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Habitat-driven distribution patterns of sparid species: Insights from a north Atlantic artisanal fishery

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ABSTRACT

Artisanal fisheries worldwide play a crucial role in supporting coastal communities, providing livelihoods, and contributing to food security. Understanding and comprehending the diversity and distribution of species across different habitat types is essential for implementing sustainable management measures for exploited fish populations. This study examines the associations of demersal fish in shallow water habitats around the Macaronesian region (NE Atlantic Ocean) focusing on sparid species captured using traps. Results revealed distinct bathymetric and habitat-related distribution patterns among sparids, strongly influenced by recruitment and trophic level. Herbivorous and omnivorous adults of *Sarpa salpa*, *Diplodus sargus*, and *Spondyliosoma cantharus* were more abundant in shallower areas and vegetated habitats, while carnivorous species like *Pagrus pagrus* and *Dentex gibbosus* dominated deeper zones and non-vegetated substrates. Recruitment stages significantly affected spatial distribution, with juveniles often occupying different depths and substrates than adults. Substrate type also played a key role, with species-specific preferences observed across rocky, mixed, and sandy bottoms. Seasonal reproductive periods further modulated habitat use, especially among adult specimens. This study emphasizes the need for monitoring specialized artisanal fisheries to understand both the specific distribution of species and their level of exploitation, providing valuable information for the management and conservation of coastal marine ecosystems.

1. Introduction

Currently, the fishing industry encompasses a diverse array of vessel sizes, power capacities, and operational characteristics (FAO, 2018). These range from small boats engaged in coastal shellfish harvesting to larger vessels operating in distant international or third-country waters (García, 2017). One example of this diversity is the artisanal fleet of the Canary Islands, which consists of versatile vessels involved in minor fishing arts, totaling 522 boats with an average tonnage of 177 GT. These vessels primarily employ trap fishing techniques, in addition to other methods such as line fishing, longlining, purse seining, and gillnetting. Furthermore, there is a subset of larger artisanal vessels dedicated exclusively to tuna fishing, comprising 48 boats with an average tonnage of 515 GT (IEO, 2025). Passive fishing gears, commonly utilized in artisanal or small-scale fisheries (SSFs), include fish traps that capture a diverse range of demersal species, contributing to sustenance in many tropical and subtropical reef fisheries, as observed in the Canary Islands (Munro, 1974; Gobert, 1998; Agar et al., 2008; Vadziutsina and Riera, 2020, 2021).

One of the primary advantages of utilizing fish traps for this study is their versatility, allowing for deployment across various substrate types commonly found on the continental shelf, either above or in proximity to reefs. Their application is also feasible along the slope of the insular shelf and in deeper banks, enabling effective operation throughout the entire depth range of the targeted resource (Miller and Hunte, 1987; Mahon and Hunte, 2001; Williams and Bax, 2001; Doherty et al., 2017; Bacheler, 2023). The increased habitat heterogeneity observed, including variations in topography and substrate, plays a crucial role in enhancing niche diversification and facilitating the colonization of distinct patches by various macrofaunal life-history strategies within a structurally complex landscape (De Leo et al., 2010). The substrate is a key factor influencing benthic and demersal communities and may indicate local environmental energy dynamics and stability (Allee et al., 2000). Ultimately, these factors shape the assemblages of demersal fish

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(Kuo-Shu et al., 2022).

By offering insights into ecosystem dynamics, effective management strategies can be formulated that not only preserve the natural integrity of ecosystems but also address human needs (Máñez-Crespo et al., 2022). Achieving this balance is vital for ensuring the sustainable use of resources while safeguarding biodiversity and ecosystem services. Information regarding the distribution and abundance of benthic fish assemblages in various Macaronesian coastal habitats remains limited, with most research primarily relying on visual observations conducted through diving techniques (Brito et al., 1999; Tuya et al., 2002, 2003, 2004; Tuset et al., 2013; Cruces et al., 2024). This method, while valuable, may have limitations in capturing the full diversity of species and understanding habitat preferences across different life stages. The FAO (2022) emphasizes the necessity for participatory approaches in fisheries assessment and management, which integrate ecological, social, and economic considerations, recognizing their interconnectedness for sustainable fisheries. García et al. (2003) and Harvey et al. (2012) highlighted the necessity for employing a variety of fishing gears to comprehensively assess habitat preferences throughout various life stages of the species. In regions where prior biogeographic mapping has been conducted, the study of trap catches offers a practical approach to elucidating the behaviour and distribution of demersal species across their various substrates and habitats (Cruces et al., 2024).

Recognizing environmental preferences is crucial for developing targeted management strategies (Cooke et al., 2023). Integrating participatory approaches, ecosystem knowledge, and an understanding of environmental drivers of biodiversity is also essential for effective conservation efforts. This integration enables the creation of comprehensive management strategies that promote sustainability and resilience in fisheries and marine ecosystems. Insights into species distribution and trophic dynamics play a crucial role in the conservation of coastal marine environments, aligning with the holistic approach advocated by the FAO (2022) and García et al. (2003), emphasizing the need for ecosystem-based management strategies that consider the interconnectedness of ecological, social, and economic dimensions, while also acknowledging the crucial role of habitat in supporting biodiversity (Cresswell et al., 2017). Our research concentrates on Sparidae fish assemblages in shallow-water habitats surrounding the island of Gran Canaria (Canary Islands, NE Atlantic Ocean), with a particular emphasis on analyzing the species diversity captured by traps across various habitats.

The family Sparidae, within the order Perciformes, includes numerous species of high economic importance that are intensively exploited by commercial fisheries, aquaculture, and recreational fishing activities (Pavlidis and Mylonas, 2011). Sparids are widely distributed from tropical to temperate regions, occurring throughout the Atlantic, Indian, and Pacific Oceans, as well as the Mediterranean Sea (Basurco et al., 2011). They are predominantly demersal fishes associated with the continental shelf and slope, although some species also utilize estuarine environments, which function as important nursery areas during early life stages (Carpenter and Niem, 2001). This broad ecological range highlights the relevance of ontogenetic habitat shifts, with recruitment processes playing a central role in shaping spatial distribution patterns. In this context, the observed assemblage structure and habitat preferences offer valuable information for improving local fisheries management and informing conservation strategies aimed at sustaining sparid populations.

Between 2020 and 2024, Sparidae fisheries in the Canary Islands accounted for 4.32 million kg of landings, generating €30.87 million at first sale and underscoring their economic importance to the primary sector. Trap based fisheries target *ca.* 24 sparid species, which represented 63% of the total catch in 2024, highlighting the need to better understand their habitat use and ecological interactions (GOBCAN, 2025). Accordingly, this study aims to assess how key habitat drivers, including depth, substrate, and vegetation, shape the distribution, trophic structure, and ontogenetic habitat shifts of sparids in shallow coastal waters of Gran Canaria. The specific objectives are (i) to evaluate differences in habitat use between juvenile and adult stages, (ii) examine the influence of trophic level on habitat preference, and (iii) determine whether reproductive stage modifies habitat associations. The study tests the hypotheses that habitat preferences vary across growth phases, that higher trophic level species are associated with deeper and non-vegetated habitats, and that reproductive periods amplify these patterns. The results are intended to inform both fisheries management and ecosystem conservation, contributing to sustainable and resilient marine resource use in regions with comparable ecological settings, in line with ecosystem based management principles (Kuo-Shu Chen et al., 2022; FAO, 2022).

2. Material & methods

2.1. Study area

Data were obtained from coastal areas in the island of Gran Canaria (Canary Islands, NE Atlantic Ocean). Within the echo-mapped study area, sandy habitats dominate, with communities of macroalgae, mainly *Caulerpa* spp., and in some cases, the presence of garden-eels (*Heteroconger longissimus*). This is followed by mixed substrates with mostly dead bioclasts, as well as rocky substrates where barren bottoms dominate. To a lesser extent, rocky and mixed areas with vegetation are represented, as well as areas with the presence of the seagrass *Cymodocea nodosa*, due to the prohibition of setting traps below 18 m (BOE 2015), where these habitats predominate. Therefore, they are not representative and were not included in the analyses.

2.2. Data collection

All data were collected on-site by marine biologists as part of studies initiated by public administrations, specifically the Cabildo de Gran Canaria and the Consejería de Agricultura, Ganadería, Pesca y Aguas del Gobierno de Canarias. Aboard 25 professional artisanal fishing vessels regularly distributed from different fishing ports on the island, during a first period that spanned from July 2016 to September 2017, a second from April to November 2018, and the last period from August to September 2020. The results were analyzed based on the total catches obtained from traps set by professional fishermen in the surrounding waters of the island, extending from the Northeast to the West.

A total of 3661 traps were analyzed to determine the composition of the catches. The GPS coordinates were recorded on-site, along with the draft and lifting depth of each trap for subsequent analysis. All catches were identified, measured (total length in mm; TL) and weighed (total weight in g), those that did not reach the legally established size by regional (BOC, 1986) and national regulations (BOE 1995) or did not have commercial interest were immediately measured on board and returned to the sea. The biomass estimate for specimens that could not be measured was obtained using length-weight relationship equations. (Froese and Pauly, 2019).

2.3. Types of traps and techniques used

Two different hexagonal mesh sizes were used, ranging from 31.6 (S = Small mesh size) to 50.8 mm (L = Large mesh size). The trap total length ranged between 100 and 200 cm for S-traps and between 200 and 410 cm for L-traps. The commonly utilized trap shapes include rectangular configurations (S-traps ranging from 1 to 4 m^2 and L-traps ranging from 4 to 16 m^2) and circular configurations (S-traps ranging from 0.785 to 3.142 m^2 and L-traps from 3.142 to 12.566 m^2). Small traps are normally used with a single tunnel entrance, with a *ca.* maximum opening length of 20 cm and the deployment is usually done in shallow areas. The large traps generally have two tunnel entrances, each with a *ca.* maximum opening length of 40 cm and the set maneuver in deeper bathymetric zones. The soaking time of the different types of traps generally varies from several days to weeks for small traps, and from several weeks to months for large traps. The bait used is mostly bread due to its low economic cost, as well as sardines or small pelagics on some occasions. The deployment is carried out by placing one or more traps on the bottom, leaving several meters of separation between them. Connecting lines link the traps, and a signaling beacon is used for location and retrieval.

2.4. *Data processing*

To analyze the size selectivity in the main Sparidae catches across different types of traps, the first maturity size (SMF50) and the reproductive period were employed, as outlined in accordance with González et al. (2012). To determine the distribution of total catches from traps in the mapped area, CPUE (catch per unit of effort) values were calculated for "marketable" specimens meeting the minimum legal size. (BOC, 1986; BOE, 1995), using the formula employed is CPUE = C (catches in grammes)/E (effort in soak days). However, to analyze the behavior across different life stages of main sparid species, all specimens were evaluated in assessing substrate and habitat distribution, regardless of size.

The description of the catches based on different habitats was conducted using the bionomic cartography provided by GRAFCAN (https://visor.grafcan.es/visorweb/). The bionomic shapefile contains data from shallow areas up to 60 m in specific regions of the island; above this depth, only limited echo-mapping data are available. However, for the bathymetric distribution of the catches, data were collected from shallow areas extending to 130 m. Once the CPUE of each of the main specimens captured was calculated, the database was integrated into QGIS v3.24.2 using the “Intersect” option. This process generated an attribute table that integrates the CPUEs of the species with the bionomic data, allowing for the attribution of catch values to each type of substrate and habitat. Substrate types were categorized into rocky substrates (RS), mixed substrates (MS), and sandy substrates (SS), within habitats that were either with vegetation (SV) or without vegetation (SW). The main communities encompassing these substrate types were unified as follows: For sandy substrates, the recorded categories included bare sand, *Heteroconger longissimus* community, *Caulerpa* spp. community, and *Avrainvillea canariensis*. For mixed substrates, the categories comprised mixed grains, stones, dead and live bioclasts, scattered rocks, and maërl. For rocky substrates, the categories included grazed rocks, rounded stones, gorgonians, and other algal communities associated with the rocks. In the classification of habitats, all substrates that contained any algal community, such as *Caulerpa* spp., *Avrainvillea canariensis*, maërl, and others associated with rocks, were categorized as vegetated habitats. Conversely, all remaining substrates were classified as belonging to the group of habitats without vegetation.

2.5. *Data analysis*

To assess habitat-specific patterns in Sparidae assemblages, we conducted a multivariate analysis of trap catch data collected across a gradient of shallow-water habitats surrounding Gran Canaria for different age classes and reproductive cycles. Habitats were classified into two categories: those with vegetation and those without. Based on substrate type, three categories were identified: sand beds, shallow rocky reefs, and mixed substrates. The abundance and composition of the catch assemblage were determined, as well as the average size of each species across the different trap types.

For the depth and CPUE data of the different species, Kolmogorov-Smirnov (K-S) tests were performed to assess the normality of the data. Subsequently, Levene's tests for equality of variances were conducted to determine the necessity of performing non-parametric tests, such as the Mann-Whitney *U* test for analyses involving two groups (habitat and depth), or the Games-Howell test when using three groups (substrate). Significance values were considered based on the robust Welch's ANOVA for mean equality. For cases where the variances of the groups were equal, ANOVA was conducted.

3. Results

In the sampled traps, a total of 66 species across 33 families were captured and identified, including 17 species from the Sparidae family. Supplementary Table 1 details the number of specimens captured for each species along with their respective trophic levels. Additionally, the average sizes of each species, total length (TL) range, and biomass captured in each trap type (*S* and *L*) are presented. The "marketable" CPUE exhibited a wide range, varying between 4 and 3368 (g/traps/days) in different areas (Fig. 1).

3.1. *Bathymetric distribution patterns among sparids*

The results indicate a general trend of displacement toward deeper bathymetric zones among individuals at higher trophic levels, exemplified by species such as *P. pagrus* and *D. gibbosus*. While juvenile specimens of *P. erythrinus* ($Z = -8.112$, $p = 0.000$) and *P. acarne* ($Z = -3.876$, $p = 0.000$) are significantly found in deeper areas, adult sparids exhibit a more pronounced bathymetric displacement, especially at higher trophic levels. This behavior results in lower trophic level species, including herbivorous and omnivorous feeders like *S. salpa* ($Z = -2.152$, $p = 0.031$), *S. cantharus* ($Z = -1.972$, $p = 0.049$), and *D. sargus* ($Z = -3.074$, $p = 0.002$), exhibiting significant differences in mean catch at deeper depths. Similarly, carnivorous species at higher trophic levels, such as *P. pagrus* ($Z = -15.991$, $p = 0.000$) and *D. gibbosus* ($Z = -22.216$, $p = 0.000$), also demonstrated significant variations in their catch data (Fig. 2; Suppl. Table 2).

3.2. *Substrate-related distribution patterns among sparids*

The analysis of catch differences across various reproductive stages revealed that certain species, independent of their trophic levels, exhibit varied catchability across different substrate types: rocky substrates (RS), mixed substrates (MS), and sandy substrates (SS). Notably, adult and juveniles of *P. erythrinus* and *P. pagrus* demonstrated strong preferences for mixed substrates ($Z = 53.582$, $p = 0.000$; $Z = 8.164$, $p = 0.000$) and sandy substrates ($Z = 44.252$, $p = 0.000$; $Z = 84.688$, $p = 0.000$), respectively, compared to rocky substrates. Additionally, juveniles of *S. cantharus* ($Z = 15.533$, $p = 0.000$) and adult specimens of *S. salpa* ($Z = 10.095$, $p = 0.000$) also favored mixed and sandy substrates. Adults of *S. cantharus* ($Z = 8.160$, $p = 0.000$) exhibited a distinct preference for sandy substrates over mixed and rocky ones. In contrast, *P. acarne* ($Z = 0.219$, $p = 0.803$; $Z = 1.990$, $p = 0.138$) and *D. gibbosus* ($Z = 2.038$, $p = 0.131$; $Z = 0.551$, $p = 0.576$) showed no significant differences in catches for both adults and juveniles, indicating a preference for rocky substrates compared to other examined species. However, juveniles of *D. sargus* ($Z = 4.073$, $p = 0.018$) demonstrated a preference for both rocky and mixed substrates. (Fig. 3; Suppl. Table 3).

3.3. *Influence of vegetation on sparid habitat preferences across growth phases*

Analysis of the growth phase across various sparid species revealed that, except for *D. sargus* ($p = 0.165$) and *P. pagrus* ($p = 0.617$), which showed no significant differences in catches, juvenile sparids generally exhibited higher catches in habitats devoid of vegetation. The only exception was *S. cantharus*, which demonstrated a preference for vegetated habitats ($p = 0.011$). For adult specimens, herbivorous and omnivorous species such as *S. salpa* ($p = 0.410$), *S. cantharus* ($p = 0.873$), and *D. sargus* ($p = 0.638$) exhibited higher catches per unit effort in vegetated habitats, though these differences were not statistically significant compared to non-vegetated areas. In contrast, carnivorous sparids showed greater catches in habitats without vegetation. Species at

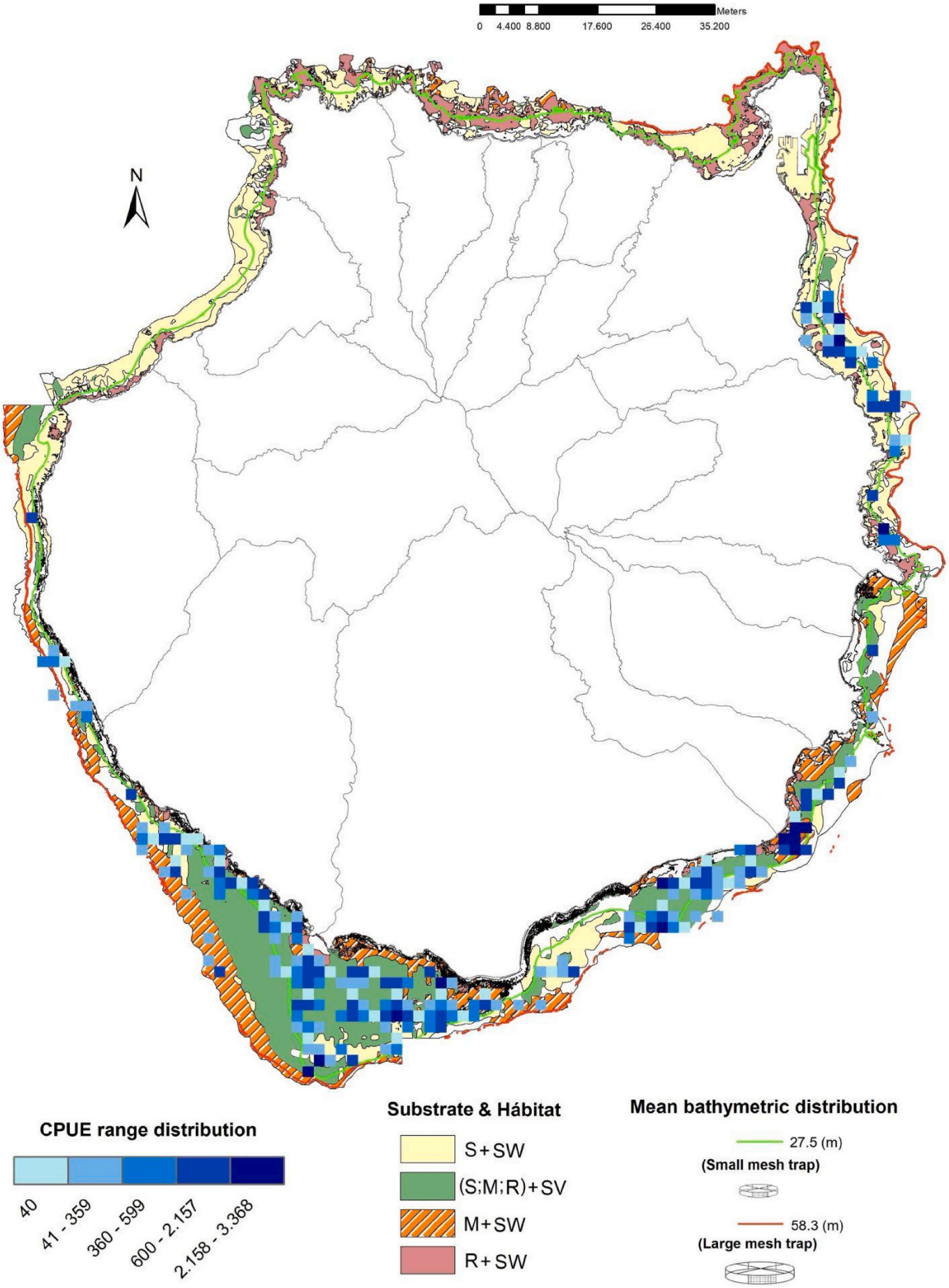

Fig. 1. Study area featuring a heatmap that displays the marketable CPUE (g per trap per day) values from the set of captures in sandy (S), mixed (M), and rocky (R) substrates and in non-vegetated (SW) and vegetated habitats (SV) within 600 × 600 m grids. The figure also includes the average depth (m) for the different types of traps (large and small) used along the bathymetric lines.

intermediate or higher trophic levels, including *P. erythrinus* ($p = 0.015$), *P. pagrus* ($p = 0.009$), and *D. gibbosus* ($p = 0.000$), significantly favored non-vegetated environments. Although *P. acarne*, which has a higher trophic level than *P. erythrinus*, achieved greater catches in vegetated habitats, no significant differences were detected ($p = 0.121$) (Fig. 4; Suppl. Table 3).

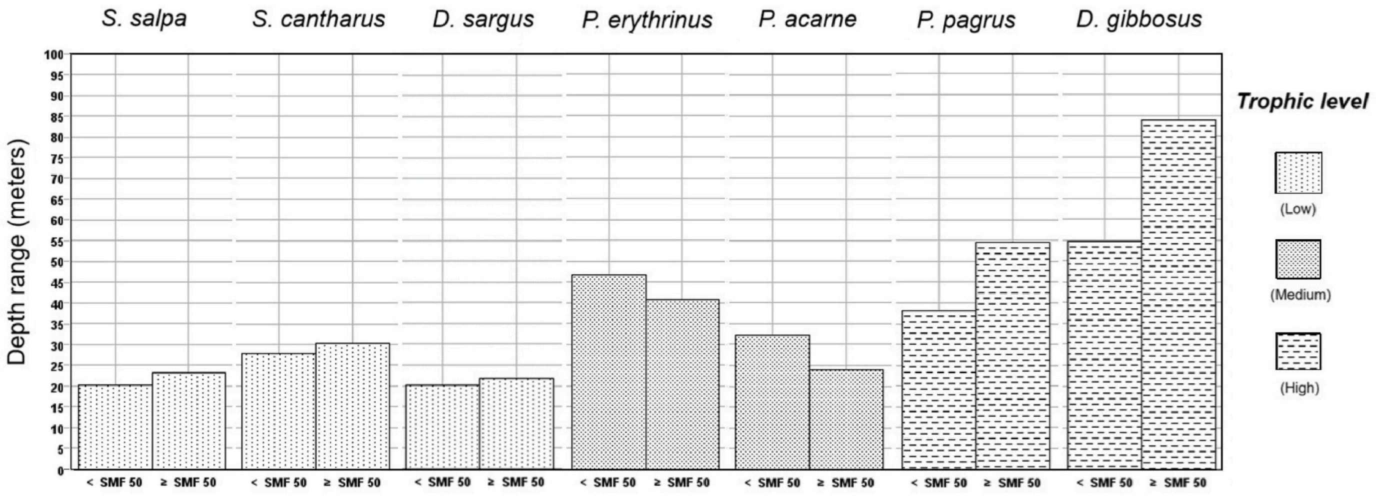

Fig. 2. Mean catch depth (in meters) of juvenile and adult Sparidae species categorized by trophic level (from lowest to highest), highlighting significant differences in catches between age categories. Statistical results are available in Supplementary Table 3.

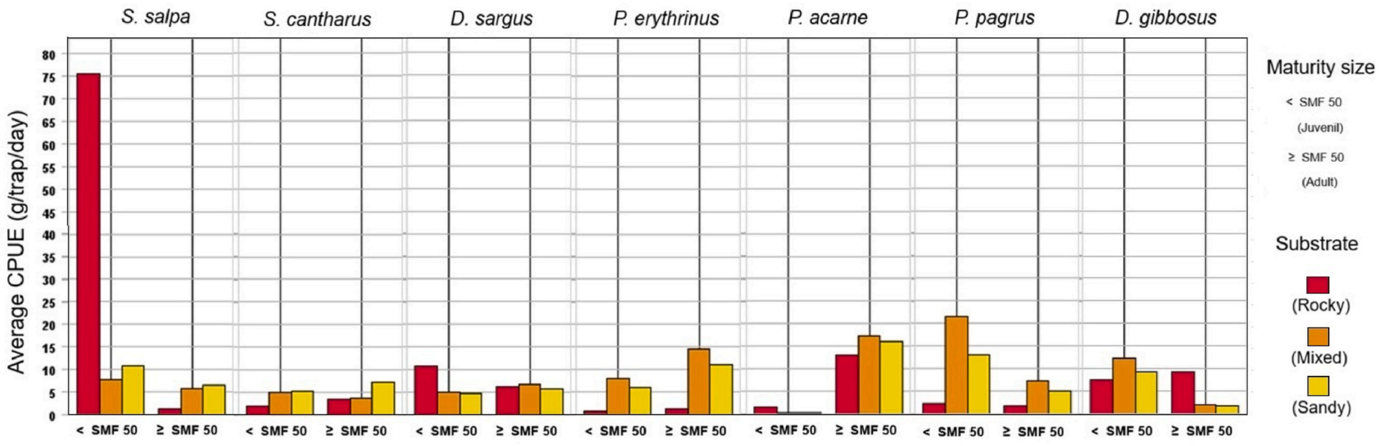

Fig. 3. Mean CPUE (g per trap per day) of juvenile and adult Sparidae species in rocky, mixed and sandy substrates and trophic level (from lowest to highest), with significant differences in catches between substrate types for selected species. Statistical results are provided in Supplementary Table 3.

3.4. Habitat preferences during reproductive periods across growth phases and trophic levels

Upon analyzing the behavior of recruit and non-recruit specimens during reproductive periods, it was generally observed that juvenile sparids exhibited preferences for habitats devoid of vegetation, demonstrating differences in total catches during these periods. However, *S. cantharus* was excluded, as the primary catches for this species during the reproductive period were recorded in vegetated habitats ($Z = -2.119$, $p = 0.034$). Similarly, for *D. sargus*, although higher catches were recorded in this type of substrate, the differences were not significant ($Z = -0.021$, $p = 0.983$). In the case of *P. pagrus*, despite obtaining higher catches of juvenile specimens in non-vegetated substrates, the differences did not reach statistical significance during the reproductive periods ($Z = -0.838$, $p = 0.402$) (Supp. Table 3).

Adults with lower trophic levels demonstrated a clear tendency to be captured more frequently in vegetated areas during reproductive periods, with *D. sargus* showing significant differences ($Z = -2.531$, $p = 0.011$). In contrast, species at intermediate and higher trophic levels exhibited greater catches in non-vegetated substrates during these periods. Notably, adult specimens of *P. erythrinus* had significantly higher catches in non-vegetated habitats ($Z = -2.135$, $p = 0.033$). *D. gibbosus* also showed significantly greater catches in non-vegetated habitats during both reproductive ($Z = -4.066$, $p = 0.000$) and non-reproductive periods ($Z = -5.282$, $p = 0.000$), as well as for juveniles in both periods ($Z = -9.910$, $p = 0.000$; $Z = -5.282$, $p = 0.000$) (Fig. 5; Supp. Table 4).

4. Discussion

This study demonstrates clear habitat driven and ontogenetic structuring of Sparidae assemblages around Gran Canaria, with spatial patterns shaped by life stage, trophic level, and reproductive seasonality. Juveniles were mainly associated with shallow, non vegetated habitats, although *S. cantharus* showed a consistent affinity for vegetated substrates, particularly during reproductive periods. While macroalgae and vegetated rocky reefs are known to provide shelter and food for juvenile sparids (James and Whitfield, 2022), smaller sized species below the effective capture range of light traps were underrepresented. Catch patterns indicate that most sparids progressively move away from vegetated habitats as they approach reproductive age, although species such as *D. sargus* retain strong associations with rocky habitats, likely using them as refuges (Belo et al., 2016; Giacalone et al., 2022). These species may later return to vegetated areas in response to dietary requirements, especially during reproductive periods when food availability is critical (Vigliola et al., 1998; Abecasis et al., 2015). Accordingly, higher adult abundances were observed in species with

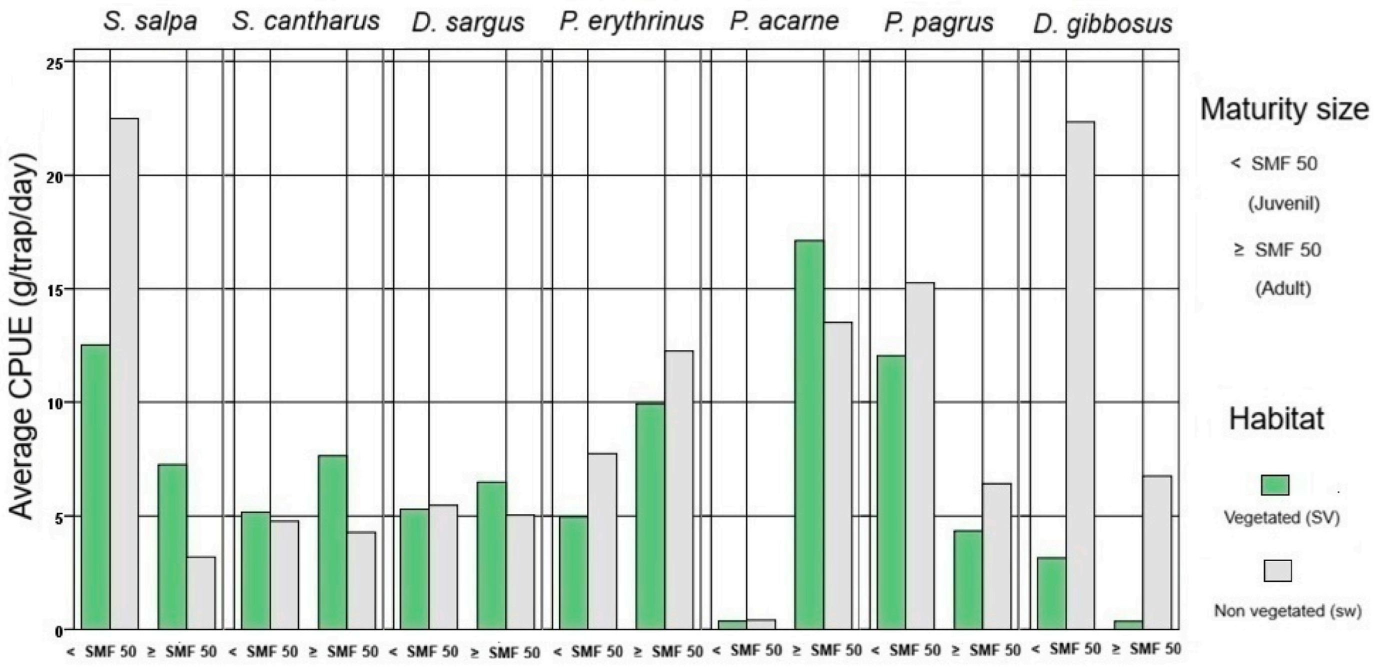

Fig. 4. Mean CPUE (g per trap per day) of juvenile and adult Sparidae species in vegetated and non vegetated habitats and trophic level (from lowest to highest), with significant differences in catches between habitat types for selected species. Statistical results are provided in Supplementary Table 3.

lower trophic levels, including *S. salpa*, *D. sargus*, and *S. cantharus*, reflecting increased herbivory linked to digestive ontogeny (Stoner and Livingston, 1984; Yúfera et al., 2011).

Trophic level emerged as a key driver of sparid distribution, with herbivorous and omnivorous species predominantly occupying shallow, structurally complex habitats, while carnivorous taxa such as *P. pagrus* and *D. gibbosus* were more frequent in deeper, sparsely vegetated areas (Alves and Vasconcelos, 2012). Ontogenetic habitat shifts were evident in *D. gibbosus*, with juveniles occurring in coastal waters and adults inhabiting deeper zones, whereas *P. erythrinus* and *P. acarne* displayed the opposite pattern, with juveniles found deeper than adults, indicating species specific recruitment strategies. Size related depth segregation in *P. erythrinus* is consistent with Mediterranean observations between 50 and 150 m (Busalacchi et al., 2014). The presence of adult sparids with intermediate to high trophic levels, particularly *P. acarne*, in shallow vegetated habitats outside reproductive periods appears to be driven by access to suprabenthic prey, i.e., peracarid crustaceans, rather than plant consumption (Izquierdo and Guerra-García, 2010; Iwasa-Arai et al., 2021; Álvarez-González and López, 2024). In contrast, *P. erythrinus* showed an association with sandy, non vegetated substrates linked to epibenthic prey availability (Fanelli et al., 2011). While habitat type broadly reflected trophic level, substrate preference varied among species without clear interspecific patterns. Seasonal reproduction further modulated habitat use, with spawning periods coinciding with increased juvenile abundance, consistent with earlier studies (Buxton and Garratt, 1990; Whitfield and Mann, 2023) and supporting the role of habitat complexity and trophic specialization in sparid ecology (Carpenter and Niem, 2001; Pavlidis and Mylonas, 2011).

Our results align with broader patterns in Atlantic and Mediterranean coastal systems, reinforcing that habitat complexity is crucial for sparid recruitment and distribution. Similarly, *P. pagrus* individuals, both juveniles and adults, preferred sedimentary and mixed substrates in the Azores (Afonso et al., 2008) and rhodolith-rich areas along the Brazilian coast (Anderson et al., 2022). Cheminée et al. (2016) demonstrated that habitat homogenization negatively affects juvenile sparid recruitment, emphasizing the role of vegetated and structurally diverse habitats in supporting early life stages. Monteiro (1989) and Erzini et al. (2002) documented juvenile sparids preferentially settling in seagrass beds and rocky substrates in the Atlantic, highlighting the importance of nursery habitats in population dynamics. These studies emphasize that habitat features such as vegetation cover, substrate type, and depth gradients are crucial for juvenile survival and growth. Ontogenetic shifts and the influence of trophic level on habitat selection mirror patterns in other regions, where herbivorous and omnivorous species prevail in shallow areas, while carnivorous species are more common in deeper habitats according to reproductive stages (Harmelin-Vivien et al., 1995; Escalas et al., 2021). These parallels strengthen the ecological validity of the present study and suggest that habitat-based management approaches may be broadly applicable across sparid fisheries.

Comparisons with South African sparid assemblages reveal shared ecological patterns alongside region specific adaptations in life history strategies. Sparids display flexible habitat use in response to local environmental conditions (Whitfield and Mann, 2023). In Gran Canaria, this flexibility is reflected in the use of shallow coastal habitats by species such as *S. cantharus* and *D. sargus*, where protection status and predator abundance influence juvenile survival and recruitment, consistent with observations from Mediterranean protected areas (Arceo et al., 2012). Regional habitat availability and anthropogenic pressures further shape assemblage structure, as documented in South African and other systems (Cowley and Whitfield, 2001; Tserkova et al., 2025). These comparisons highlight the adaptive capacity of sparids and the importance of maintaining habitat diversity to support their life cycles. They also underscore the need for region specific management and marine protected area design that account for local habitat characteristics and species specific ecological requirements, particularly for commercially important taxa (FAO, 2022; FishBase, 2024).

Several limitations may constrain the generalizability and precision of the conclusions. Trap based sampling may underrepresent cryptic, highly mobile, or nocturnal species, potentially biasing estimates of abundance and habitat associations. The restricted temporal coverage and limited spatial focus around Gran Canaria may also overlook seasonal and interannual variability in sparid distributions. In addition, the absence of explicit measurements of environmental and anthropogenic factors, such as temperature, salinity, fishing pressure, and habitat degradation, limits the ability to separate their influence from habitat

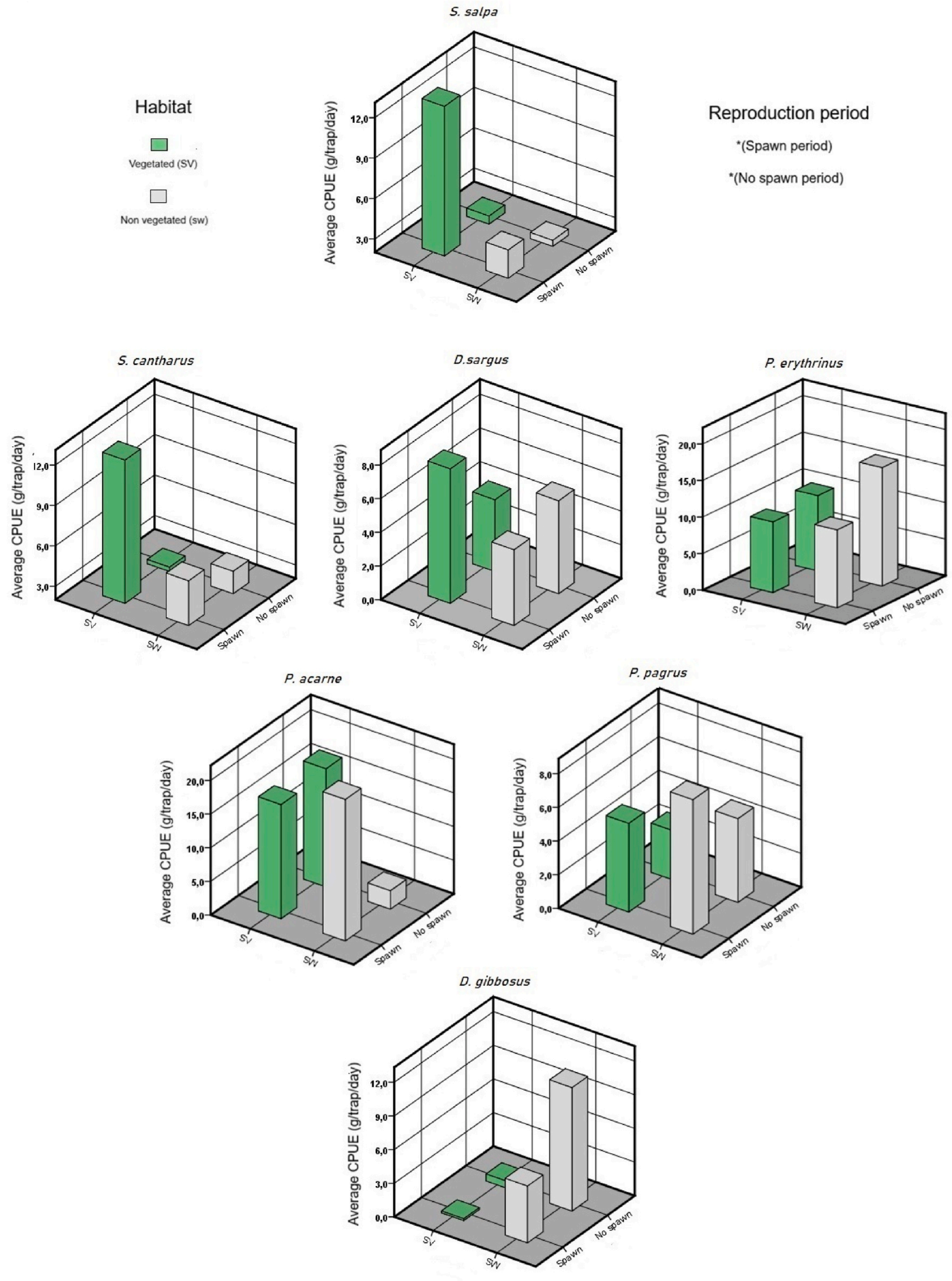

Fig. 5. Mean CPUE (g per trap per day) of adult Sparidae species in vegetated and non vegetated habitats across different growth phases (spawn and no spawn) and trophic level (from lowest to highest), with significant differences in catches between habitat types for selected species. Statistical results are provided in Supplementary Table 4.

driven patterns. Addressing these constraints will require longer term and broader spatial sampling, combined with complementary approaches including underwater visual census, telemetry, and genetic tagging to better resolve movement and habitat use (Palsbøll, 1999; Power et al., 2011; Belo et al., 2016; Jungblut et al., 2018). Integrating environmental variables and functional trait analyses would further strengthen ecological interpretation. Expanding the framework to include ecosystem services provided by sparid assemblages, such as nutrient cycling, habitat maintenance, and fisheries yield, would enhance relevance for conservation and management. A multidisciplinary approach integrating ecological, genomic, and socio economic perspectives remains essential for developing sustainable strategies to protect sparid populations and their habitats (Pavlidis and Mylonas, 2011; Nelson et al., 2016).

5. Conclusions

This study demonstrates the importance of habitat heterogeneity, ontogenetic shifts, and trophic specialization in structuring Sparidae assemblages around Gran Canaria. Juveniles approaching first maturity were primarily associated with shallow, non vegetated habitats, whereas adults occupied deeper environments with mixed substrates, reflecting clear life stage specific habitat use. Trophic level and reproductive timing further modulated spatial distribution, reinforcing the complexity of habitat selection among sparid species. These patterns are consistent with observations from Mediterranean and Atlantic systems, indicating broadly conserved ecological strategies that remain flexible under regional environmental conditions.

Several limitations should be considered when interpreting these results. Trap based sampling may underestimate cryptic or highly mobile species, potentially affecting abundance estimates. The restricted spatial and temporal focus around Gran Canaria limits the representation of seasonal variability, while the absence of direct environmental measurements constrains interpretation of habitat associations. Future research would benefit from multi seasonal and broader spatial sampling, combined with complementary approaches such as telemetry and genomic analyses, and from the inclusion of key environmental variables to refine ecological inference and support sustainable fisheries management.

Overall, the findings underscore the need to protect structurally diverse habitats and to incorporate species specific life histories into management frameworks to maintain sparid populations and their ecological functions. The results provide a basis for ecosystem based management and conservation planning in coastal systems where nursery habitats are increasingly threatened by habitat degradation and fishing pressure, while also highlighting the value of multidisciplinary approaches for ensuring long term sustainability of sparid assemblages.

CRediT authorship contribution statement

Lorenzo Cruces: Writing – review & editing, Writing – original draft, Visualization, Investigation, Formal analysis, Data curation, Conceptualization. **Myriam Rodríguez:** Validation, Resources, Investigation. **Óscar Monterroso:** Resources, Project administration, Funding acquisition, Data curation. **Eva Ramos:** Methodology, Data curation. **Amaya Miguel:** Validation, Resources, Investigation. **Rodrigo Riera:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Conceptualization.

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.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.marenvres.2026.107918.

Data availability

Data will be made available on request.

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