

**Inventory and stand structure of species associated with two target fish
(*Spicara maena* and *Pagellus acarne*) in Algerian landings**

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ملخص

لقد تم دراسة الحيوانات المرتبطة والهيكلة الديموغرافية في لها من خلال قائمة أنواع الأسماك المرافقة للنوعين *Spicara maena* و *Pagellus acarne* عند الصيد. ولقد استخدمنا في ذلك نماذج التوزيع و الوفرة. على 114 نوعا مسجلا، 97 منها كان سمكا (85 %)، 11 من الرخويات (9,7 %) و 6 من القشريات (5,3 %). الحيوانات المرتبطة تبدو شديدة التنوع لكن معظمها أسماك. إن الأنواع المميزة، الغالب عليها عائلة السباريدي هي *Mullus barbatus*, *Pagellus erythrinus*, *Trachurus trachurus*, *Boopsboops*, *Merluccius merluccius*, *Pagellus bogaraveo*. معامل Mac Gowan و Fager يبدو المعامل الأكثر ملائمة لوصف المجتمعات مع الكتلة. إذا كانت النماذج النظرية الثلاثة المستعملة لتوزيع الوفرة ملائمة للبيانات الملاحظة فإن معامل Preston هو الأفضل سيما البيانات الخاصة بالوزن. الثوابت البيئية المتعلقة بالنموذجين Preston و Motomura تعطي فكرة مماثلة للمتحصل عليها بطريقة الانتظام. القيم المميزة للمستوطنات هي التنوع نوعيا في الشرق و الغرب و التنوع والتوازن في الوسط.

الكلمات المفتاحية: سمك - معامل - نموذج الوفرة - الجزائر.

Abstract

The associated fauna and the demographic structure of the stands are studied from the species list accompanying two target fish (*Spicara maena* and *Pagellus acarne*) in landings. Abundance distribution models are used. 97 out of the 114 species recorded are fish (85%); 11 are molluscs (9.7%) and 6 are crustaceans (5.3%). The associated fauna seems very diversified but essentially ichthyological. The most characteristic species, dominated by the Sparidae family, are *Mullus barbatus*, *Pagellus erythrinus*, *Trachurus trachurus*, *Boopsboops*, *Merluccius merluccius* and *Pagellus bogaraveo*. The Fager and Mac Gowan's coefficient seems, with the biomass, the most appropriate index to describe the communities. If the three theoretical models of abundance distribution used fit well with the observed data, that of Preston appears to be the best, especially for representations by weight. The environment constants of the first two models (Preston and Motomura) give an idea in accordance with that obtained for regularity; the values characterize relatively diversified stands in the East and the West and a diversified and balanced trend in the Center.

Keywords: Fish – Indices - Abundance models – Algeria.

Résumé

La faune associée et la structure démographique des peuplements sont étudiées à partir de la liste des espèces accompagnatrices à deux poissons cibles (*Spicara maena* et *Pagellus acarne*) dans les mises à terre. Les modèles de distribution d'abondance sont utilisés. Sur 114 espèces recensées, 97 sont des poissons (85 %), 11 des Mollusques (9.7 %) et 6 des Crustacés (5.3 %). La faune associée apparaît très diversifiée mais essentiellement ichthyologique. Les espèces les plus caractéristiques, dominées par la famille des Sparidés, sont *Mullus barbatus*, *Pagellus erythrinus*, *Trachurus trachurus*, *Boopsboops*, *Merluccius merluccius* et *Pagellus bogaraveo*. Le coefficient de Fager et Mac Gowan paraît, avec la biomasse, l'indice le plus approprié pour décrire les communautés. Si les trois modèles théoriques de distribution d'abondance utilisés s'adaptent bien aux données observées, celui de Preston apparaît comme le meilleur, en particulier pour les représentations en poids. Les constantes de milieu relatives aux deux premiers modèles (Preston et Motomura) donnent une idée conforme à celle obtenue pour la régularité ; les valeurs caractérisent des peuplements relativement diversifiés à l'Est et à l'Ouest et à tendance diversifiée et équilibrée au Centre.

Mots clés : Poissons – Indices - Modèles d'abondances – Algérie.

1. INTRODUCTION

The associated nectobenthic fauna and the demographic structure of the characteristic stands are studied from the list of companion species of *S. maena* and *P. acarne* in the different trawls, in parallel with an application of abundance distribution models (Motomura called log-linear (1932), Mac Arthur (1957) and Preston called log-normal (1962)).

S. maena and *P. acarne*, whose biology and ecology were studied by Harchouche (2006 and 1988), are two species that live globally under identical ecological conditions. In the first phase, we are interested in all of the Algerian littoral, while the two other phases are treated by sector from the list of the characteristic associated species selected according to their biomass (B).

The existing interrelationships between different species in time or space are described qualitatively and quantitatively by several indices that will allow to see possible demographic variations depending on the sector. The main ones are specific richness, specific diversity and regularity or fairness.

2. MATERIAL AND METHODS

For many authors, such as Bell and Harmelin-Vivien (1982), Centracanthidae and Sparidae are common to all collections at *Posidonia oceanica* meadows. The species of these two families, *S. maena* and *P. acarne*, in particular, have almost the same habitat and accept almost the same ecological conditions.

According to Bertin (1946) and Bougis (1969), they are close relatives and are distinguished by the mouth. As a result, the study of the stand structure, common to both these fish, is carried out from the list of companion species in the different trawls.

Given the high number of listed fishes accompanying *S. maena*, we chose Peres (1976) definition that can report our results: nectobenthic fish are "species that swim permanently or sometimes at daytime in the immediate vicinity of the floor". From this definition, we consider a stand as a set composed of zoological groups (Fish, Molluscs, Crustaceans), both nectobenthic and living in a given geographical space.

In the first stage, we are interested in the whole Algerian coastline while the other two phases are processed by sector (Figure 1) from the list of the most characteristic accompanying species selected according to their biomass (B).

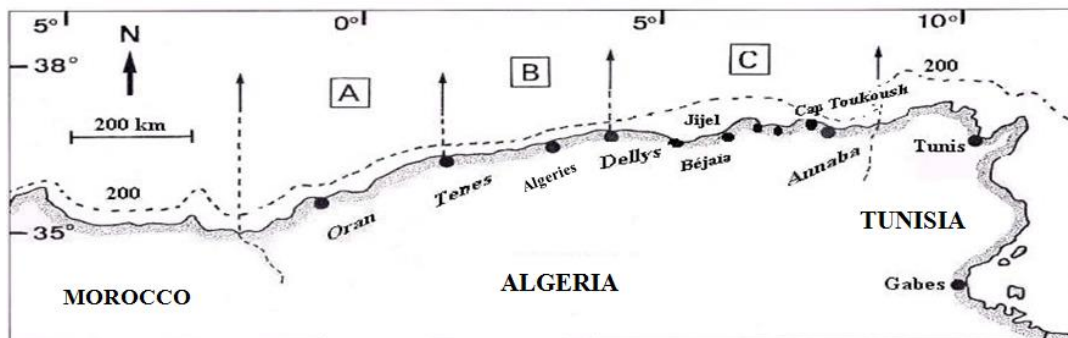


Figure 1. Algerian Basin (A: Western region; B: Region Center; C: East region)

Indeed, Frontier (1983) notes that ignoring rare species does not affect the study of the other species. Moreover, according to Daget (1976), it does not seem logical to give equal importance to a large size species and to a smaller one. The biomass index is therefore introduced in the processing of this part result.

As a first step, we identified the species and set faunistic lists, by zoological group, at the 53 stations common to *S. maena* and *P. acarne*. In a second step and so as to highlight the most characteristic species, four classification criteria are taken into consideration: the relative frequency: ratio in percentage: the number of stations (St) where *S. maena* and *P. acarne* were captured to the number of stations (T') prospected at a depth between 0 and 180 m.

$$F (\%) = (St / T') \times 100$$

Relative abundance: number of individuals (N), fished, expressed as a percentage of the number of stations (St) where *S. maena* and *P. acarne* occur in a given area.

$$A (\%) = (N / St) \times 100$$

Relative biomass: weight (W) as a percentage of individuals over the number of stations (St).

$$B (\%) = (W / St) \times 100$$

The Fager and Mac Gowan coefficient (1963, in Legendre and Legendre, 1979): $S(y-y_i)$. It defines the degree of dependence of the associated species (y_i) at both *S. maena* (y) and *P. acarne* (y) according to the expression:

$$S(y-y_i) = [a / (a + b)(a + c)] - 1/2(a + c)$$

a: number of stations where y and y_i (species i) are both present.

b: number of stations where y are absent and y_i present. This factor is null in our case because the species noted (y) are present in all the 53 stations.

c: number of stations where y_i is absent compared to y .

This index, $S(y - y_i)$, varying between 0 and 1, marks a presence - absence of data between *S. maena* - *P. acarne* and a species i .

When the value of a criterion exceeds or equals the average value, the species are considered characteristic and are therefore retained.

According to Legendre and Legendre (1984), rank-frequency diagrams can be studied analytically rather than via a synthetic measure like Ish. Among the many models proposed, the only ones that present a real practical interest are paradoxically the simplest.

Three models are exposed by Daget (1976), were applied from the numbers and weight:

- Motomura called log-linear (1932),
- MacArthur (1957),
- Preston called log-normal (1962).

3. RESULTS AND DISCUSSIONS

The associated fauna appears very diversified but essentially ichthyological (Table 1). Of the 114 species recorded, 97 are fish (85%), 11 are molluscs (9.7%) and 6 are crustaceans (5.3%).

The most characteristic species, dominated by Sparids, are *M. barbatus*, *P. erythrinus*, *T. trachurus*, *B. boops*, *M. merluccius* and *P. bogaraveo*.

Table 1. Species characteristics associated with *S. maena* and *P. acarne*.

Species	F (%)	A (%)	B (%)	S (y – yi)
+ <i>Mullusbarbatus</i>	100	24.8	15.5	0.9
+ <i>Boopsboops</i>	88.7	5.7	5.9	0.9
+ <i>Pagelluserythrinus</i>	84.9	14.2	20.6	0.8
+ <i>Trachurustrachurus</i>	83	27.4	14	0.8
● <i>Loligo vulgaris</i>	81	3.6	1.3	0.6
+ <i>Merlucciusmerluccius</i>	75.5	1.6	2.3	0.8
+ <i>Pagellusbogaraveo</i>	64.2	8	3.9	0.7
+ <i>Citharusmacrolepidotus</i>	64.2			0.7
+ <i>Mullussurmuletus</i>	62.3	1	1.2	0.7
● <i>Sepia officinalis</i>	60.4			0.6
+ <i>Scomberscombrus</i>	50.9	1.6	2.7	0.6
+ <i>Triglalucerna</i>	49.1			0.6
* <i>Diplodusannularis</i>	41.5	1.8	1.1	0.6
+ <i>Lepidotriglacavillone</i>	39.6	1.3		0.6
+ <i>Serranus hepatus</i>	39.6			0.6
+ <i>Arnoglossuslaterna</i>	39.6			0.6
+ <i>Raja miraletus</i>	37.7			0.5
+ <i>Scorpaenanotata</i>	37.7			0.5
+ <i>Uranoscopus scaber</i>	35.8			0.5
* <i>Sparuspagrus</i>	34	1.5	2.2	0.5
● <i>Eledonemoschata</i>	34			
▲ <i>Squillamantis</i>	34			0.5
* <i>Diplodus vulgaris</i>	32.1		2.2	0.5
● <i>Octopus sp.</i>	32.1			0.5
* <i>Serranuscabrilla</i>	26.4			
* <i>Dentex gibbosus</i>	26.4		1.8	
+ <i>Dentex macrphthalmus</i>	24.5	2	2.3	
+ <i>Raja asterias</i>	24.5			
+ <i>Zeus faber</i>	24.5			
+ <i>Mustelusmustelus</i>	22.6		3.6	
+ <i>Trachinusdraco</i>	22.6			
▲ <i>Parapenaeuslongirostris</i>	20.7			
* <i>Sphyaenasphyaena</i>	18.9			
+ <i>Lophiusbudegassa</i>	18.9			
+ <i>Torpedomarmorata</i>	18.9			
* <i>Mustelusmediterraneus</i>			3.6	
* <i>Dasyatis pastinaca</i>			1.3	
* <i>Epinephelusguaza</i>			1.2	
■ <i>Serioladumerili</i>			1	
Number of speciesretained	35	13	19	23

F (%): Frequency, A (%): Abundance, B (%): Biomass, S: the coefficient of Fager and Mac Gowan+ : Species to broad bathymetric distribution 0-1000 (m); ● : molluscs (0-300 m) * : Species of the Continental Shelf (0-200 m); ■ : species of the Continental Shelf (coastal 0-50 m); ▲ : Crustaceans (0-700 m)

According to Papaconstantinou *et al.*, (1988, in Stergiou *et al.*, 1996), in their study of the species composition of trawl catches in the South-East of the Aegean Sea - the numerically dominant and associated species are: *B. boops*, *S. cabrilla*, *P. phycis*, *P. acarne*, *M. surmulletus* and *S. maena*. Gaertner *et al.*, (1999), in the « Golf du Lion », show a distribution gradient considering depth but not the horizontal direction. This is the case of coastal fish such as *B. luteum*, *D. annularis*, *S. maena*, *A. obscura* and *T. trachurus*.

The high frequency of some semi-pelagic or pelagic species confirms the semi-pelagic nature of *S. maena*. But the mullet frequency and abundance show that *Spicara* lives close to the seafloor.

The Fager and Mac Gowan coefficient appears, with the biomass, the most appropriate index to describe the communities. It measures the intensity of the relationship between species.

The specific wealth places the East sector in the first position. In the East, the Shannon-Weaver index (1949), calculated from weight and to a lesser degree the population, is close to maximum diversity. This index measures the specific heterogeneity of a community (Bach, 1985).

The parallel analysis of this index and of regularity shows that the East and the West are characterized by multispecific and balanced stands. The Center tends towards this aspect (Table 2). The diversity of associated species shows that *S. maena* is a fish that lives, depending on age, both close to the floor and in midwater.

Taking into account the bathymetric distribution of the fish fauna established by Fredj and Maurin (1987), the characteristic accompanying species can be classified as follows:

- 23 listed species, rated +, have a broad bathymetric distribution (0-1000 m).
- 09 fish (*) are continental shelf species (0-200 m).
- Only 1 species (■) of the coastal continental shelf (0-50 m), was captured. It is the *Serioladumerili*.

According to Fischer *et al.* (1987), the associated characteristic molluscs, noted ●, are distributed at a depth between 0 and 300 m. While -according to the same authors - crustaceans, designated by a (▲), live between 0 and 700 m.

Table 2. Demographic indices by sector calculated from the number (Q) and weight (W)
S : Specific richness, Ish : Index of Shannon-Weaver, R : Regularity

	East		Center		West	
	Q	W	Q	W	Q	W
Indices	41298	2368	25242	1195	23992	1954
S	19		12		13	
Log₂ S	4.25		3.58		3.70	
Ish	2.78	3.47	1.96	2.58	2.42	2.68
R	0.65	0.82	0.55	0.72	0.65	0.72

The use of abundance distribution models is complementary to the demographic indices. Preston's appears to be the best (Figure 2). It assumes that species populations all depend on the same set of biotic or abiotic factors (interspecific competition).

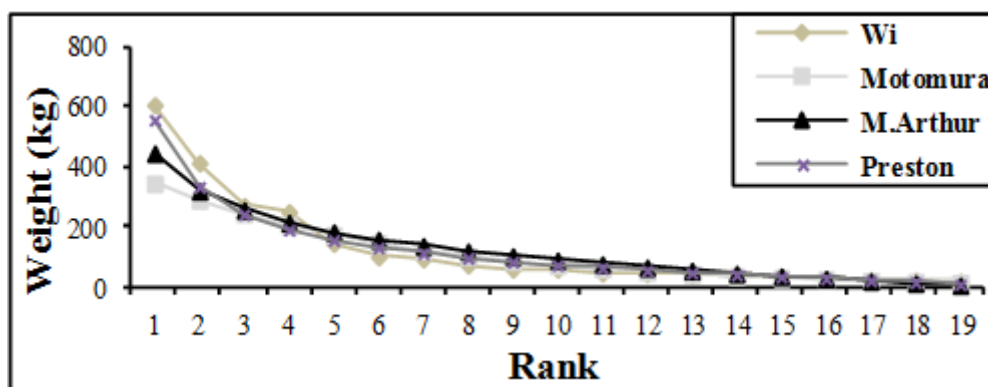


Figure 2. Fit of the models for the distribution of the abundances.

In eastern Algeria, the *P. acarne*, *M. barbatus*, *T. trachurus* and *P. erythrinus* species make up 82.22% of individuals with a total relative biomass of 64.62%.

At the Center, *P. acarne*, *P. bogaraveo* and *M. barbatus* contain 79.73% of the abundances for a relative total weight percentage of 60.84%.

In the West sector, three fish are dominant (93.82% of the total population corresponding to a proportion by weight of 73.95%). These are *P. acarne*, *T. trachurus* and *P. erythrinus*.

In general, the polygons are more or less close to an inverted J shape whose concavity is greater between ranks 1 and 2 than in the interval 3 - 6.

Finally, it should be noted that *P. acarne* remains, in the three sectors, by far the most abundant species as well as the one that clearly dominates in terms of biomass.

4. CONCLUSION

The fauna associated with both *S. maena* and *P. acarne* is very diversified but essentially ichthyological. The most characteristic species, dominated by the Sparidae family, are *Mullus barbatus*, *Pagellus erythrinus*, *Trachurus trachurus*, *Boopsboops*, *Merluccius merluccius* and *Pagellus bogaraveo* in a different order of importance, depending on the criterion considered. The high frequency of some semi-pelagic or pelagic species, such as *Boopsboops* and *Trachurus trachurus*, confirms the semi-pelagic nature of *S. maena*. But the frequency and abundance of *Mullus barbatus* show that *Spicara* lives not only in midwater but also close to the floor; the same is about the presence, quite important in catches, of *Loligo vulgaris* and *Sepia officinalis*.

The Fager and Mac Gowan coefficient appears, with the biomass, the most appropriate character to describe the communities. According to Legendre and Legendre (1979), it measures more the intensity of the relationship between species than demonstrates the presence or absence of a relationship.

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