

Structure and diversity of benthic fish assemblages off the Latakia coast (eastern Mediterranean Sea): a pilot bottom trawl study

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Received: 28/ 3/ 2026

Accepted: 13/ 5/ 2026

Abstract

In August and September 2024, three bottom trawl hauls were conducted off the coast of Latakia at depths ranging from 55 to 140 m as a pilot study to describe the structure of benthic fish assemblages and provide an initial evaluation of trawling-related patterns. The Shannon–Weaver diversity index (H') ranged between 1.3 and 1.7. Hill number q_1 values varied from 3.67 to 5.57 effective species, while q_2 values indicated numerical dominance by a limited number of species, which was further supported by Pielou's evenness index ($J'=0.59-0.70$). Based on the Index of Relative Importance (IRI), *Pagellus erythrinus* and *Pagellus acarne* were identified as dominant species. Catch per unit effort (CPUE) ranged from 6.9 to 33.06 kg h^{-1} . These results reflect the current status of benthic fish assemblages during the study period and provide an essential baseline for future ecological and fisheries studies in the region.

Keywords: Benthic fish assemblages, Biodiversity, Hill Numbers, CPUE, Bottom trawling, Latakia coast.

Introduction:

The sandy-bottom habitat in Latakia Governorate extends from opposite the southern part of Latakia city in the north ($35^{\circ}29'53.93''N$, $35^{\circ}44'0.71''E$) to opposite the Sanobar beach, Jableh in the south ($35^{\circ}26'9.50''N$, $35^{\circ}44'47.54''E$). This type of substrate allows bottom trawling, whereas rocky or coarse bottoms are unsuitable for this fishing method. Trawling is currently restricted in coastal waters except for research purposes. Bottom trawling is considered an unselective fishing gear (Bearzi *et al.*, 2024), making it suitable for reliably assessing the structure of demersal fish assemblages in sandy-bottom habitats, where no previous quantitative studies have been conducted. Local studies on marine fish biodiversity have mainly focused on documenting native species (Khrema *et al.*, 2025; Khrema *et al.*, 2023), recording new Lessepsian migrants from the Red Sea and Atlantic (Alnesser *et al.*, 2025), and updating regional checklists (Saad & Khrema, 2024; Ibrahim *et al.*, 2025). Hussein (2023) studied the qualitative composition of fish found in shallow beach ponds (less than 1.5 m depth) from the Splash Zone and the Supralittoral Zone, as well as species in the Sub-littoral Zone to a depth of about 25 m. Although it addressed species composition across sites using Jaccard's index, it did not quantify diversity within each site using metrics such as Shannon–Weaver, Simpson, Hill numbers, or Pielou's evenness. Additionally, diversity in deeper waters, where the commercial catch occurs, was not studied. Both Saad *et al.* (2016) and Alcheikh Ahmad (2022) studied the qualitative

and quantitative composition of the catch in Tartous. Saad *et al.* (2016) determined the abundance of the most common fish species in artisanal catches and calculated catch per unit effort, whereas Alcheikh Ahmad (2022) focused only on Lessepsian fish migrating from the Red Sea. Although these studies provided valuable ecological insights, their methodological frameworks differ substantially from the present work, particularly in terms of sampling gear, spatial coverage, and analytical metrics. This study represents a preliminary assessment, as available data on bottom trawling in the region are limited, and bottom trawling is currently restricted in coastal waters, preventing continuous research in these habitats.

Materials and Methods:

This study was conducted as a pilot study in Latakia, Syria between (35°29'53.93"N, 35°44'0.71"E; 35°26'9.50"N, 35°44'47.54"E) (Fig. 1).



Figure (1): Study area map showing the specific locations of trawling activities conducted off the southern coast of Latakia.

using a trawler from The General Commission for Fisheries Resources and Aquatic Life (Fig. 2), measuring 19.10 m in length with a 6 m beam and powered by twin 250 hp Mercedes diesel engines. The vessel is equipped with a laboratory and standard navigation instruments, including sonar, GPS, VHF radio, compass, and an anemometer. A bottom-trawl net was deployed during sampling, with a mouth circumference of approximately 60 m and an overall length of 25 m. The mesh size decreased from 35 mm at the anterior section to 20 mm at the cod-end. The trawl was operated using 400 m sweep lines and 1500 m steel cables on each side. Two hauls were carried out in August and one haul in September 2024, at depths ranging from 55 to 140 m.



Figure (2): General Commission for Fisheries Resources and Aquatic Life' trawler at Fishing and leisure port, Latakia, Syria.

On board, all fish were sorted, and the number (N) and weight (W) of each species were recorded. Cephalopods, crustaceans, and elasmobranchs were excluded from the analysis. The following indices were calculated for each haul:

- Species richness (q_0)
- Shannon–Weaver diversity index (H') (Shannon & Weaver, 1949).

$$H' = - \sum_{i=1}^n P_i \ln P_i$$

- Hill numbers q_1 and q_2

$$q_1 = \exp(H'), q_2 = 1 / \sum p_i^2$$

- Pielou's evenness (J') (Pielou, 1966)

$$J = H' / \ln S \text{ where } S = \text{total number of species}$$

- Catch per unit effort (CPUE)

$$CPUE = \sum c_i / \sum t$$

where ' c_i ' is the catch amount (kg) for species i , and ' t ' is haul duration in hours.

Fishing time was converted to decimal hours before being used in catch-per-unit-effort (CPUE) calculations.

The Index of Relative Importance (IRI) was calculated following the method of Pinkas *et al.* (1971).

$$IRI = F_i (\%N_i + \%W_i),$$

where $N\%$ is the percentage of individuals, $W\%$ is the percentage of total biomass, and $F\%$ is the frequency of occurrence. Species were classified as dominant ($IRI\% > 20\%$), important ($IRI\% = 10-20\%$), or rare ($IRI\% < 10\%$). Statistical analyses, including simple regression, were performed using Microsoft Excel 2024, with significance set at $p < 0.05$.

Results and Discussion:

A total of 2,140 individuals belonging to 25 species and 18 families were collected, with a total biomass of 70.36 kg. The most represented families were Mullidae, Sparidae, and Tetraodontidae (three species each), followed by Serranidae (two species), while all other families were represented by a single species.

A. Biodiversity Patterns

Species richness (q_0) was highest in the first August haul (15 species), followed by the September haul (12 species), and lowest in the second August haul (9 species). Shannon–Weaver diversity (H') was 1.7 for both the first August and September hauls, and 1.3 for the second August haul.

Although sandy substrates typically support lower species richness and biomass (Giakoumi & Kokkoris, 2013), the diversity values observed here were higher than those reported for sandy bottoms in the central Mediterranean (Cecapoli *et al.*, 2024). However, they were lower than values reported from Mersin Bay ($H' = 2.76$) at shallower depths (Gökçe *et al.*, 2016), likely due to the deeper sampling range in the present study.

Hill numbers (q_1) were 5.51, 3.67, and 5.57 for the first August, second August, and September hauls, respectively. Hill numbers q_2 were consistently lower (3.59, 2.58, and 3.62), indicating numerical

dominance by a few species. Pielou's evenness (J') ranged from 0.59 to 0.70, with the highest evenness observed in September.

B. Species Dominance

Based on the index of relative importance (IRI%), *Pagellus erythrinus* and *Pagellus acarne* were classified as dominant species, *Pomadasys stridens* as important, and all remaining species as rare. This dominance pattern aligns with the q_2 values, which highlight the influence of a few numerically abundant species (table 1).

C. Catch per Unit Effort

CPUE ranged from 6.9 to 33.06 kg h⁻¹, with the highest value recorded in the second August haul. These values were lower than those reported in nearby regions such as Karataş–Adana (Çiçek *et al.*, 2014) and Mersin Bay (Gökçe *et al.*, 2016), likely due to deeper sampling and local environmental variability.

D. Regression Analysis

Regression analysis revealed :A negative but non-significant relationship between CPUE and diversity (H') ($R^2 = 0.93$, $p = 0.16$).

No meaningful relationship between depth and diversity ($R^2 = 0.007$, $p = 0.94$). The lack of statistical significance is likely due to the small sample size inherent to pilot studies

Table (1): Species composition and relative importance index (IRI) of all captured species.

Family	Species	IRI	IRI%	Category
Apogonidae	<i>ostorhinchus fasciatus</i>	2.434735	2.495896	Rare
Callanthiidae	<i>Callanthias ruber</i>	0.04815	0.04936	Rare
Centriscidae	<i>Macroramphosus scolopax</i>	0.141608	0.145165	Rare
Citharidae	<i>Citharus linguatula</i>	0.798255	0.818308	Rare
Congridae	<i>Conger conger</i>	1.514639	1.552688	Rare
Fistulariidae	<i>Fistularia petimba</i>	0.357458	0.366437	Rare
Haemulidae	<i>Pomadasys stridens</i>	11.00603	11.28251	Important
Merlucciidae	<i>Merluccius merluccius</i>	2.270993	2.328042	Rare
Mullidae	<i>Mullus barbatus</i>	2.962041	3.036449	Rare
	<i>Upeneus moluccensis</i>	4.77797	4.897995	Rare
	<i>Parupeneus rubescens</i>	2.122116	2.175425	Rare
Nemipteridae	<i>Nemipterus randalli</i>	3.819809	3.915764	Rare
Peristediidae	<i>Peristedion cataphractum</i>	0.094879	0.097263	Rare
Scombridae	<i>Auxis rochi</i>	0.812236	0.832639	Rare
Scorpaenidae	<i>Pterois miles</i>	1.563762	1.603044	Rare
Serranidae	<i>Serranus cabrilla</i>	0.132	0.135316	Rare
	<i>Serranus hepatus</i>	0.094879	0.097263	Rare
Soleidae	<i>Solea solea</i>	3.335138	3.418918	Rare
Sparidae	<i>Pagellus erythrinus</i>	27.96831	28.67089	Dominant
	<i>Pagellus acarne</i>	21.77305	22.32	Dominant
	<i>Boops boops</i>	1.480653	1.517848	Rare
Synodontidae	<i>Saurida lessepsianus undosquamis</i>	2.473664	2.535804	Rare
Tetraodontidae	<i>Lagocephalus suezensis</i>	1.223644	1.254382	Rare
	<i>Lagocephalus sceleratus</i>	2.462737	2.524602	Rare
	<i>Torquigener flavimaculosus</i>	1.880746	1.927991	Rare
25			100	

Conclusion:

This pilot bottom-trawl survey provides the first quantitative assessment of benthic fish assemblages off the Latakia coast at depths between 55 and 140 m. Despite the limited number of hauls, the study revealed clear patterns in species richness, diversity, and dominance structure. Diversity indices collectively indicate moderate diversity and numerical dominance by a few species, particularly *Pagellus erythrinus* and *Pagellus acarne*.

The relatively low CPUE values compared with nearby regions may be attributed to deeper sampling, local environmental conditions, and temporal variability in fish distribution. Regression analyses did not show significant effects of depth or fishing effort on diversity, likely due to the small sample size.

Recommendations:

Overall, this study provides essential baseline data for future ecological and fisheries research in Syrian waters. Expanding sampling efforts across seasons, depths, and habitat types will be crucial for developing a comprehensive understanding of demersal fish communities and informing sustainable fisheries management in the region.

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بنية وتنوع تجمعات الأسماك القاعية قبالة ساحل اللاذقية (شرق البحر الأبيض المتوسط): دراسة استطلاعية باستخدام شبك الجر القاعية

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تاريخ القبول: 2026 / 5 / 13

تاريخ الاستلام: 2026 / 3 / 28

الملخص

أُجريت ثلاث عمليات صيد بشباك الجر القاعية في آب وأيلول 2024، قبالة سواحل اللاذقية على أعماق تتراوح بين 55 و140 م، كدراسة تجريبية لوصف بنية تجمعات الأسماك القاعية وتقديم تقييم أولي للأنماط المرتبطة بالصيد بشباك الجر. تراوح مؤشر التنوع شانون-ويفر (H') بين 1.3 و1.7. وتراوحت قيم عدد هيل (q_1) بين 3.67 و5.57 نوعاً فعالاً، بينما أشارت قيم (q_2) إلى هيمنة عددية لعدد محدود من الأنواع، وهو ما أكدته مؤشر بيلو للتجانس ($J' = 0.59$). وبناءً على مؤشر الأهمية النسبية (IRI)، تم تحديد نوعي *Pagellus erythrinus* و *Pagellus acarne* كأصناف سائدة. تراوح معدل الصيد لكل وحدة جهد (CPUE) بين 6.9 و33.06 كيلوغرام/ساعة. تعكس هذه النتائج الوضع الحالي لتجمعات الأسماك القاعية خلال فترة الدراسة، وتوفر أساساً جوهرياً للدراسات البيئية ودراسات مصايد الأسماك المستقبلية في المنطقة.

الكلمات المفتاحية: تجمعات الأسماك القاعية، التنوع البيولوجي، أرقام هيل، المصيد لكل وحدة جهد، الجرف القاعي، ساحل اللاذقية.