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Satellite tracking of tiger sharks in the Eastern Central Atlantic reveals varied space-use patterns and ocean-basin connectivity

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Large-bodied sharks, including the tiger shark (*Galeocerdo cuvier*), play crucial roles as top predators in marine ecosystems, regulating lower trophic-level populations and connecting ecosystems across vast distances. However, elasmobranchs, particularly highly migratory species, face significant threats, with over one-third of species threatened with extinction. In the Eastern Central Atlantic (ECA), a data-poor region for sharks and rays, prolific shark fisheries have led to severe declines in elasmobranch populations, highlighting the urgent need for conservation measures. This study presents the first tracking data for tiger sharks from the region and notably Cabo Verde, describing their movements within and outside the archipelago. Fishing surveys conducted between 2016 and 2019 captured and tagged 42 tiger sharks, revealing the presence of both juvenile and adult individuals. Satellite tracking of 12 individuals showed high variability in movement patterns, with some remaining near tagging sites while others undertook long-distance migrations, including a female shark tracked on a complete return migration to Brazil, representing the second-longest recorded movement and the first double trans-Atlantic journey for the species. The study underscores the importance of Cabo Verde as a habitat for tiger sharks throughout their life cycle in the ECA including Cabo Verde and suggests large-scale connectivity of populations across the Atlantic basin. However, the presence of threats such as unregulated small-scale and industrial fishing activities poses conservation challenges. Conservation efforts should focus on implementing effective management measures, notably in critical hotspot habitats, while addressing data deficiencies to ensure the long-term viability of tiger shark populations in the region.

KEYWORDS

biologging, Cabo Verde, elasmobranch, marine megafauna, migration, West Africa

1 Introduction

Large bodied sharks are thought to play key roles in marine ecosystems, acting as top predators that regulate the population abundance of a number of lower trophic-level consumers (Barnett et al., 2012; Ferretti et al., 2010; Heupel et al., 2014). Furthermore, migratory sharks can connect ecosystems across very large distances (Afonso et al., 2017; Lea et al., 2015), therefore acting as key regulators at both local and global scales. Nonetheless, elasmobranchs are among the most vulnerable marine taxa, with over one-third of species being threatened with extinction (Dulvy et al., 2021; Pacoureau et al., 2021) and 13% missing crucial data through at least part of their range (Dulvy et al., 2021). Highly migratory species are particularly at risk (Lascelles et al., 2014; Pacoureau et al., 2021), since they are more likely to face numerous and varied threats in their vast movements and require large scale international cooperation to design and implement effective conservation measures.

The Eastern Central Atlantic (ECA) is a particularly data-poor area for sharks and rays, although substantial shark fisheries have been operating in West Africa for decades (Diop and Dossa, 2011; Sall et al., 2021), and have led to severe declines of elasmobranch populations, with several stocks being almost completely depleted (Diop and Dossa, 2011). As such, the ECA has been highlighted as a critical area for the conservation of this group (Dulvy et al., 2017; Stein et al., 2018). Increasingly, hotspots of shark diversity and abundance are being documented in the region (e.g. Cabo Verde Rosa et al., 2023; Seymour et al., 2024; Mauritania de la Hoz Schilling et al., 2024), with several Important Shark and Ray Areas (ISRA) identified, for example, within Cabo Verde (Rosa et al., 2023; Seymour et al., 2024).

The tiger shark (*Galeocerdo cuvier*) is a globally distributed species (Compagno, 2001) known to inhabit coastal areas (Domingo et al., 2016; Hazin et al., 2013; Holland et al., 1999) but also able to undertake large-scale migrations (Afonso et al., 2017; Heithaus et al., 2007; Werry et al., 2014), connecting ecosystems and fisheries across long distances (Afonso et al., 2017). The tiger shark is a highly adaptable species, found to inhabit a multitude of marine habitats, often linking coastal reefs to pelagic environments (Ferreira et al., 2017). Despite its circumglobal distribution, important gaps in ecological knowledge for this species persist throughout its range (Holland et al., 2019), with the eastern and southern Atlantic Ocean being a particularly data-poor region (Balanin et al., 2023).

In the western Atlantic, key areas of abundance have been identified in Brazil (Aximoff et al., 2022), the Bahamas (Smukall et al., 2022), and the USA coast (Smukall et al., 2022), and genetic analyses suggest some degree of separation between the northern and southern populations of the species (Bernard et al., 2021; Carmo et al., 2019). To date, however, no published description exists of tiger shark populations in the eastern Atlantic, despite the species being known to fishermen in the region (e.g. Ghana, Sekey et al., 2022; Cabo Verde, Seymour et al., 2018, 2024).

Equally, the degree to which eastern and western populations of the species may be linked remains unknown. Satellite tracking studies have revealed varied movement strategies or tiger sharks in the western Atlantic, with regular long-distance movements towards the central Atlantic Ocean (Afonso and Hazin, 2015; Ajemian et al., 2020; Lea et al., 2015), but only one record exists of a putative migration of a female tiger shark across the Atlantic towards the African continent (Afonso et al., 2017). The lack of information on the presence and connectivity of tiger shark populations in the ECA hampers large-scale conservation planning and needs to be addressed.

The insular nation of Cabo Verde is a centre of marine diversity in the ECA (Benchimol et al., 2009), hosting diverse populations of cetaceans (Berrow et al., 2021; Hazevoet and Wenzel, 2000; Ryan et al., 2014), teleosts (Barcelos et al., 2025; Freitas, 2014), and elasmobranchs (Rosa et al., 2023; Seymour et al., 2024; Varela et al., 2025a). One of the largest rookeries of the loggerhead turtle (*Caretta caretta*) in the world (Casale and Marco, 2015; Patino-Martinez et al., 2022) is also found in the easternmost islands of the archipelago (Sal, Boavista, and Maio), where tiger sharks have also been previously recorded (Seymour et al., 2024). Tiger sharks are known to predate on sea turtles (Aines et al., 2018; Dicken et al., 2017; Witzell, 1987), with reptiles, elasmobranchs, and other larger animals found in increasing proportions in the stomachs of larger individuals (Dicken et al., 2017; Lowe et al., 1996; Simpfendorfer et al., 2001). Indeed, reports of shark attacks on adult loggerheads are known in the country (Sanchez-Sierra Campillo, 2017), and most likely attributed to tiger sharks (FG pers. obs. and comms. with veterinaries on site). The presence of a large population of loggerhead turtles may hence explain the sightings of tiger sharks in the islands and suggests the possible existence of a larger population across multiple life stages in Cabo Verde, also supported by fishermen's answers to structured interviews (RTG unpublished data).

Here, we present results from fishery-independent surveys aimed at qualifying the tiger shark population found in Cabo Verde, describe the movements of 12 satellite-tracked individuals within and outside the archipelago, and discuss potential connections with other populations across the Atlantic, the overlap with different fishing activities, and their consequences for the conservation of the species.

2 Materials and methods

All fieldwork for the study was conducted under research permits released by Direção Nacional do Ambiente do Cabo Verde (No 2016/03, 2017/03, 2018/03, and 2019/03), following the 3Rs principles and reported according to ARRIVE guidelines.

2.1 Longline surveys

Fishing surveys for tiger sharks were conducted between 2016 and 2019, predominantly in the summer months of June-October, at three sites of the archipelago of Cabo Verde (ECA): from the east of Sal island, to mid-north-east island Boavista, and the offshore reef

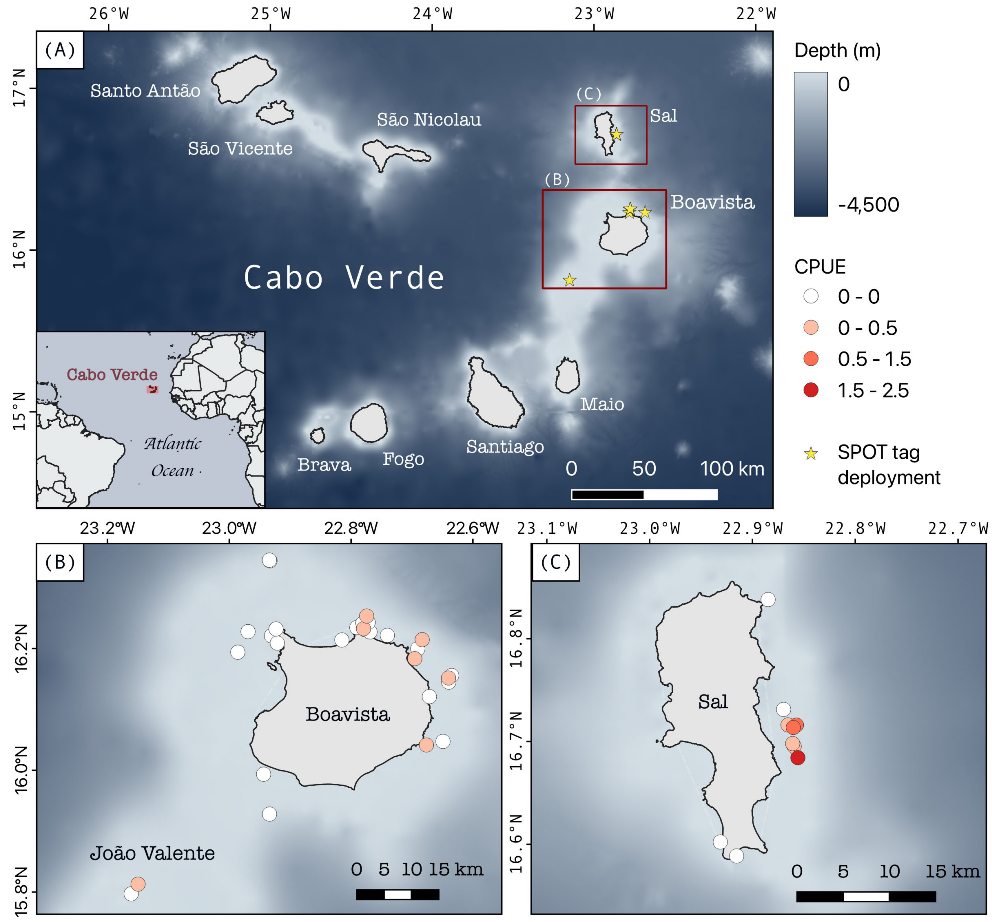

FIGURE 1
Fieldwork locations for scientific longline targeting tiger sharks (*Galeocerdo cuvier*) in Cabo Verde, Eastern Central Atlantic. **(A)** The top panel shows the archipelago of Cabo Verde and its location within the Atlantic Ocean. Panels **(B, C)** show zoomed-in portions of the map with visible fishing locations in Boavista **(B)** and Sal **(C)** (dots, coloured according to Catch Per Unit Effort, CPUE), and locations of satellite tag deployments (star symbols).

João Valente (Figure 1). Tiger sharks were captured using short demersal longline sets (10–15 hooks) fitted with 4m steel wire gangions and terminal 16/0 circle hooks and baited with frigate tuna (Auxis thazard) or other oily fish. Lines were set at different times of day and were left to soak for a maximum of 1.5 hours between checks to maximise shark survival post-release. Upon capture, sharks were brought close to the boat and secured by a tail rope to keep the animals close and headfirst towards the water current to ensure a constant flow of oxygen through the gills per Graham et al. (2012).

For each shark, pre-caudal and total length were recorded, as well as sex and clasper length and calcification stage for male sharks. Identification tags (roto-tag, Dalton, UK https://www.daltontags.co.uk/) were applied to the lower lobe of the first dorsal fin of each individual, and fin clippings taken from the second dorsal fin were stored for genetic analysis.

Catch-per-unit-effort (CPUE) was calculated for each survey and for the two islands as the number of individuals caught per hour by dividing the total catch number by the cumulative effort time. Differences in total length, sex composition, and maturity status of individuals between islands were visually investigated. Maturity status of female sharks and male sharks for which clasper calcification could not be assessed was inferred from total length measurements by comparing to known estimates of length-at-maturity for other populations in the Atlantic Ocean (Afonso et al., 2012; Santana et al., 2024).

2.2 Electronic tagging

Smart position only tags (SPOT 5; Wildlife Computers, Redmond, Washington. https://Wildlifecomputers.com) were also deployed on 12 subadult and adult tiger sharks: five tags were deployed in Boavista, six in Sal, and one at João Valente (Figure 1). Tags were fitted to the dorsal fin of the shark using four nylon bolts coated in antibiotic salve and passed through the fin tissue and secured by stainless steel nuts with washers. Tags were fitted so that they stood almost perpendicular to the body of the shark, following the anterior rake of the fin, and high enough to ensure that the saltwater switch would clear water at the surface, triggering data transmission to the satellite. The tags were programmed to transmit location messages throughout the diel period, any time the fin of the shark broke the water surface, with a limit of 250 transmissions per day.

2.3 Movement analysis

Location data was processed by and retrieved through the Argos Data Collection and Location Service (www.argos-system.org). Raw location data were filtered to exclude duplicate locations, locations with poor accuracy (i.e. Location Class Z), and locations on land. As large temporal gaps existed between many locations, speed of movement between locations could not be accurately estimated; as such, a speed filter was not applied to the dataset to avoid removing realistic positions.

To regularise locations for the study of movement, state space modelling was applied to all tracks for which sufficient location data were available (at least 20 position fixes, 8 sharks). To avoid spurious extrapolation resulting from irregular transmission, individual tracks were first divided whenever gaps between successive location fixes were 7 days or longer. State-space models were then applied to all track segments comprising 20 or more locations, using hierarchical discrete random walk models in the package bsam (Jonsen, 2016) for the statistical software R. The models used 1000 samples and 1000 adaptation/burn in samples, with a thinning factor of 5 and a span factor of 0.2 and 0.5. The most likely location of each shark was estimated in 12-hour intervals, reflecting the average daily number of raw transmissions received. Raw locations from tracking segments containing less than 20 locations were posteriorly added to the regularised locations.

Differences between sexes and life stages were examined with respect to maximum displacement distance (distance between each estimated location and the location where an individual was tagged) and total distance travelled (sum of linear distance between locations for each individual), though small sample sizes prevented statistical analysis.

Displacement graphs were created for each individual by plotting the distance of each location from the tagging site as a function of time. Tiger sharks space use within Cabo Verde was then quantified for sharks that displayed long periods of residency near the tagging site (i.e. <150 km; identified through the displacement plots as periods when no directional movement away from or towards the tagging site could be identified). Habitat use was quantified from raw Argos-derived locations by calculating kernel density estimates through the R package ctmm (Calabrese et al., 2016). The package allows fitting of continuous-time stochastic process models to regularise location data, to select the best fitting models based on the AIC criteria, and finally to calculate a host of functions to describe home range and activity space of individuals. Home range was defined here to be the space within the 90% isopleth of the kernel density function, while core habitat was restricted to the 50% isopleth.

3 Results

3.1 Tiger shark abundance and demographic in Cabo Verde

Over the course of 39 fishing trips, 42 tiger sharks were caught, and 39 were measured and tagged with conventional roto tags (n=37) and satellite tags (n=12). Three sharks were released without measuring or tagging: one escaped before it could be secured, and two were deemed in too poor condition to undergo procedures. One shark immediately released was deep-hooked, while the other had been recently finned and, while still alive, was missing all pectoral and dorsal fins. Catch per unit effort (sharks hour-1) was highest in the east of Sal and in the north-east of Boavista (Figure 1).

Catches contained both subadult and adult individuals, measuring, on average, 285.6 ± 43.8 cm TL (mean ± standard deviation; Figure 2A). Male sharks caught in surveys were, on average, significantly longer than females (299.1± 40.1 cm TL vs 265 ± 42.3 cm TL; Wilcoxon rank sum test, W = 91.5, p = 0.016) and 11 males (48% of individuals), ranging in size from 282 to 361 cm TL, had calcified claspers and were considered to be sexually mature. Assuming similar lengths at maturity as those observed in the western Atlantic (267–310 cm TL; Rangel et al., 2023; Shields, 2018), at least 3 and up to 7 female sharks caught in the study were likely also sexually mature. Overall, catches contained a higher proportion of males than females (62% and 38% of catches, respectively); However, sex composition was considerably different between the islands of Sal and Boavista (Figure 2). Tiger shark catches in Boavista were slightly skewed towards higher female abundance (56%), while males made up 88% of catches in Sal (Figure 2). No adult females were caught in Sal, while both adult females and males were caught in Boavista.

3.2 Tiger shark movements in Cabo Verde and the southern Atlantic Ocean

All but one (PTT 172747) of the deployed satellite tags successfully transmitted positions post-deployment and tags varied greatly in the number of transmissions and the duration of tracking (Table 1). The average tracking time across all sharks was 146 ± 123 (mean ± standard deviation) days, ranging between 28 and 404 days (Table 1). Following filtering, an average of 130 ± 140 location points were available for each individual, though less than 30 points were available for five sharks (Table 1) - which could therefore not be included in habitat use analysis.

On average, male tiger sharks transmitted substantially fewer messages than females did (123 ± 233 vs 229 ± 165 locations), despite having somewhat longer average tracking times (161 ± 119 vs 134 ± 135 days).

Tiger sharks varied greatly in the extent of their movement, though most (8 out of 11) individuals never moved far from the place of tagging or left the Cabo Verdean Exclusive Economic Zone (EEZ). Only two sharks, both adult males (PTT 172749 and 172750), were observed to visit more than one island of the

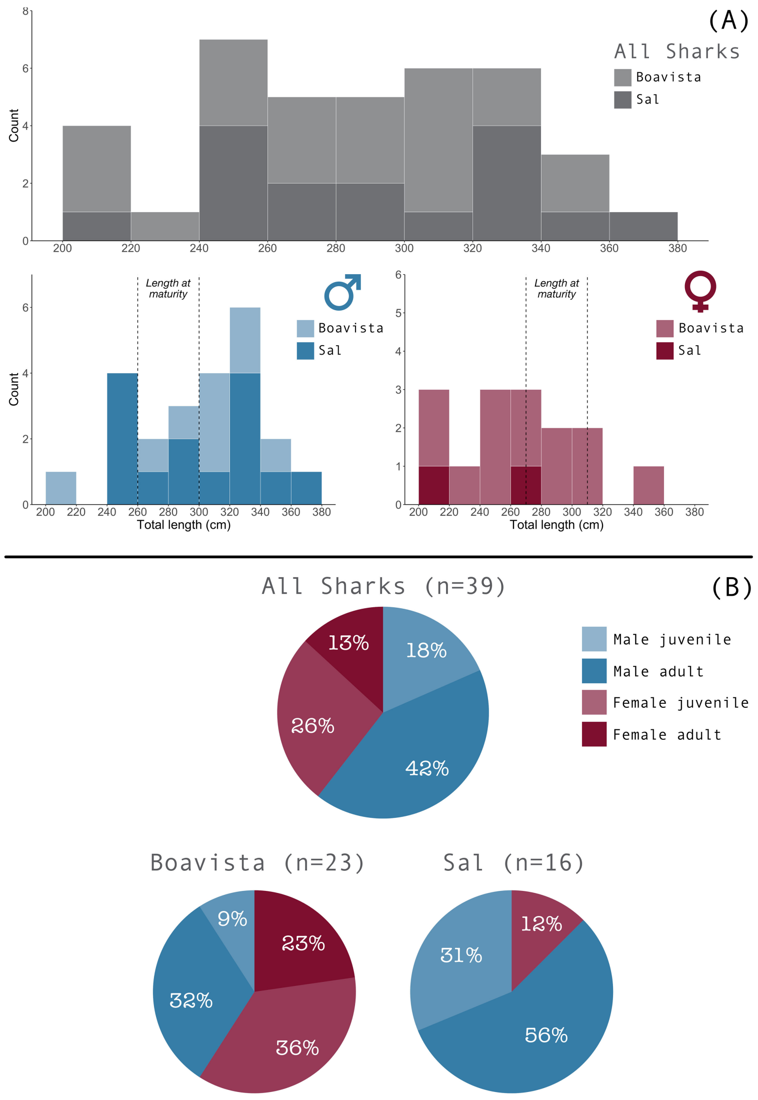

FIGURE 2
Size and sex composition of tiger sharks (*Galeocerdo cuvier*) caught in Cabo Verde. **(A)** Length distribution of all (top) sharks caught in scientific longlines in Sal and Boavista, Cabo Verde, and divided by sex (bottom). Vertical dotted lines indicate the range of length-at-maturity obtained from the literature. **(B)** Demographic composition of shark assemblages in all longline sets (top), and parsed by island (bottom). Numbers in parentheses indicate sample sizes.

archipelago, having been tagged in Sal and subsequently moved to Boavista. Tiger shark 172746, an adult female, was tagged at the offshore reef of Joao Valente and moved further south to the island of Maio. No shark was observed to move to any other island of the archipelago. For five of these sharks, enough data was available to estimate centres of activity through kernel density estimation (Figure 3). Core space use areas in Cabo Verde were hence identified across the easternmost islands of Boavista, Sal, and Maio (Figure 3).

Two sharks left the Cabo Verdean EEZ to move towards continental Africa. Tiger shark 118267 was observed moving south from its tagging site in Sal before turning north-east and heading for continental Africa, while tiger shark 72746 showed more extensive movements towards the Guinea Plateau before heading further offshore (Figure 4). This adult female was tagged on 28 September 2017 in João Valente (Figure 4-1) and spent 51 days around the offshore reef before (Figure 4-2) moving south to the island of Maio. The shark then spent 31 days in Maio, leaving for a brief offshore rendezvous on 19th December (Figure 4-3) before returning to Maio briefly and then (Figure 4-4) initiating a directed migration towards coastal Africa on 31st December, eventually leaving Cabo Verdean waters on 4th January 2018. Tiger shark 172746 then spent 11 days in the EEZ waters of Senegal and Guinea-Bissau, finally moving into international waters where its last location was received on 22nd January 2018 (Figure 4-5).

Finally, tiger shark 172752 (female, 311 cm TL) was tracked through a complete return migration across the Atlantic Ocean to Brazil, totalling a straight-line distance of 17,901 km and maximum displacement of 4,121 km (Table 1). This individual was tagged on

TABLE 1 Summary information on tiger sharks fitted with satellite tracking devices in Cabo Verde between 2016 and 2018.

ID	Sex	TL[a] (cm)	Tagging site	Tagging Date	Last Location	N Locations	Tracking Time (days)	Distance Travelled (km)	Maximum Dispersal (km)
172753	F	209	Boavista	2017-11-09	2018-02-12	281	95	1,128	109
118269	F	263	Boavista	2016-09-10	2016-12-14	316	95	901	34
118266	F	272	Sal	2016-08-12	2016-11-11	167	91	400	29
172752	F	311	Boavista	2018-10-28	2019-12-06	186	404	17,901	4,121
172751	F	312	Boavista	2018-11-28	2018-12-26	2	28	15	15
172746	F	355	João Valente	2017-09-28	2018-01-23	477	117	3,288	905
118268	M	264	Boavista	2016-09-01	2017-02-01	541	153	1,705	47
118267	M	278	Sal	2016-08-12	2016-09-24	26	43	690	480
172750	M	327	Sal	2017-10-25	2018-05-13	29	200	484	85
172747	M	338	Sal	2017-10-24	2017-10-24	0	0	0	0
172749	M	356	Sal	2017-10-25	2017-12-11	12	47	155	55
172748	M	361	Sal	2017-10-25	2018-07-19	8	267	25	14

Tiger shark 172747 never transmitted any messages after tagging.

[a] Total length (length from tip of snout to end of upper lobe of tail).

28th October 2018 in the north-east of Boavista (Figure 5-1), although the first transmissions from the tag were received on 1st February 2019 and placed the shark near the mid-Atlantic ridge in Brazilian waters (Figure 5-2). From here, the shark continued to move south-west towards coastal Brazil, spending 57 days in coastal waters near Salvador (Figure 5-3). The shark commenced a return migration around 19th June and was placed just outside the Senegalese EEZ on 2nd August, with the first location within Cabo Verdean waters received on 30th November 2019 (Figure 5-5). The last location for this individual was received on 6th December 2019, just south of the Cabo Verdean EEZ (Figure 5-6).

No clear pattern was found that could suggest a relationship between displacement distance and the total length of a shark. However, the top two longest net displacement distances (4121 and 905 km) were recorded for two adult females (individual 172752 and 172746, measuring 311 cm and 355 cm TL, respectively; Table 1), surpassing the third longest maximum displacement (480 km, recorded by a 278 cm TL male) by 425 km (1.9 times shorter). The smaller females (range 209–272 cm TL) all remained close to their tagging location (Table 1).

4 Discussion

Tiger sharks are known to occur throughout the west Africa coast, with published records of capture in fisheries in Ghana (Seidu et al., 2022; Sekey et al., 2022) and Mauritania (Lemrabott et al., 2025), instances or reported attacks on humans in Senegal (Trape, 2008), and sightings in fishery-independent surveys in Cabo Verde (Seymour et al., 2024). However, systematic studies of the spatial ecology and population connectivity of this species are lacking in the ECA and the wider southern Atlantic. Here, we present the first structured data supporting the existence of a population of the species in the insular nation of Cabo Verde, and describe the movements of 10 individuals, which suggest large-scale connectivity of tiger shark populations across the Atlantic basin.

4.1 Population composition of tiger sharks (*Galeocerdo cuvier*) in Cabo Verde

Longline surveys conducted in the islands of Boavista and Sal between 2016 and 2020 confirm the continued presence of tiger sharks in the country, also indicated by Cabo Verdean fishers (Seymour et al., 2018) and baited camera surveys (Seymour et al., 2024). Shark catches included both male and female individuals of varying lengths and age classes (according to length-at-maturity estimates from other Atlantic populations; Rangel et al., 2023; Shields, 2018), though caught male sharks were more likely to be sexually mature than female sharks. Clear spatial segregation between sexes was furthermore observed from longline catches, with only two juvenile female sharks ever caught in Sal and a predominance of both adult and juvenile female sharks in catches from the island of Boavista. Separation of individuals across sexes and ontogeny is known for tiger sharks (Afonso and Hazin, 2015), and female-only hotspots of abundance have also been observed, for example, in The Bahamas (Ayres and Gallagher, 2025; Sulikowski et al., 2016), These sites, often found in shallower, warmer areas such as those found in the east of Boavista, are thought to facilitate embryonic development and offer refuge from male harassment. Adult females were overall rare in catches from both islands, with only 5 individuals encountered across 5 years of surveys. An ontogenetic shift in habitat from coastal areas to pelagic, open ocean environments has been suggested for female tiger sharks

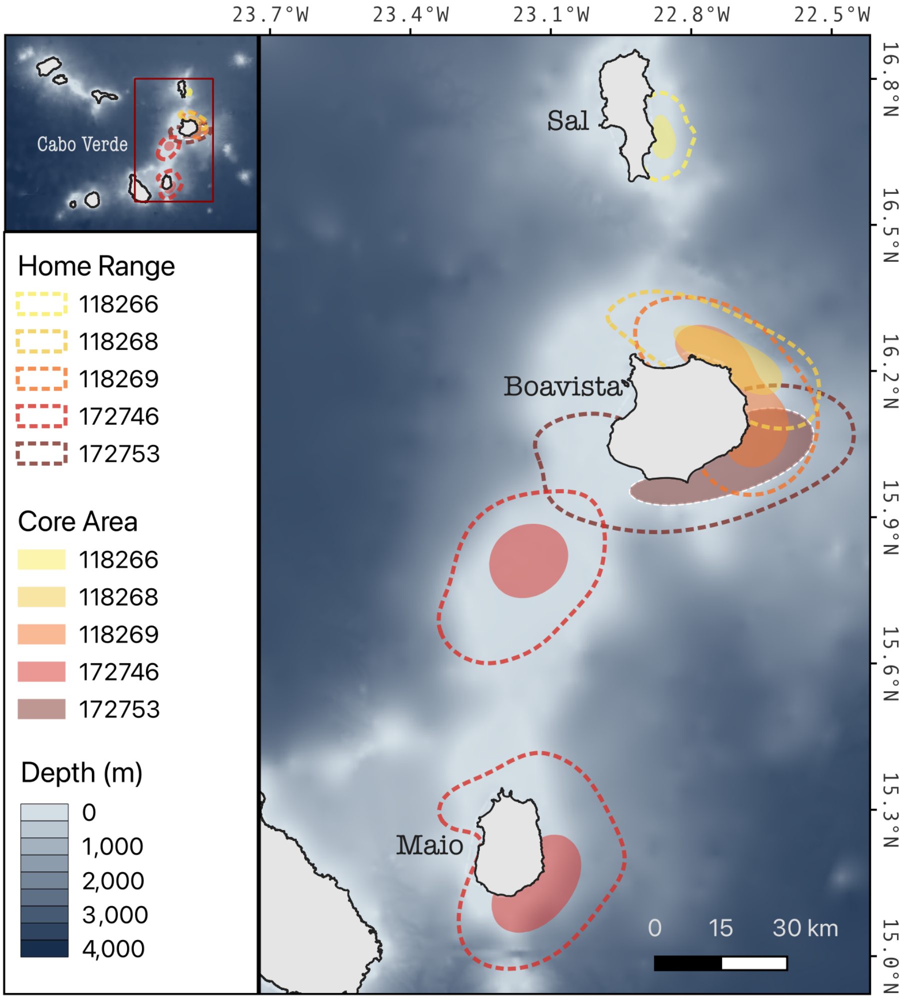

FIGURE 3
Tiger shark (*Galeocerdo cuvier*) habitat use in Cabo Verde. Home range (90% isopleths of Kernel density estimates) and core area use (50% isopleths) of tiger shark habitat use within Cabo Verde for all individuals for which enough data were available to calculate kernel densities (N = 5).

elsewhere in the Atlantic (Afonso and Hazin, 2015; Ajemian et al., 2020), and this may explain the under-representation of this demographic class in coastal catches. Satellite tracking data from this study further supports this hypothesis, as the largest female sharks were observed to travel further and spend more time within the high seas than smaller females.

Young individuals (<200 cm TL) were absent from longline surveys, though this was not considered an indication of the absence of this age class from the country. The fishing gear used in the study (16/0 circle hooks) may have biased catches towards larger animals, though captures of sub 1 and 2 m tiger sharks were made in other locations using similar gear (RTG unpublished data). Furthermore, tiger sharks are known to segregate ontogenetically and by sex (Afonso and Hazin, 2015; Driggers et al., 2008; Sulikowski et al., 2016), and smaller sharks may seek to avoid foraging sub-adults and adults (Heupel et al., 2018). Surveys were limited to the two easternmost islands of Boavista and Sal, although tiger sharks are known to occur throughout the archipelago (ZS, unpublished data). Indeed, very young (<100 cm TL) individuals have been captured by baited camera surveys in the island of Maio (Seymour et al., 2024). Further surveys employing gear of varying sizes and extending to other islands of the archipelago are necessary to fully describe the composition and distribution of tiger sharks in Cabo Verde.

Nonetheless, the data collected in this study suggest Cabo Verde may represent an important area for the species within the ECA with juvenile-subadults and adults of both sexes detected in surveys, suggesting that tiger sharks could be in the country throughout their life cycle.

4.2 Movement and distribution of tiger sharks (*Galeocerdo cuvier*) in the ECA

Tiger sharks are known to exhibit high variability in the degree of residency among individuals, with both coastal and long-distance movements recorded in populations across the world (Domingo et al., 2016; Heithaus et al., 2007; Holland et al., 1999; Werry et al., 2014). The tiger sharks tracked in this study also appear to show

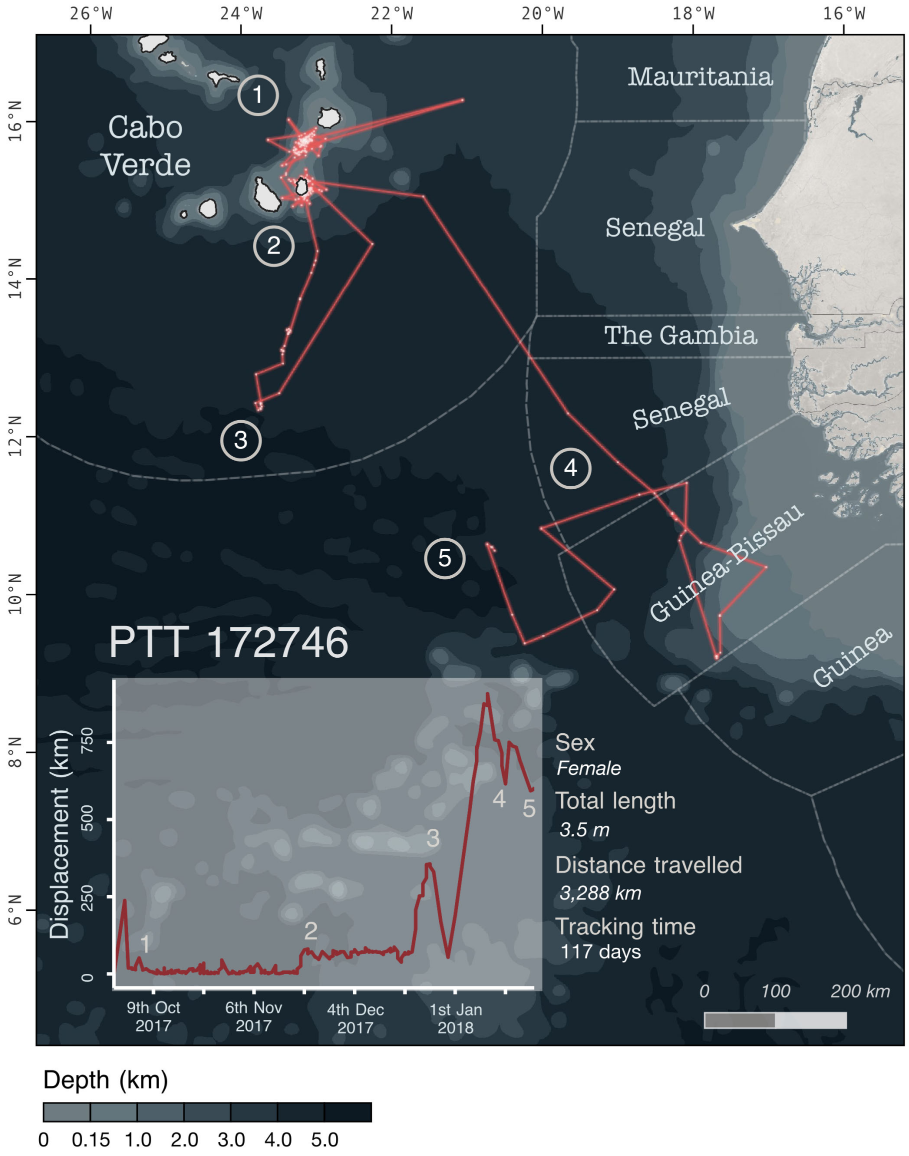

FIGURE 4
Regional connectivity of tiger sharks (*Galeocerdo cuvier*) in the East Atlantic Ocean. Tiger shark 172746 was the only individual to show extensive movement towards the coast of Africa. Red line and dots represent the filtered location data and the track followed by the shark. The circled numbers along the track indicate significant events along the track (see text). The insert graph shows the shark's displacement (distance from tagging site) as a function of time; numbers in the graph refer to the events described above.

high variability in space use regardless of size or sex, with several juvenile and adult individuals remaining close to the coast of one island for the entirety of the tracking period and others travelling much further towards continental Africa and, in one case, to Brazilian waters in South America. An interesting difference in average number of transmissions was observed between sexes, with female sharks generating 2.3 times more the number of locations, on average, than males. A difference in water column use may explain the discrepancy in transmission volume and could derive from tracked male sharks preferentially inhabiting waters near Sal, where a steeper bathymetry may allow easier access to deep water than in Boavista. Male sharks tracked in this study were also larger, on average, than females (321 ± 41 cm vs 287 ± 50 cm) and, while sex-specific depth use patterns have not been observed in this species, the tendency for larger tiger sharks to use deeper waters has been widely documented (Afonso and Hazin, 2015; Vaudo et al., 2014; Ajemian et al., 2020).

Within the Cabo Verdean EEZ, tiger shark space use was concentrated along the eastern and northern coast of the three easternmost islands of Sal, Boavista, and Maio, showing no movement towards the western islands of the archipelago. These coastal waters face some of the largest loggerhead turtle rookeries in the world (Casale and Marco, 2015; Hays et al., 2022; Patino-Martinez et al., 2022), suggesting that these islands may represent both critical nursery and feeding sites for tiger sharks in the ECA and able to support a large population of this species at different

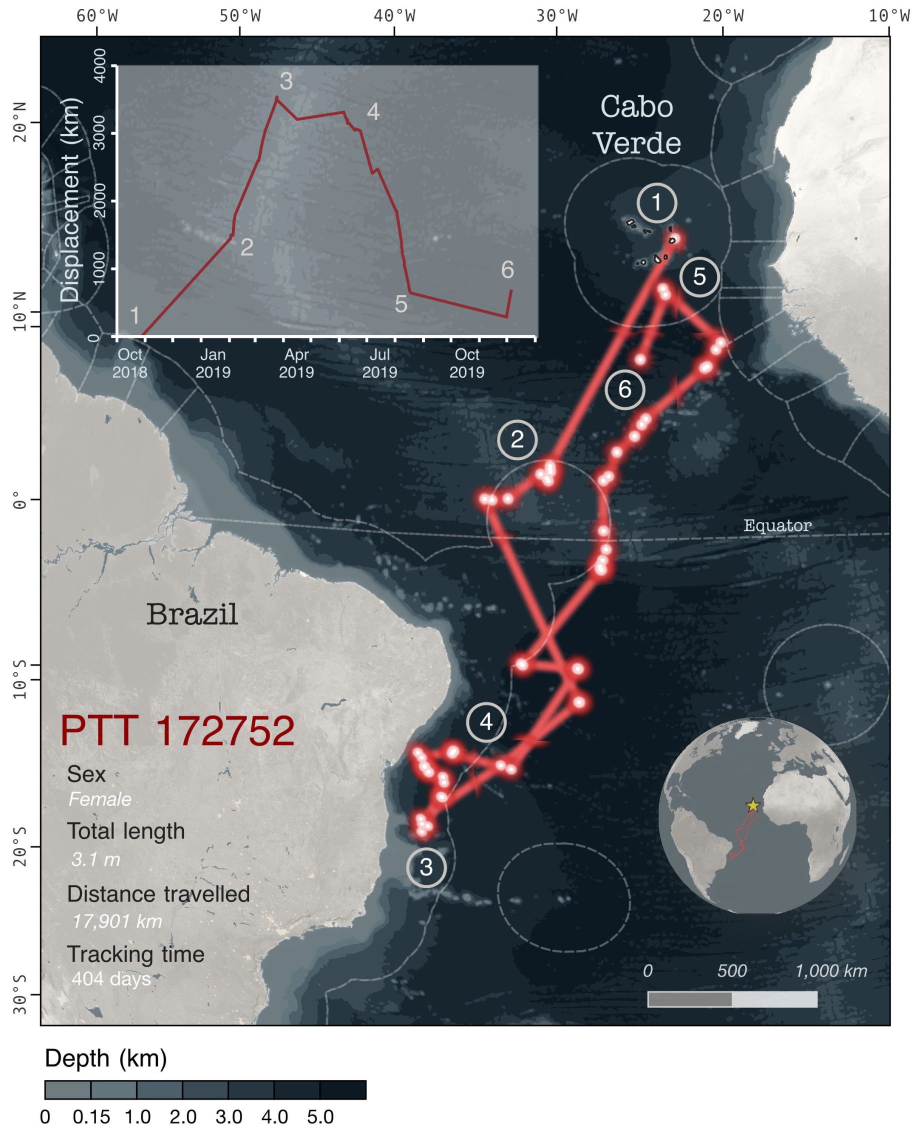

FIGURE 5
Transatlantic migration of a female tiger shark (*Galeocerdo cuvier*) from Cabo Verde. Tiger shark 172752 was tracked along a complete return migration across the Atlantic Ocean. Red line and dots represent the filtered location data and the track followed by the shark. The circled numbers along the track indicate significant events along the track and are explained in the bar at the bottom of the map. The insert graph shows the shark's displacement (distance from tagging site) as a function of time; numbers in the graph refer to the events described above.

stages in their life history. While female loggerhead presence in the archipelago is seasonal (Marco et al., 2011), some males and juvenile sea turtles can be found in coastal waters of these islands year-round (FG pers. obs.), offering a possible source of prey alongside teleosts and other elasmobranchs. While shark attacks on female loggerhead turtles have been reported in Boavista during the sea turtle mating season (FG pers. obs.), a better understanding of the interaction between the two species in the archipelago is required to understand the extent to which tiger sharks rely on the species for their diet and how this may shape their distribution.

Connectivity of tiger shark populations across the Atlantic Ocean has been assumed in the past (Afonso et al., 2017), and at least one tiger shark has been tracked moving from Fernando de Noronha archipelago in Brazil towards Africa (Afonso et al., 2017), though tracking data were confounded by potential capture in fisheries and showed no return movement to Brazil. In the present study, we confirm linkages between eastern and western South Atlantic tiger shark populations. The return migration between Cape Verde and Brazil of one female tiger shark in this study is the first of its kind documented in the literature and highlights the highly mobile nature of the species: totalling an estimated 17,901 km, this track represents the second longest recorded movement of a tiger shark globally.

The reason for this long-distance movement could not be determined in the present study. Ontogenetic shifts in prey preference and ephemeral foraging and/or mating opportunities are common drivers of migration (Graham, 2007; Lea et al., 2015; Pratt et al., 2022). Indeed, both mating and foraging areas can be found in Brazil: instances of tiger shark predation on sea turtles are known in the coastal areas of Brazil visited by this individual (Bornatowski et al., 2012), and tiger shark mating grounds are found at the Fernando de Noronha archipelago (Rangel et al., 2023), which the shark may have visited before reaching coastal waters. However, both prey items and sexually mature male individuals are also abundant in Cabo Verde, suggesting that other motives or mechanisms may be behind this migration. This behaviour seems, furthermore, uncommon in the population, with other individuals of the same sex and/or of similar size tracked in this study instead displaying high levels of residency in the archipelago. Further tracking studies could help in elucidating the prevalence of this behaviour, as well as its phenology, route, and role in the tiger sharks' life history. Genetic and isotopic comparisons of Cabo Verdean and Brazilian individuals could also provide information on the significance of the migration for feeding and mating of the population and its role in linking populations across the basin.

4.3 Threats and conservation issues for tiger sharks in the southern Atlantic Ocean

Shark populations have declined drastically in western Africa (Sall et al., 2021), chiefly due to unregulated extraction in artisanal and industrial fisheries. One exception to the overfishing of elasmobranchs in West Africa is represented by the archipelago of Cabo Verde, where shark fisheries have so far been relatively underdeveloped (Diop and Dossa, 2011). However, over the subsequent years, fishing pressure on sharks has been increasing in the archipelago with 70% of fishers surveyed in 2018 throughout the Cabo Verdean archipelago (n = 250) noting a significant decline in sharks over the previous decade of fishing (Seymour et al., 2018). In order to prevent severe declines in elasmobranch populations similar to those observed along the west African coast, conservation and fishery regulation measures should be put in place while fisheries are developing. At the same time, the lack of data regarding the spatial ecology and conservation status of many species in the archipelago needs to be addressed, so that efforts can be properly targeted.

Given the variable space use displayed by tiger sharks tracked in this study, these animals likely experience different threats according to their life stages. Most sharks spent a significant proportion of tracking time in coastal areas, where they overlap with small-scale traditional fishing grounds as well as semi-industrial vessels operating (sometimes illegally) in the country (Montrond, 2020; Varela et al., 2025b). Between 2012 and 2016, artisanal and semi-industrial fishing vessels in Cabo Verde landed an estimated 21.77 mt shark catch (De Bruyne and Labyedh, 2024), including tiger sharks (PEAGRP, 2020). While tiger sharks are not often landed whole by traditional fishermen in Cape Verde (RTG unpublished data), they are one of the most common species of sharks caught in the eastern islands (Varela et al., 2025b) and they are usually retained because their meat can either be sold for consumption or used as bait (ZLM pers. comm.), while their fins can be sold in the shark fin market passing through Senegal (Sall et al., 2021). Finning of tiger sharks is uncommon among small scale fishermen, but it is practiced by foreign semi-industrial and industrial vessels operating in the EEZ, with at least one instance of a tiger shark alive but lacking all fins recorded by the authors in the north-east of Boavista island. Similar fisheries also exist in Senegal and across west-African coastal nations where at least two sharks tracked in the study were headed.

Large-scale industrial fishing operations are active throughout the Atlantic, but especially in waters south of Cabo Verde and outside the Brazilian EEZ (Kroodsma et al., 2018, 2022; Welch et al., 2022), posing a potential threat to at least a portion of the tiger shark population (Balanin et al., 2023). It was not possible, in the present study, to quantify the overlap between tiger shark space use and fisheries, owing to the lack of data on fisheries within the EEZ and the limited tracking set of animals moving into international waters. Continued tracking efforts in the eastern Atlantic and collating of existing tracking data are urgently needed to better quantify the threat level for this species during the different stages in their life cycle.

4.4 Conclusions

Despite the circumglobal distribution and assumed relatively healthy global population status of tiger sharks (listed as Near Threatened; Ferreira and Simpfendorfer, 2019), critical data gaps exist for this species, particularly in the southern Atlantic Ocean (Balanin et al., 2023). The data presented in this study offer the first description of a potentially large population of this species in the eastern Atlantic, and suggest possible inter-oceanic population linkages between critical habitats required for the species' life cycle that were previously unknown and may be of consequence for the assessment of the conservation status of the species in the Atlantic. Much remains to be understood about the abundance, distribution, and movement ecology of this species in the eastern Atlantic, and further attention should be directed towards traditional ecological surveys and tracking studies that may shed light on the biology of the species.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The animal study was approved by Direção Nacional do Ambiente do Cabo Verde (permit No 2016/03 - 2019/03). The study was conducted in accordance with the local legislation and institutional requirements.

Author contributions

ZS: Conceptualization, Data curation, Investigation, Project administration, Writing – original draft. FG: Data curation, Formal analysis, Investigation, Visualization, Writing – original draft, Writing – review & editing. ZM: Investigation, Writing – original draft, Methodology. RG: Investigation, Writing – original draft, Conceptualization, Data curation, Funding acquisition, Project administration, Supervision, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The author(s) declared that Generative AI was not used in the creation of this manuscript.

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