Regional Studies in Marine Science 37 (2020) 101342

Contents lists available at ScienceDirect

Regional Studies in Marine Science

journal homepage: www.elsevier.com/locate/rsma

"Urbanite" rays and sharks: Presence, habitat use and population structure in an urban semi-enclosed lagoon

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ARTICLE INFO

Article history:
Received 7 January 2020
Received in revised form 12 June 2020
Accepted 20 June 2020
Available online 29 June 2020

Keywords:
Biodiversity
Chondrichthyans
Batoids
Conservation
Seasonality
Atlantic ocean

ABSTRACT

There is a vital necessity to provide more biological data on rays and sharks to promote efficient conservation. In this study, we assembled a database of weekly sightings to describe temporal (seasonal) patterns in the presence of elasmobranchs within an urban, semi-enclosed, landscape (Las Canteras beach, Gran Canaria Island, eastern Atlantic). Data also provided insight into their habitat use and population structure. From October 2015 to October 2018, eight species, either endangered or "data deficient" according to the IUCN red list, were reported, including: the common eagle ray, *Myliobatis aquila*, the common stingray, *Dasyatis pastinaca*, the round stingray, *Taeniurops grabatus*, the spiny butterfly ray, *Gymnura altavela*, the bull ray, *Aetomylaeus bovinus*, the angel shark, *Squatina squatina*, the marbled electric ray, *Torpedo marmorata* and the hammerhead shark, *Sphyrna zygaena*. All species were predominantly observed at night. The species varied in their habitat use; *D. pastinaca*, *G. altavela* and *S. squatina* dominated in sandy and mixed bottoms, while *M. aquila* and *T. grabatus* were mostly found in rocky and mixed bottoms. Both *D. pastinaca* and *T. grabatus* did not show any seasonal pattern, with consistent records all year around. In contrast, *M. aquila*, *G. altavela* and *S. squatina* showed some degree of seasonality. For five species, small-sized individuals were observed. If semi-enclosed embayments at oceanic islands, under intense human presence, are used by juveniles of endangered rays and sharks, proper management, e.g. limitation of putative human interactions, need to be considered to avoid disturbances.

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1. Introduction

Elasmobranchs encompass a wide group of carnivorous and detritivorous fish distributed worldwide, from shallow waters to abyssal depths. About 25% of rays and sharks face extinction risk, with recent declines in the abundance of certain species in the last few decades, mostly as a result of overfishing (Dulvy and Forrest, 2010; Dulvy et al., 2014; Lawson et al., 2019). Batoid species are particularly at risk of extinction, due to increasing anthropogenic threats, e.g. overfishing (Martins et al., 2018). In addition, a large number of elasmobranchs are biologically and ecologically unknown, e.g. abundance patterns and habitat uses, from most of their distribution ranges. In this sense, a considerable number of rays and sharks are considered by the International Union for the Conservation of Nature (IUCN) red list as "data deficient". Clearly, there is a vital necessity to provide more biological data on this fauna to promote conservation strategies (Dulvy et al., 2014; Martins et al., 2018; Lawson et al., 2019). For example, describing patterns of distribution, foraging, reproduction, pupping and habitat use is a key factor to optimize management of these species (Le Port et al., 2012). Importantly, knowledge on the ecology of rays and sharks is relevant in areas of strong interactions with humans, as is the case of urban environments, where a range of human actions (fishing, industrial activities, tourism and leisure,) takes place (Gonçalves Silva and Vianna, 2018).

Certain areas of the world are rich, not only in terms of the diversity of elasmobranchs, but also in the frequency of observations along nearshore waters. The Canary Islands is a clear example; this Atlantic archipelago is the last worldwide stronghold of the angel shark, *Squatina squatina* (Linnaeus, 1758) (Meyers et al., 2018; Lawson et al., 2019) and large aggregations of elasmobranchs are spotted near the shore (Assis et al., 2008; Narváez, 2013), even linked to human facilities, such as sea-cage fish farms (Dempster et al., 2005; Tuya et al., 2006). The lack of bottom-trawling, as a result of a reduced continental shelf, is a key mechanism explaining the large abundance of rays and sharks in this oceanic Archipelago (Brito et al., 2002). Coastal landscapes of the Canary Islands typically include a mosaic of

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https://doi.org/10.1016/j.rsma.2020.101342
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habitats, such as rocky reefs, seagrass meadows, unvegetated sediments (sandy bottoms), which offer suitable habitat for different life history stages of marine fish (Espino et al., 2015a), including elasmobranchs (Brito et al., 2002; Espino et al., 2015b).

In this study, we assembled a database of species records (sightings) through weekly tours carried out by an ecotourism (snorkeling) enterprise to describe temporal (seasonal) patterns in the presence of elasmobranchs. More specifically, we used a 3 years-database (from October 2015 to October 2018) to assess whether seasonality affected the presence of elasmobranchs and to provide insight into their habitat use and population structure within a highly populated urban landscape (Las Canteras beach, Gran Canaria Island, northeastern Atlantic) that include several habitats (Tuya et al., 2019). This data may be relevant, for example, to infer potential movement of adults, as well to determine their reproductive, parturition, pupping seasons. From a management perspective, this biological data is valuable to help conservation actions; for example, protection of juveniles at certain seasons, or restriction of certain human activities in the seasons of large aggregations of elasmobranchs (Heupel et al., 2007; Lawson et al., 2019). This is particularly pertinent in our case-study, as all analyzed species are either endangered or considered as "data deficient" by the IUCN red list.

2. Materials and methods

2.1. Study site

This research was undertaken at Las Canteras beach, a nearshore semi-enclosed lagoon system located in the metropolitan area of Las Palmas de Gran Canaria, at the northern side of Gran Canaria Island (northeastern Atlantic Ocean) (Fig. 1a). The city has approximately 400,000 inhabitants and the beach is a pivotal core for its social and economic progress, with more than 300,000 tourists, on average, visiting the beach every year (www.grancanaria.com/turismo/es). The beach is about 3 km long and is used by hundreds to thousands of people every day for sunbathing, swimming, snorkeling, diving, paddling or surfing. Sandy bottoms and rocky reefs are interconnected as irregular mosaics, typically between zero and three meters of depth (Fig. 1A, Tuya et al., 2019). An offshore sedimentary bar (ca. 2 km long) delimits the system's seaward extent (Fig. 1b, Fig. 1A); the bar is fragmented at several places and ranges between 200 and 300 m offshore. At low tide, the bar is above the surface, providing protection against swells. This semi-lagoon embayment has a maximum depth of 4 m; most of the study area is uniformly between 1 to 3 m depth. At high tide, however, the system is open to offshore waters. The study site is protected within the framework of a "Special Area of Conservation" (code ES7010037, EU "Natura 2000" framework) (www.miteco.gob.es/es/costas/temas/proteccion-medio-marino/biodiversidad-marina/espacios-marinos-protegidos/red-natura-2000-ambito-marino/zec-es7010037.aspx). Commercial and recreational fishing is banned across the entire beach. In addition, the beach holds the environmental quality certification UNE-EN ISO 14001 (AENOR). Seawater surface temperatures ranged between 18°C in winter (March–April) and 24.5°C in summer (September–October) through the study period (Fig. 2A).

2.2. Data compilation

Data on the presence of elasmobranchs (Fig. 3A) was provided by tours (2–3 persons) carried out by the ecotourism enterprise Snorkeling Experience (www.snorkelingexperience.com), from October 2015 to October 2018, including in all months through 3 successive years. Normally, 2 to 4 snorkeling tours

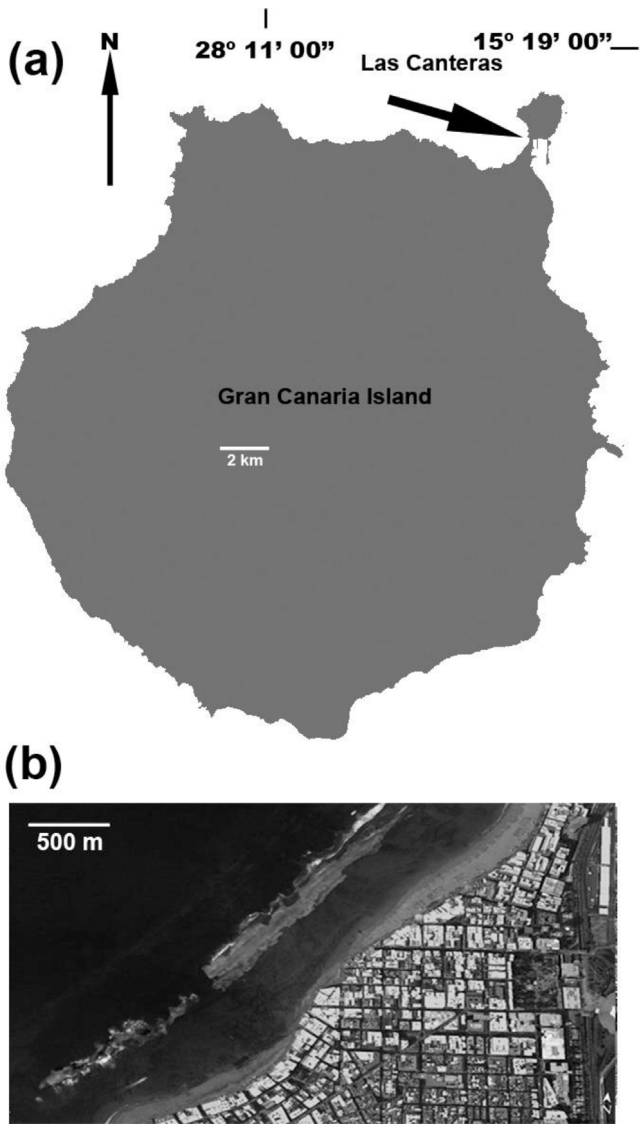

Fig. 1. Location of (a) the study site (Las Canteras beach) at Gran Canaria Island (eastern Atlantic), including (b) an aerial view of the semi-enclosed lagoon (source: Google Earth).

are carried out per week, always at low tide, during both day and night. Snorkeling guides collected data of occurring elasmobranchs on each tour, which typically took *ca.* 80–90 min, following the same routes (Fig. 1A). During this period, a total of 671 tours (*ca.* 900 h of underwater observation) were carried out. About 60% of this sampling effort was at daytime and 40% at nighttime. Seawater visibility typically ranged between 10 and 25 m. Underwater torches were used at night. For each observation, the habitat around each elasmobranch was recorded. Three habitat types were considered: sandy (interior of sandy bottoms located at least > 25 m from sandy–rocky transitions), mixed (sandy–rocky transitions) and rocky bottoms (interior of rocky bottoms at > 25 m from sandy–rocky transitions) (Tuya et al., 2019). We also visually estimated the size of each elasmobranch (in intervals of 10 cm for adults and 5 cm for juveniles). Initially, we validated length measurements by taking underwater pictures with a marked (scale) of known length. For semi-rhomboidal rays: the common eagle ray, *Myliobatis aquila* (Linnaeus, 1758), the common stingray, *Dasyatis pastinaca* (Linnaeus, 1758), the spiny butterfly ray, *Gymnura altavela* (Linnaeus, 1758), and the

Table 1
List of the elasmobranchs at Las Canteras beach between October 2015 and October 2018. The status of each species, according to the IUCN red list, is included. DD: data deficient, LC: least concern, NT: near threat, VU: vulnerable, EN: endangered, CR: critically endangered. The percentage of observations at day and night are included, as well as a Chi-square statistic (χ^2, df = 1) and the associated P-value to test for significance of deviations from a 1:1 distribution. Species are alphabetically arranged.

Species	Authority	Total	Night	Day	χ^2	P
Aetomylaeus bovinus (**DD**)	(Geoffroy Saint-Hilaire, 1817)	1	100%	0%	66.66	$3.21\ e^{-16}$
Dasyatis pastinaca (**DD**)	(Linnaeus, 1758)	14	85%	15%	27.92	$1.2\ e^{-6}$
Gymnura altavela (**VU**)	(Linnaeus, 1758)	69	70%	30%	8.33	$3.8\ e^{-3}$
Myliobatis aquila (**DD**)	(Linnaeus, 1758)	14	84%	16%	26.14	$3.1\ e^{-6}$
Sphyrna zygaena (**EN**)	(Griffith and Smith, 1834)	4	100%	0%	66.66	$3.2\ e^{-16}$
Squatina squatina (**CR**)	(Linnaeus, 1758)	21	90%	14%	30.09	$6.7\ e^{-10}$
Taeniura grabata (**DD**)	(Geoffroy Saint-Hilaire, 1817)	66	86%	14%	29.77	$4.8\ e^{-7}$
Torpedo marmorata (**DD**)	(Risso, 1810)	1	100%	0%	66.66	$3.2\ e^{-16}$

bull ray, *Aetomylaeus bovinus* (Geoffroy Saint-Hilaire, 1817), the length of the largest diagonal (in cm) was documented; for semi-rounded rays: the round stingray, *Taeniurops grabatus* (Geoffroy Saint-Hilaire, 1817), and the marbled electric ray, *Torpedo marmorata* (Risso, 1810), the diameter (= the width, in cm) of the disc was considered; for the angel shark, *Squatina squatina*, and the hammerhead shark, *Sphyrna zygaena* (Linnaeus, 1758), the total length (TL, in cm) of the body was visually estimated. The sex was also determined visually, by the presence (males) or absence (females) of genital claspers, for species where sexual determination was straightforward; this was the case for *D. pastinaca*, *G. altavela* and *S. squatina*. Individuals of *T. grabatus* and *M. aquila* were difficult to sex due to the difficulty in visualizing the presence of small-sized genital claspers. This protocol resulted in the creation of a database of 187 observations, including the date, hour (day *vs*. night), size, sex (whenever possible) and habitat of each record. The status of each species, according to the IUCNRedListofThreatenedSpecies (www.iucnredlist.org), was considered (Table 1).

To partition juveniles (small-sized, recently-born, individuals with no operational reproductive system) from subadults and adults, we considered the maturity development information provided by: Capapé et al. (2008) for *M. aquila*, Ismen (2003) for *D. pastinaca*, Capapé et al. (1992) for *G. altavela*, Osaer et al. (2015) for *S. squatina*, and Trindade-Santos and Freire (2015) for *S. zygaena*. Despite the fact that no information was available for *T. grabatus*, we considered that a size < 40 cm would correspond to juveniles, considering the maturity states of rays of the family Dasyateidae.

2.3. Data analysis

For each species, a χ^2 statistic (df = 1) was used to test whether the proportion of day *versus* night observations statistically differed from an expected 1:1 ratio, for the overall study. Similarly, a χ^2 statistic was used to test for significance of deviations from a 1:1 sex ratio. A χ^2 statistic (df = 2) tested for significant differences in the habitat use, i.e. proportions of observation between habitats, by each species through the entire study. All contingency tables and associated χ^2 statistics were implemented in the R-package "Rcommander" (Fox and Bouchet-Valat, 2018). Temporal series of observations throughout the entire study period were analyzed by means of the R-package "forecast" (Hyndman et al., 2019). We accounted for temporal variation in the sampling effort by considering the total number of monthly tours; the number of sightings per month were then divided by the total number of monthly tours. Firstly, we graphically partitioned seasonal components, from the additive and irregular (noisy) components, through the "stl" function. Then, we obtained correlograms, using the "Acf" function, to determine those temporal lags (here, months) with significant temporal autocorrelation through time. Confidence bounds were established at the 0.05 alpha level. This analysis was applied to species with a total number of observations > 10, including: *Myliobatis aquila*, *Dasyatis pastinaca*, *Taeniurops grabatus*, *Gymnura altavela* and *Squatina squatina*. In brief, the aim of this analysis was to provide insight into whether the frequency in the observation of elasmobranchs followed any temporal pattern. Decomposing a time series means separating it into its constituent components, which are usually a regular and seasonal trend component and an irregular component.

Table 2
Total number of males, females and not assigned (na) for *Dasyatis pastinaca*, *Gymnura altavela* and *Squatina squatina*. A Chi-square statistic (χ^2, df = 1) tested for significance of deviations from a 1:1 ratio.

Species	Males	Females	na	χ^2	P
Dasyatis pastinaca	5	5	4	0	1
Gymnura altavela	21	17	26	0.30	0.580
Squatina squatina	3	14	5	6.13	0.013

3. Results

Over the 36 months, a total of eight species of elasmobranchs were recorded (Table 1), for a total of 187 observations (Fig. 2). Three out the eight species were rarely observed; only one individual of *Aetomylaeus bovinus* and *Torpedo marmorata* were observed, while only four records were accounted by *Sphyrna zygaena*, all within the same month (Fig. 2d).

All species were predominantly spotted at nighttime (Table 1, P< 0.01 for all species). Certain species tended to be mainly observed in certain habitats of the study landscape (Fig. 3). In particular, *Dasyatis pastinaca* ($\chi^2 = 64.28$, df = 2, $P = 1.1e^{-14}$), *Gymnura altavela* ($\chi^2 = 26.79$, df = 2, $P = 1.5\ e^{-5}$), and *Squatina squatina* ($\chi^2 = 83.66$, df = 2, $P < 2.2e^{-16}$), dominated in sandy and mixed bottoms (Fig. 3). On the other hand, *Myliobatis aquila* ($\chi^2 = 46.43$, df = 2, $P = 8.2e^{-11}$), and *Taeniurops grabatus* ($\chi^2 = 15.99$, df = 2, $P = 3.3e^{-4}$), were predominantly found in rocky and mixed bottoms (Fig. 3). For the three species we identified the sex, both *D. pastinaca* and *G. altavela* showed balanced populations that did not differ from a 1:1 sex ratio (Table 2). However, *S. squatina* showed a larger presence of females relative to males through the entire study (Table 2). Most species displayed a wide range of sizes (Fig. 4, Table 1A).

We registered a number of juveniles for five, out of the eight, elasmobranch species (Fig. 5). Two records were accounted for by *M. aquila*, both between October and November 2018. A total of nine observations of juvenile *T. grabata* were registered in March 2017 and May 2018. For *G. altavela*, four juvenile records were annotated, in October 2015 and October 2018. We registered 4 sightings of juvenile *S. squatina*, one in March 2016 and three between September and October 2016. Finally, four records were annotated for *S. zygaena* in September 2018.

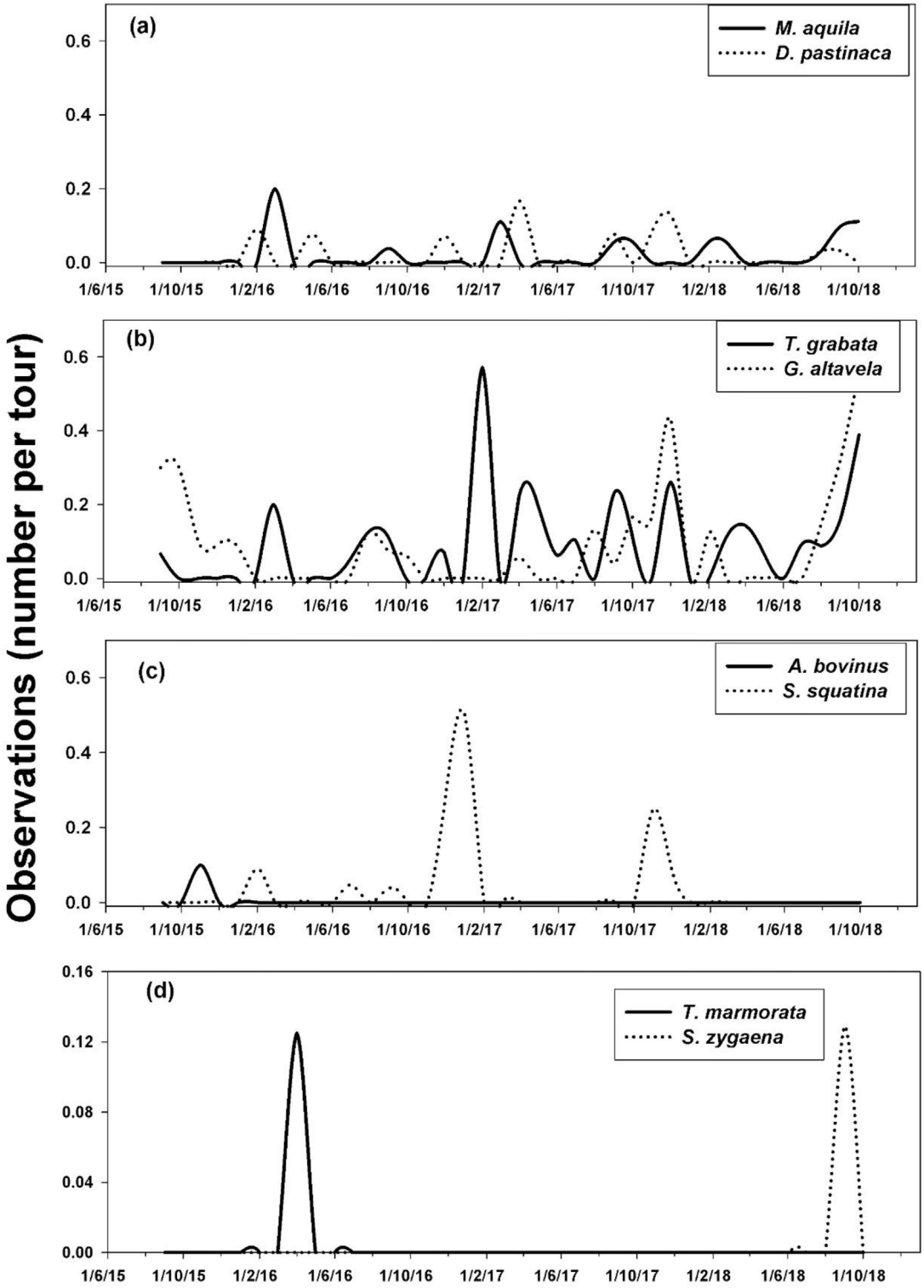

Fig. 2. Number of observations (standardized according to the monthly number of tours) throughout the study period (N= 671 tours) for (a) *Myliobatis aquila* and *Dasyatis pastinaca*, (b) *Taeniurops grabatus* and *Gymnura altavela*, (c) *Aetomylaeus bovinus* and *Squatina squatina*, and (d) *Torpedo marmorata* and *Sphyrna zygaena*.

Correlograms (Fig. 6) provided varying evidence of autocorrelation (frequency) in sightings between species. Both *D. pastinaca* and *T. grabatus* did not show any seasonal pattern, with records all year around (Fig. 2a and Fig. 2b, respectively). In turn, graphical inspection of decomposed seasonality did not reveal any trend for these two species (Fig. 4A). In contrast, *M. aquila*, *G. altavela* and *S. squatina* showed some degree of seasonality (Figs. 2a, 2b and 2c, respectively), also revealed by graphical examination of decomposed seasonal patterns (Fig. 4A). The species *M. aquila* displayed two seasonal peaks, in winter (March to April) and summer (August to October); the autocorrelation at lag = 12 months was over the significance of the correlogram upper

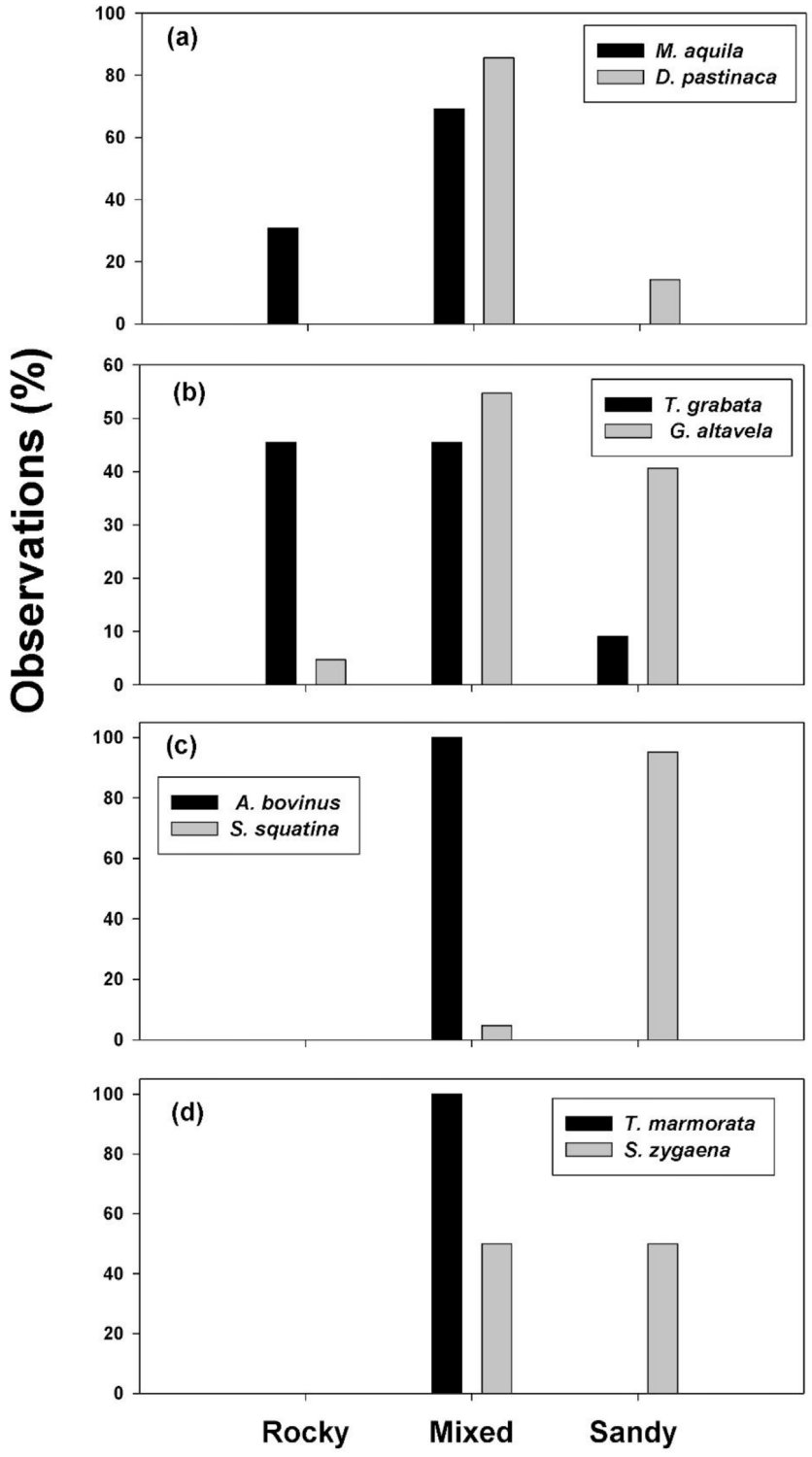

Fig. 3. Percent of observations for (a) *Myliobatis aquila* and *Dasyatis pastinaca*, (b) *Taeniurops grabatus* and *Gymnura altavela*, (c) *Aetomylaeus bovinus* and *Squatina squatina*, and (d) *Torpedo marmorata* and *Sphyrna zygaena*, in each of the three habitat types.

bound (Fig. 6a, Fig. 4A). The only two juveniles of this species also occurred in summer (October 2018). In the case of *G. altavela*, this ray showed a clear autocorrelation at lag = 1 and 2 months (Fig. 6d); therefore, observations between successive months were considerably correlated. This species also showed a certain level of autocorrelation between lags 10 and 12 (Fig. 6d, Fig. 4A), suggesting seasonality in their sightings with two peaks, one in late summer to autumn and another in winter. Importantly, the peak in summer included both adults and juveniles in 2015 and 2018 (Fig. 5), while the peak in winter only included adults. Similarly, *S. squatina* showed a clear autocorrelation at lag = 1 month (Fig. 6e), i.e. observations between two successive months were highly correlated. A certain level of autocorrelation was also observed between lags 10 and 11 (Fig. 6e, Fig. 4A),

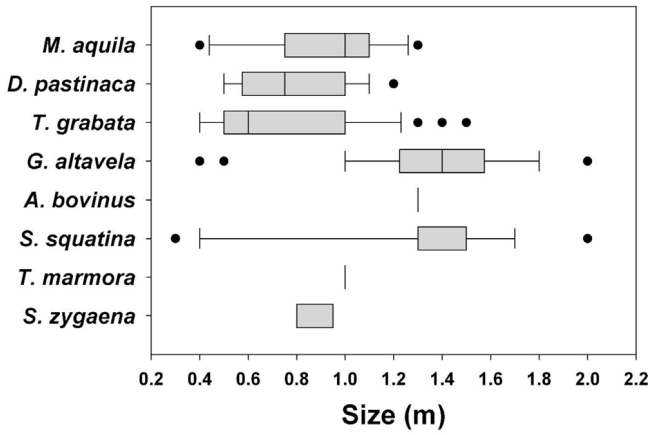

Fig. 4. Range of sizes of the eight elasmobranchs registered at the study site. For *Myliobatis aquila*, *Dasyatis pastinaca*, *Gymnura altavela* and *Aetomylaeus bovinus*, the length of the largest diagonal was accounted. For *Taeniurops grabatus* and *Torpedo marmorata*, the width of the disc was considered. For *Squatina squatina* and *Sphyrna zygaena*, the total length of the body was estimated.

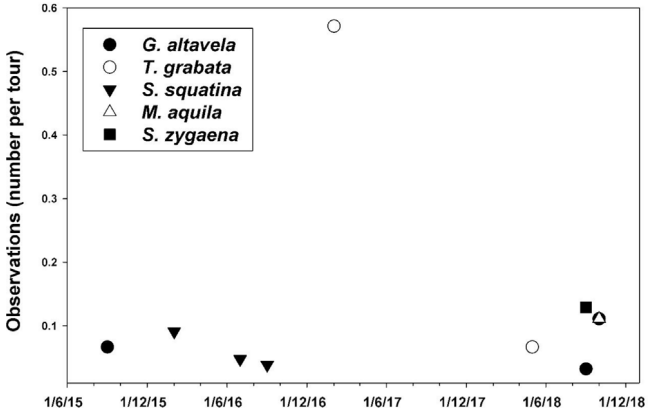

Fig. 5. Number of monthly observations of juveniles (standardized according to the number of tours) throughout the study period.

suggesting some degree of seasonality in their sightings. Juveniles of *S. squatina* only appeared in 2016 (Fig. 5), which precluded a connection between the seasonality in the number of sightings and recruits.

4. Discussion

The study site is a semi-enclosed embayment under strong human presence by both locals and tourists. At first, it is somehow surprising that such *a priori* sensitive species inhabit this seascape. Several reasons can help us to understand why this semi-lagoon might be a hotspot for elasmobranchs. First, this is the only large semi-lagoon embayment across the northern coast of the island. The rest of the coastal perimeter is mainly composed of vertical cliffs and beaches directly exposed to large oceanic swells. The semi-lagoon is covered by extensive vegetation, providing habitats for a large diversity of marine fauna (Tuya et al., 2019). Most observations of elasmobranchs, however, occurred at night; this is when direct human presence on the beach and onshore waters is almost negligible. Initially, this could reflect short-distance daily movements onshore–offshore, i.e. circadian (diel) migrations. As reported for other coastal elasmobranchs (Nelson et al., 1997; Barnett et al., 2010; Huston et al., 2017), it is plausible that, at daytime, most individuals are located offshore, resting in deeper waters, entering into the study landscape at

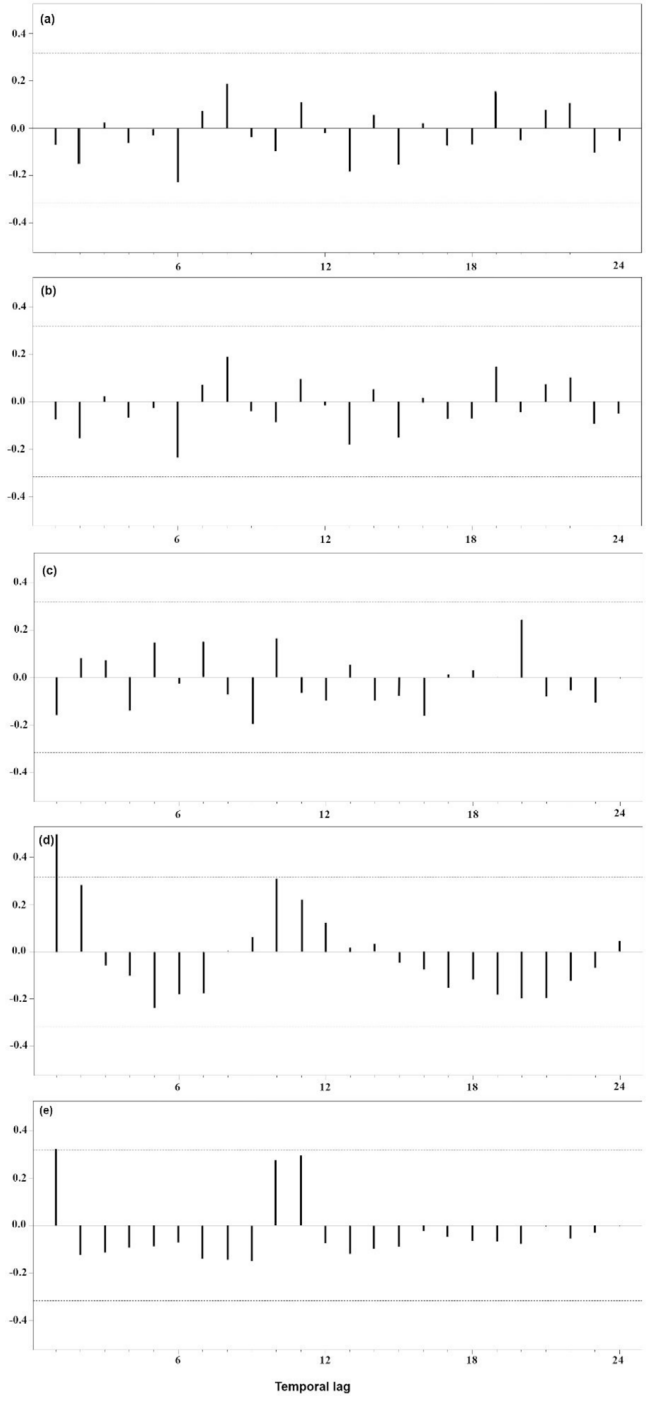

Fig. 6. Correlograms denoting temporal correlations for (a) *Myliobatis aquila*, (b) *Dasyatis pastinaca*, (c) *Taeniurops grabatus*, (d) *Gynmura altavela* and (e) *Squatina squatina*.

night to feed, or even to hide from large-sized predators. It is also possible that individuals are hiding inside caves, or buried in the sediment, and become active at night. Nocturnal behavior is common for rays and sharks inhabiting nearshore waters (Barnett et al., 2010; Huston et al., 2017), which is often related to foraging on small-sized fishes and invertebrates in shallow waters (Cartamil et al., 2003), while minimizing predation risks (Holland et al., 1993). This is particularly the case for juveniles and, therefore, seems to be a plausible explanation for the presence of juveniles of several species at the study site, similar to other

coastal embayments (Holland et al., 1993; Heupel et al., 2007). Of course, we lack movement data (e.g. via telemetry) to specifically assess these diel patterns, so we are not able to describe either the degree of site fidelity, or the animals' foraging ranges between daily phases. Despite the fact that human presence at night is minimal, it remains unclear whether human-induced noise, as well as night illumination at the beach waterfront, could affect the behavior of these species. Future research in the study area should initially aim at tagging elasmobranchs to determine the degree of site-fidelity, foraging ranges, and seasonality in the presence of particular specimens.

The study site contains a range of interconnected habitats (Fig. 1A, (Tuya et al., 2019). Because most rays have compressed bodies to inhabit sedimentary habitats, we initially would expect a larger presence of rays in sandy and mixed habitats (Farré et al., 2015); this was the case for *Dasyatis pastinaca*, *Gymnura altavela* and *Squatina squatina*, a dorso-ventrally compressed shark. However, *Myliobatis aquila* and *Taeniurops grabatus* were mainly found in rocky and mixed bottoms. Initially, this outcome arises from the fact that sandy bottoms are juxtaposed with rocky reefs in the study system. It is plausible, moreover, that the larger presence of these two rays in rocky bottoms is a way to minimize competition in homogeneous habitats with low feeding resources, such as sandy bottoms, particularly since both species can be found in both sandy and rocky bottoms in the study region (Brito, 1991; Brito et al., 2002; Espino et al., 2006). Our results support the idea that sandy bottoms should not be initially underrated in terms of conservation, from the perspective of the presence of elasmobranchs, particularly when reefs are interconnected with sandy bottoms (Tuya et al., 2019).

Both *Dasyatis pastinaca* and *Gymnura altavela* displayed sexually balanced populations. However, *Squatina squatina* showed a larger presence of females relative to males. In autumn–winter, males of *S. squatina* often move onshore, while they remain at deeper waters the rest of the year. Most likely, males approach nearshore waters in autumn–winter to copulate with females, which are otherwise present in shallow waters of the Canary Islands all year round (Meyers et al., 2018). Seasonal movements of elasmobranchs are widely known (Carlisle and Starr, 2009; Barnett et al., 2010; Le Port et al., 2012), in particular for certain batoids inhabiting nearshore waters (Snelson Jr et al., 1988; Gray et al., 1997; Hoisington and Lowe, 2005; Le Port et al., 2012). In this sense, *Myliobatis aquila* seems to follow a seasonal pattern at the study site, including a winter and a summer peak, in terms of the number of sightings, even though we lack tagging or telemetry data to assess potential seasonal migrations.

The two most conspicuous species detected by this study showed contrasting patterns in the seasonality of their occurrences. *Taeniurops grabatus* had a consistent number of records all year around, whereas *Gymnura altavela* showed a clear seasonality with two peaks, in summer and winter, respectively. Importantly, the peak in summer included both adults and juveniles of *G. altavela*, while the peak in winter only included adults. Obviously, at this stage, it is impossible to unravel the exact number of observations attributed to different individuals. It is very likely that the same individuals are re-sighted several times, particularly in successive days and months. This seems to be particularly the case for species with strong autocorrelation at small temporal scales, such as *G. altavela*. The larger presence of *G. altavela* in summer fits with observations from the Mediterranean (Özgür Özbek et al., 2016) and two beaches (Melenara and Salinetas) from the east coast of Gran Canaria (Pers. Obs). Interestingly, well-structured populations of *G. altavela* have also been described from a highly impacted estuary off the metropolitan area of Río de Janeiro (Gonçalves Silva and Vianna, 2018). Considering that *G. altavela* shows one reproductive seasonal peak per year (Breder and Rosen, 1966; Capapé et al., 1992; Alkusairy et al., 2014) and that females and juveniles were spotted in summer, it is likely that the parturition of this species occurs in summer and juveniles remain in the area for some time. Such an outcome was here particularly recorded in the summer of 2015 and 2018. Similar coastal aggregations of adults and juveniles have also been reported in summer for certain batoids (Snelson Jr et al., 1988; Le Port et al., 2012). The absence of juveniles in 2016 and 2017, however, raises the possibility that inter-annual variation is important at local scales.

In this study, we also registered juveniles of the critically endangered shark *Squatina squatina*. The same occurs from other sites across the Canary Islands; for example, in the urban beach of Las Teresitas at the nearby island of Tenerife (Escánez et al., 2016). The geomorphological and environmental context of both urban beaches is somehow similar, because both beaches are protected by a natural and an artificial breakwater, respectively. Most likely, the presence of juveniles is related to decreased predation on neonates. Additionally, small-sized sharks can find a large amount of prey. The number of small-sized angel sharks detected by our study is notably lower than those accounted for by (Escánez et al., 2016). However, we have otherwise observed small-sized individuals (most likely juveniles) of five elasmobranch species, belonging to different phylogenetic lineages. The existence of ray or shark "nursery grounds" at shallow depths has long been described (Castro, 1993), where females and neonates are routinely encountered through time. Nurseries are, however, sometimes hard to define, with variation in their spatial configuration and environmental peculiarities (Scharer et al., 2017). Despite the fact that several criteria must be reached to label a place as a "nursery ground" (Heupel et al., 2007), different studies propose the existence of nurseries giving weight to diverse facts. This is the case for *Gymnura altavela*, where Gonçalves Silva and Vianna (2018) considered the large proportion of juveniles relative to adults, while (Alkusairy et al., 2014) considered the large number of females, particularly gravid, relative to adult males.

Not all areas where juveniles of elasmobranchs are found are nurseries (Martins et al., 2018). Actually, if we consider all available information, e.g. abundance of juveniles relative to adults, our study site is not a nursery area, according to (Heupel et al., 2007). However, we here take the chance to incorporate the presence of juveniles of different species within the same area, as a complementary way to typify a nursery area. This is particularly relevant for our study-case, because – to the best of our knowledge – this is the first study describing the presence of small-sized *Taeniurops grabatus* in two successive years. The use of "communal nurseries" may have had great importance in their life histories, despite limited data that has been presented in this regard (Martins et al., 2018). A potential shortcoming of our study, however, is the lack of local studies that define the length of juveniles of the target species.

Identification of "nursery grounds" is a critical step to promote conservation plans of endangered elasmobranchs (Heupel et al., 2007), including threatened sharks such the angel shark, *Squatina squatina* (Lawson et al., 2019). Because potential nursery habitats, such as extensive estuaries and mangroves, are reduced in oceanic islands, semi-enclosed nearshore embayments may play such a role, as both Las Canteras and Las Teresitas city beaches. The potential of these places needs to be carefully addressed. If, moreover, these semi-enclosed areas are under intense human pressure, proper management needs to be considered to avoid disturbances (e.g direct interactions with beach users). For example, limitation of putative human interactions need to be considered to avoid disturbances. Constant monitoring of the appearance of juveniles and studies to unravel the genetic structure and the degree of familiarity of elasmobranchs from the study area are particularly valuable, in terms of

management decisions. At present, information to stakeholders, managers and society need to be delivered to promote public consensus on ways to minimize disruptive interactions with humans. The existence of a public forum for management decisions of the study area (www.lpamar.com/somos-ciudad-de-mar/microarea-ecoturistica-las-canteras?locale=es) facilitates discussion on proper management actions.

CRediT authorship contribution statement

Fernando Tuya: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing - original draft, Writing - review & editing. **Maite Asensio:** CConceptualization, Data curation, Investigation, Methodology, Writing - review & editing. **Alberto Navarro:** Conceptualization, Data curation, Investigation, Methodology, Writing - review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We acknowledge our friends and colleagues from the IU-ECOAQUA, in particular F. Espino, F. Otero, R. Haroun, T. Sánchez and A. Herrera, for their support and encouragement with this study, as well as Néstor Bosch (University of Western Australia) for providing comments on a previous draft. We dedicate this paper to the memory of our colleague T. Sánchez. This study received no funding.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.rsma.2020.101342.

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