHL, Carlson JK, Charvet P, Bineesh KK, Fernando D, Ralph GM, Matsushiba JH, Hilton-Taylor C, Fordham SV, Simpfendorfer CA (2021). Overfishing drives over one-third of all sharks and rays toward a global extinction crisis. *Current Biology* 31 (22): 5118-5119.
- Griffiths CA, Wright SR, Silva JF, Ellis JR, Righton DA, McCully Phillips SR (2020) Horizontal and vertical movements of starry smooth-hound *Mustelus asterias* in the northeast Atlantic. *PLoS ONE* 15(10): e0239480.
- Heessen HJL (2010). State of the Art - Haaïen en roggen in de Noordzee. IJmuiden: IMARES Report (Wageningen UR) no. C011/10.
- Schaber M, Gastauer S, Cisewski B, Hielscher N, Janke M, Peña M, Sakinan S, Thorburn J (2022). Extensive oceanic mesopelagic habitat use of a migratory continental shark species. *Scientific Reports* 12:2047.
- Sguotti C, Lynam CP, García-Carreras B, Ellis JR, Engelhard GH (2016). Distribution of skates and sharks in the North Sea: 112 years of change. *Global Change Biology*, 22(8), 2729-2743.

Justification

Report C041/23

Project Number: 4311400041

The scientific quality of this report has been peer reviewed by a colleague scientist and a member of the Management Team of Wageningen Marine Research

Approved: Edward Schram
Researcher

Signature:



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