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The distribution and abundance of young fish in the Banc d'Arguin, Mauritania

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Abstract

The importance of the Banc d'Arguin (Mauritania) for juvenile fish has been investigated in September 1988. Fish have been sampled with a 2 m beam trawl at 50 locations in the coastal zone between Cap Sainte Anne and Cap Timiris. Water depth varied between 1 and 16 metres. Temperature and salinity at each station have been measured, as well as the weight of the catch and total length of the individual fish. The largest catches – in numbers as well as in weight – were obtained around the shallows of Tidra and Arel. This region has a large diversity in species, and contains large numbers of juvenile fish and cephalopods. The deeper areas seem to be much poorer in species, but average length and weight of the sampled fish are higher than around Tidra and Arel.

Introduction

The Banc d'Arguin (Fig. 1) is an area of about 9000 km^2, consisting of sandbanks and mudflats covered with seagrasses. Depth generally does not exceed 4 m, except in the eastern part where depths down to 16 metres occur. Water temperatures and salinities can reach quite extreme values; there is no inflow of fresh water from the continent (Wolff & Smit, 1990). Furthermore, the area is situated in a transition zone, which is twice a year swept by the passage of the northern subtropical hydrodynamic front. This causes large variability of a number of characteristics like temperature, salinity, nutrient concentrations, productivity etc. throughout the year. These variations are reflected by changes in catchability, composition and abundance of fish stocks, and cause fish migrations parallel to the coast over long distances (Troadec & Garcia, 1980). Hence, the Banc d'Arguin fish fauna will show temperate, sub-tropical as well as tropical elements.

Unfortunately, little is known of the distribution, composition and densities of the fish fauna in the shallow coastal area of the Banc d'Arguin. The trawling surveys that were carried out until present were restricted to the continental shelf and the deeper northeastern part of the Banc d'Arguin. Very few studies exist of the shallow area around Tidra (a.o. Campredon & Schrieken, 1989). The outer edge of the Banc, shallower than 20 m, has not been covered at all.

The potential function of the Banc d'Arguin as a nursery for larval and juvenile fish has hardly been investigated until now. This can partly be explained by the difficult access to this uncharted area, where only shallow-draught vessels can navigate. However, for the management of the Mauritanian marine living resources, it is important to know the relationship between the fish stocks present on the continental shelf, and those living on the Banc d'Arguin.

This inventory survey was carried out in September 1988 on the Banc d'Arguin, covering the

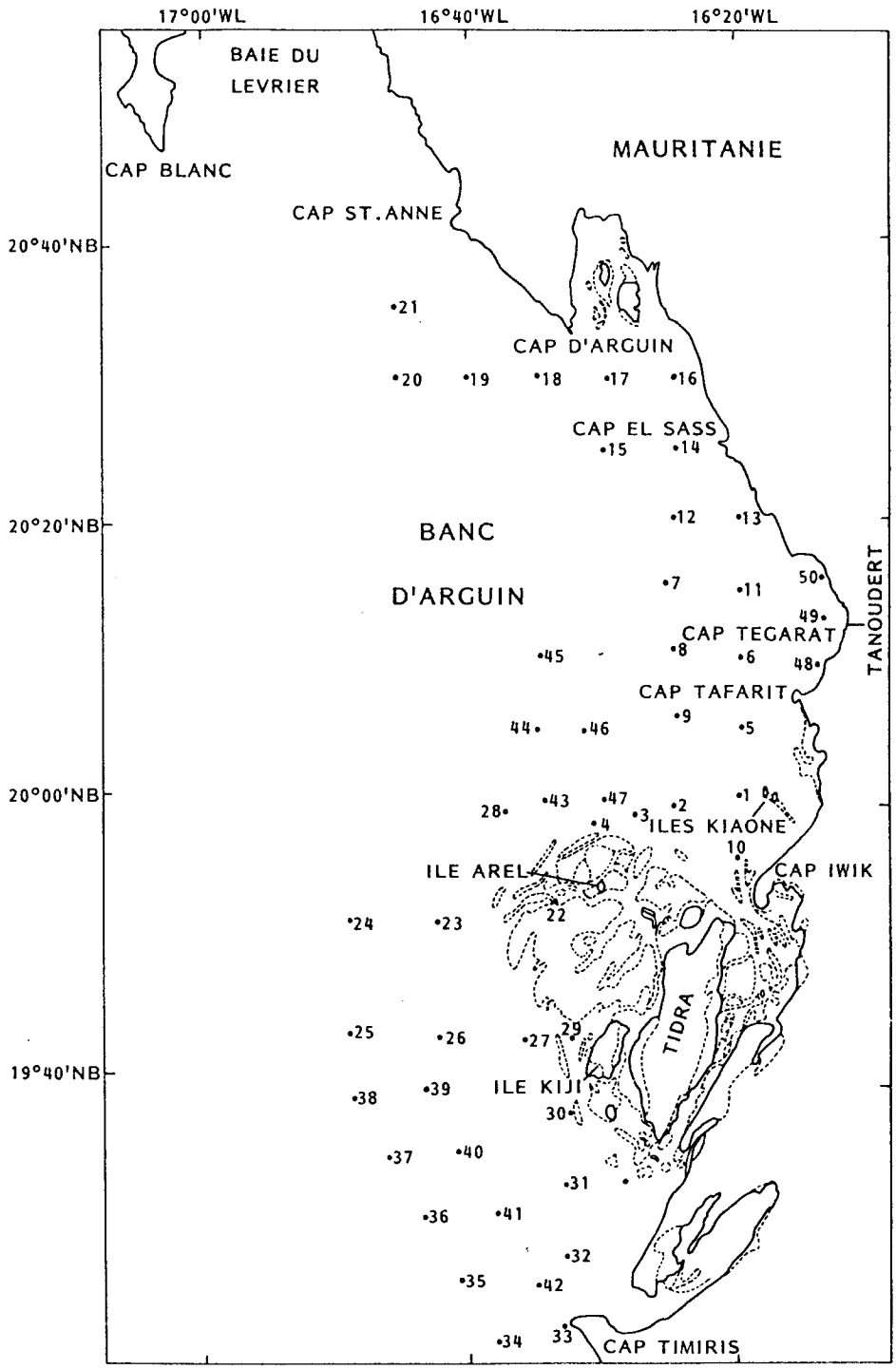

Fig. 1. Sample stations on the Banc d'Arguin, Mauritania, in September 1988. (Numbers indicate the sequence of sampling.)

area between Cap Sainte Anne and Cap Timiris (Fig. 1). Main purpose was to estimate the importance of the Banc d'Arguin for juvenile fish. To achieve this, an attempt was made to sample as many locations as possible.

Materials and methods

A two-metre beam trawl was chosen for sampling. This trawl with a mesh size of 4.7 cm at the front part and 1.7 cm at the codend is efficient in catching small fish living close to the bottom and enables a semi-quantitative comparison of the locations sampled. At some locations an extra weight of 2 kg was put on the beam of the net to be able to fish in deeper water. Generally, one haul lasted ten minutes, except in the area southwest of Tidra where hauls of five minutes were made due to the abundant vegetation bycatch filling the trawl. Haul duration was measured from the moment that the net touched the bottom until the moment we started lifting the net. The length of the pulling rope was always about four times the water depth. With a trawling speed of about two knots and haul durations of 5 or 10 minutes, 600 or 1200 m^2 were covered in one haul. Unfortunately, a meter wheel for exact determination of the distance fished was not available. Considering also that the speed indicator of the ship was often not working and that there was no information about current velocities, only rough estimates of haul length could be obtained. At each location depth, temperature and salinity were measured. Depth was measured by means of an echo-sounder; salinities were determined from watersamples afterwards in the laboratory of the Forschungsstelle Küste, Norderney, Germany. The captured fish were identified, and the total lengths of the individuals were measured. Fifty locations were sampled. Due to lack of accurate navigation means, the positions given in Fig. 1 have to be considered as a rough indication of the places sampled.

It was attempted to cluster the locations by number of species and individuals. Clustering was performed with different methods, a.o. Ward's method and Euclidian Squared Distance as (dis-) similarity measurement. The most important and consistent clusters are described.

Results

Abiotic factors

The locations sampled varied in depth between 1 and 16 m (Fig. 2). As expected, the area between Cap El Sass and Iles Kiaone is the deeper part (10–16 m). Towards Cap Timiris the 10 m-isobath is situated relatively close to the coast.

Temperatures varied between 25 and 30 °C, salinities between 38 and 43‰ (Table 1). The lower temperatures were found in the northern part, the higher temperatures in the vicinity of Ile Tidra. Salinities were highest near the coast and decreased in westward direction.

Temperature and salinity were positively correlated ($r^2 = 0.31$; $p < 0.01$). Depth and temperature were negatively correlated ($r^2 = 0.22$; $p < 0.01$); however, depth and salinity were not significantly correlated ($r^2 = 0.05$; $p > 0.05$).

Biota

In the catches, 45 fish species belonging to 22 families were present (Table 2). Catch weight reached a maximum of almost 8 kg per haul at location 48. The number of species ranged from 1 to 16 per location, the number of individuals in the catches varied between 1 and about 650 (Table 1).

A significant negative correlation existed between the natural logarithm of the number of individuals and depth, as well as between the number of species and depth. The natural logarithm of the mean length of the individuals and depth were positively correlated, whereas the natural logarithm of the mean length was not significantly correlated with temperature or salinity (Table 3).

Most of the locations shallower than 6 m (northwest of Tidra, near Tanoudert and near Timiris) were characterised by a bycatch of sea-

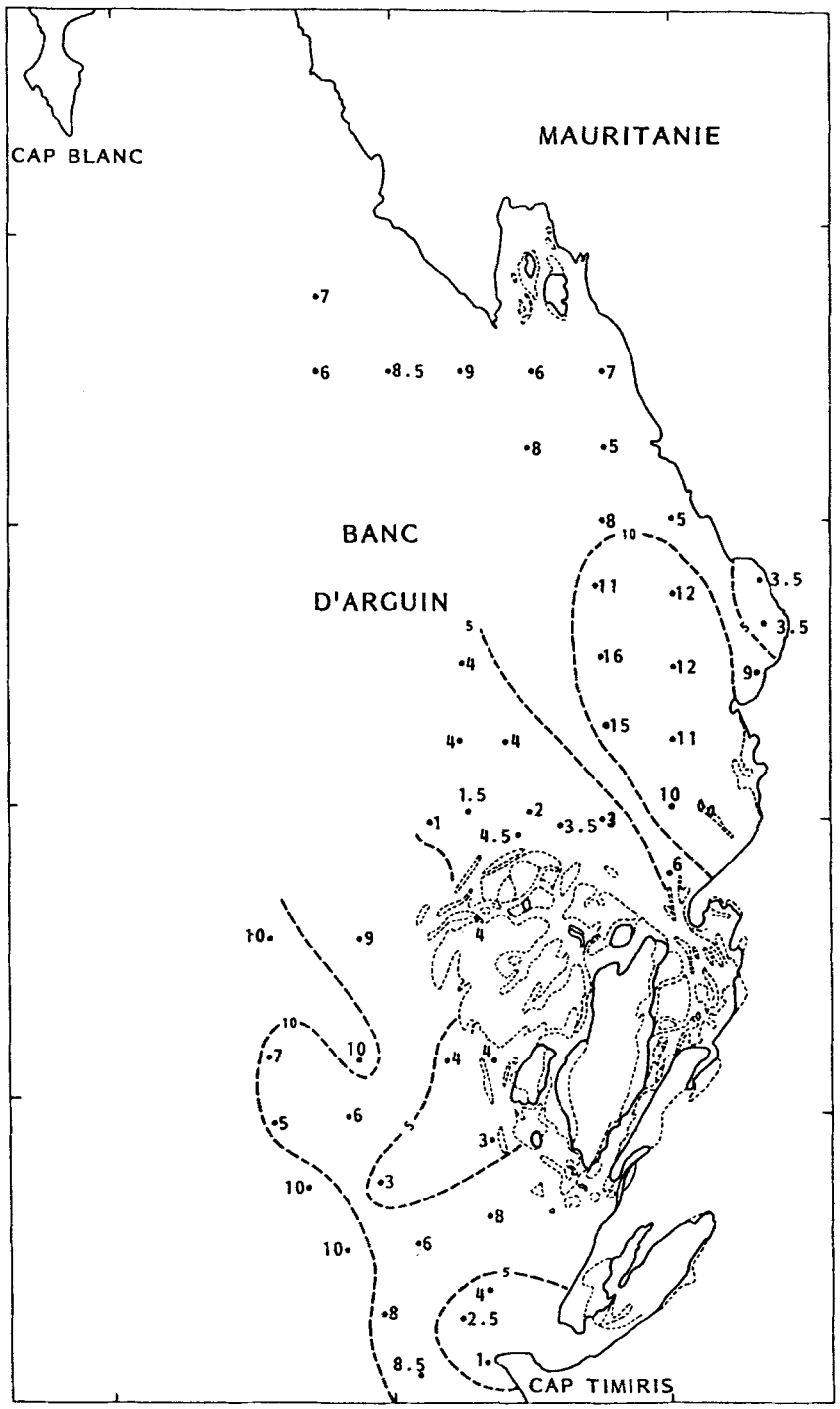

Fig. 2. Depth (in metres) of the sampled stations on the Banc d'Arguin in September 1988

Table 1. Abiotic parameters and catch characteristics of the sampled locations on the Banc d'Arguin in September 1988.

Location	Depth (m)	Temperature (°C)	Salinity (‰S)	Weight [W] (g)	Species number [Nsp]	Number of fish [nind]	Mean length (cm)
1	10		41.32	2000	3	5	28.0
2	3		41.32	2969	10	375	5.9
3	3.5		41.95	4205	16	646	5.8
4	4.5		40.99	2909	11	423	6.2
5	11	26.6	40.99	0	0	0	
6	12	26.3	40.99	0	0	0	
7	11	26.8	40.99	0	0	0	
8	16	27.0	40.99	492	5	12	10.8
9	14	26.9	41.32	38	2	7	8.7
10	6			28	5	12	3.8
11	12	27.8	40.99	346	4	6	14.5
12	8	27.7	41.62	3265	3	4	24.8
13	5	28.5	41.62	795	4	33	7.8
14	6.5	28.2	42.60	559	3	3	19.7
15	8	27.5	40.99	516	2	4	10.3
16	7	26.9	41.95	249	7	29	7.0
17	6	25.8	40.67	256	4	5	10.8
18	9	25.7	39.38	14	1	4	4.0
19	9	25.4	38.10	0	0	0	
20	6	25.2	38.10	0	0	0	
21	7	24.9	38.43	127	3	3	12.7
22	6	27.9	41.32	1482	7	97	8.6
23	9	26.8	39.38	90	2	4	10.0
24	10	26.5	39. 38	225	4	12	12.8
25	7	26.9	39.38	16	1	2	3.0
26	10	27.0	40.03	286	3	10	13.0
27	4	28.0	40.99	423	9	58	7.5
28	1	28.3	40.99	1111	11	169	5.5
29	4	28.5	41.95	2050	7	22	10.6
30	3	29.3	40.99	1370	11	97	6.3
31	8	30.0	41.32	82	3	6	9.0
32	4	28.9	40.36	480	11	24	10.4
33	1	28.8	41.32	1522	10	146	6.3
34	9	27.6	38.43	10	3	3	12.3
35	8	27.6	39.38	0	0	0	
36	10	27.6	39.08	0	0	0	
37	10	28.0	39.71	1050	2	2	28.0
38	5	28.0	39.71	125	2	6	7.7
39	6	28.5	40.67	96	3	14	6.4
40	3	28.5	40.67	935	9	43	8.9
41	6	28.9	42.92	2100	6	9	11.0
42	3	29.4	43.23	410	15	50	7.0
43	2	28.2	41.32	4071	13	490	6.2
44	4	27.9	40.36	1077	7	42	8.0
45	4	27.5	38.75	1116	6	116	6.5
46	4	27.8	39.71	1500	1	1	47.0
47	2	28.8	40.99	582	8	112	6.1
48	9	27.4	41.32	7822	7	121	11.7
49	3.5	26.9	41.62	1879	12	45	9.2
50	3.5	27.4	41.62	80	2	3	10.7
Avg	6.8	27.6	40.66	1015.2	6.0	76.16	10.94
Std	3.4	1.1	1.2	1449.6	4.0	142.5	8.0

Table 2. Fish species, present in the catches on the Banc d'Arguin in September 1988. Additionally, four unidentified species were present in small numbers.

Discobathidae	*Zanobathus schoeleinii*
Myliobathidae	*Rhinoptera marginata*
Tetraodontidae	*Ephippion guttiferum*
	Sphaeroides spengleri
Ariidae	*Arius heudeloti*
Syngnathidae	*Syngnathus* sp.
Polynemidae	*Galeoides decadactylus*
Serranidae	*Serranus scriba*
	Promicrops esonue
	Epinephelus aeneus
	Epinephelus alexandrinus
	Epinephelus guaza
Pomadasyidae	*Pomadasys incisus*
Sciaenidae	*Argyrosomus regius*
	Dicentrarchus punctatus
	Pseudotolithus brachygnatus
	Pseudotolithus senegalensis
	Sciaena umbra
Sparidae	*Diplodus bellottii*
	Diplodus sargus
	Pagellus acarne
	Sparus auratus
	Sparus auriga
	Spondyliosoma cantharus
Ephippidae	*Chaetodipterus goreensis*
Labridae	*Crenilabrus bailloni*
	Xyrichtys sp.?
Blenniidae	*Malacoctenus* sp. *nov.?*
	Parablennius incognitus?
Monacanthidae	*Stephanolepis hispidus*
Gobiidae	
Batrachoidae	*Batrachoides didactylus*
Scorpaenidae	*Scorpaena angolensis*
Dactylopteridae	*Cephalacanthus volitans*
Psettodidae	*Psettodes belcheri*
Bothidae	*Syacium micrurum*
Soleidae	*Synaptura lusitanica*
	Pegusa triophthalma
	Solea senegalensis
	Dicologoglossa cuneata
Cynoglossidae	*Cynoglossus* sp.

grasses or green algae. At most of the locations deeper than 8 m west of Tidra, red algae were present as bycatch. At the other sites, a large variety of bycatch showed up, such as corals, sponges, shells, crabs, hermit crabs and worms. Locations 32 and 42 showed a high diversity (11 and 15 species respectively), and were special due to the occurrence of *Chaetodipterus goreensis* (Cuvier, 1831), a guinean species only present on the Banc d'Arguin in the warm season (Sevrin-Reyssac, 1983).

Juvenile *Sepia* sp. (Cephalopoda) were caught in some quantity (7 to 27 per haul) at the relatively shallow (2–3 m) locations 4, 28, 30 and 43. Of some species, almost exclusively adult individuals were caught, *viz. Ephippion guttiferum* (Bennett, 1831), *Diplodus sargus* (Linnaeus, 1758), *Syngnathus* sp., and the rays *Zanobathus schoeleini* (Muller & Henle, 1841) and *Rhinoptera marginata* (E. Geoffroy Saint-Hillaire, 1817).

Cluster analysis

Cluster analyses, based on Table 4, resulted in the following clusters (Fig. 3). The largest cluster comprises all sites with a very small catch, ranging in depth from 3.5 to 16 m (7 m on average). The second cluster (2) consists of the locations 2, 3, 4 and 43 (depth 2–4.5 m, mean length of the fish *ca* 6.0 cm). These are very rich sites, with more than 350 individuals of at least 10 species per haul, and abundant presence and dominance of *Stephanolepis hispidus* (Linnaeus, 1766) and *D. bellottii* (Steindachner, 1882). The length-frequency distribution (Fig. 4) shows that the individuals range from 4 to 6 cm mainly, whereas the maximum attainable length is 25 cm for *S. hispidus*, and 15 cm for *D. bellottii* (Maigret & Ly, 1986). This means that of these two species, principally the juveniles were caught. Besides, large numbers of *Crenilabrus bailloni* (Valenciennes, 1839) and moderate numbers of *Sphaeroides spengleri* (Bloch, 1792) and gobiids were present. Of these species, a wider length-range occurred. Fish smaller than 4 cm were not fully retained by the mesh of the net.

The third cluster (3), which consists of the locations 28, 30, 33 and 47 (depth 1–3 m, mean length of the fish *ca* 6.0 cm) with between 97 and 168 individuals of about 10 species per haul, is characterised by a quite large abundance of *S. hispidus*, and the presence of several *C. bailloni.* Also, *D. bellottii* and *S. spengleri* are present. The

Table 3. Correlations between abiotic and biotic parameters.

Correlation matrix	No. of species	Ln (no. of individuals)	Ln (mean length)
Depth	$r^2 = -0.36$***	$r^2 = -0.30$***	$r^2 = 0.21$**
Temperature	$r^2 = 0.20$**	$r^2 = 0.15$*	$r^2 = 0.05$
Salinity	$r^2 = 0.20$**	$r^2 = 0.11$*	$r^2 = 0.03$

*** = Very highly significant; $p < 0.001$.
** = Highly significant; $p < 0.01$.
* = Significant; $p < 0.05$.

lengths of *S. hispidus* and *D. bellottii* are about 5 cm.

The fourth cluster (4) is composed of the sites 27, 40, 44 and 49 (depth 3–4 m, mean length of the fish *ca* 8.4 cm). This cluster is characterised by 40 to 60 animals per site; mostly, these sites have moderate (10–40) numbers of *S. hispidus* and *D. bellottii*.

Table 4. Numbers of individuals per haul of 30 species at 50 locations on the Banc d'Arguin (Sept. 1988).

Species	Code loc.	1	2	3	4	8	9	10	11	12	13	14	15	16	17	18	21	22	23	24	25	26	27
Rays	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephippion guttiferum	2	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Sphaeroides spengleri	3	0	4	5	18	0	0	2	0	0	0	0	0	0	1	4	1	68	3	6	0	4	1
Arius heudeloti	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Syngnatus typhle	5	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galeoides decadactylus	6	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Serranus scriba	7	0	1	7	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Epinephelus spp.	8	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Pomadasys incisus	9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Pseudotolithus spp.	10	0	0	0	0	3	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	1	0
Sciaena umbra	11	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Diplodus bellottii	12	0	186	64	93	0	0	0	2	0	24	0	0	12	0	0	0	21	0	0	0	0	26
Diplodus sargus	13	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sparus spp.	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Spondyliosoma cantharus	15	0	10	6	15	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Chaetodipterus goreensis	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crenilabrus bailloni	17	0	0	42	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Stephanolepis hispidus	18	2	166	492	244	0	0	2	0	0	7	0	0	0	0	0	2	3	1	3	0	4	18
Gobius spp.	19	0	0	13	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Batrachoides didactylus	20	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scorpaena angolensis	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Cephalacanthus volitans	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psettodes belcheri	23	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Syaium micrurum	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Synaptura lusitanica	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Pegusa triophtalma	26	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solea senegalensis	27	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cynoglossus spp.	28	0	1	0	0	2	2	0	2	0	0	0	0	2	1	0	0	0	0	0	0	0	0
Sepia spp.	29	0	0	4	7	2	0	2	0	2	0	0	3	3	1	0	0	1	0	0	2	0	1
Penaeus spp.	30	0	0	0	1	4	5	5	1	0	0	1	0	0	2	0	0	0	0	0	0	0	0
	Total	5	372	643	421	12	7	12	6	4	33	3	4	29	5	4	3	96	4	12	2	10	58

Table 4. (continued).

Species	28	29	30	31	32	33	34	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Rays	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0
Ephippion guttiferum	0	3	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	1	0
Sphaeroides spengleri	34	0	0	0	05	01	0	0	0	0	0	0	9	1	1	2	0	5	0	1	0
Arius heudeloti	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Syngnathus typhle	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Galeoides decadactylus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	103	2	0
Serranus scriba	1	1	0	0	0	2	0	0	0	0	3	0	5	17	0	0	0	0	0	1	0
Epinephelus spp.	0	0	1	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0
Pomadasys incisus	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	2	1	0
Pseudotolithus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Sciaena umbra	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
Diplodus bellottii	3	2	4	0	1	21	0	0	0	11	10	2	10	71	7	93	0	14	5	18	3
Diplodus sargus	0	0	1	0	0	0	0	0	0	0	0	0	0	1	6	0	0	1	0	2	0
Sparus spp.	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Spondyliosoma cantharus	2	0	3	0	2	22	0	0	0	0	0	0	7	5	0	7	0	4	0	2	0
Chaetodipterus goreensis	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Crenilabrus bailloni	1	1	10	2	0	3	0	0	0	0	6	0	2	57	1	0	0	4	0	0	0
Stephanolepis hispidus	82	13	57	3	3	76	0	0	5	2	17	0	5	298	25	12	0	79	0	14	0
Gobius spp.	13	0	9	0	0	0	0	0	0	0	0	0	3	19	0	0	0	2	0	0	0
Batrachoides didactylus	0	0	2	0	1	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0
Scorpaena angolensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cephalacanthus volitans	0	0	0	1	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Psettodes belcheri	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Syacium micrurum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synaptura lusitanica	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pegusa triophtalma	0	0	0	0	4	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Solea senegalensis	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Cynoglossus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sepia spp.	27	1	9	0	1	4	1	0	1	1	1	3	1	15	0	1	0	2	0	1	0
Penaeus spp.	1	0	1	0	0	4	1	0	0	0	1	0	1	2	1	0	0	0	0	1	0
Total	168	22	97	6	24	146	3	2	6	14	43	9	50	490	41	116	1	111	121	45	3

Finally, a fifth cluster (5) is formed by one single location, *viz.* 48. This site is unique by the presence of a large number of juvenile *Galeoides decadactylus* (Bloch, 1795), a semi-pelagic schooling species.

Discussion and conclusions

Abiotic factors

The observed temperatures and salinities in the area agree well with the descriptions given by Peters (1976) and Sevrin-Reyssac (1983): upwelling water flows into the bay south of Cap Blanc and is warmed up quickly by solar radiation, causing a negative correlation between temperature and depth. The water flowing southward over the Banc d'Arguin gains a high salinity by evaporation. This is in agreement with the observed positive correlation between temperature and salinity. The absence of a significant correlation between salinity and depth may indicate an intensive exchange of water between deeper and shallow areas at the time of the survey.

Biota

The collected number of 45 fish species is high compared to the study of Campredon &

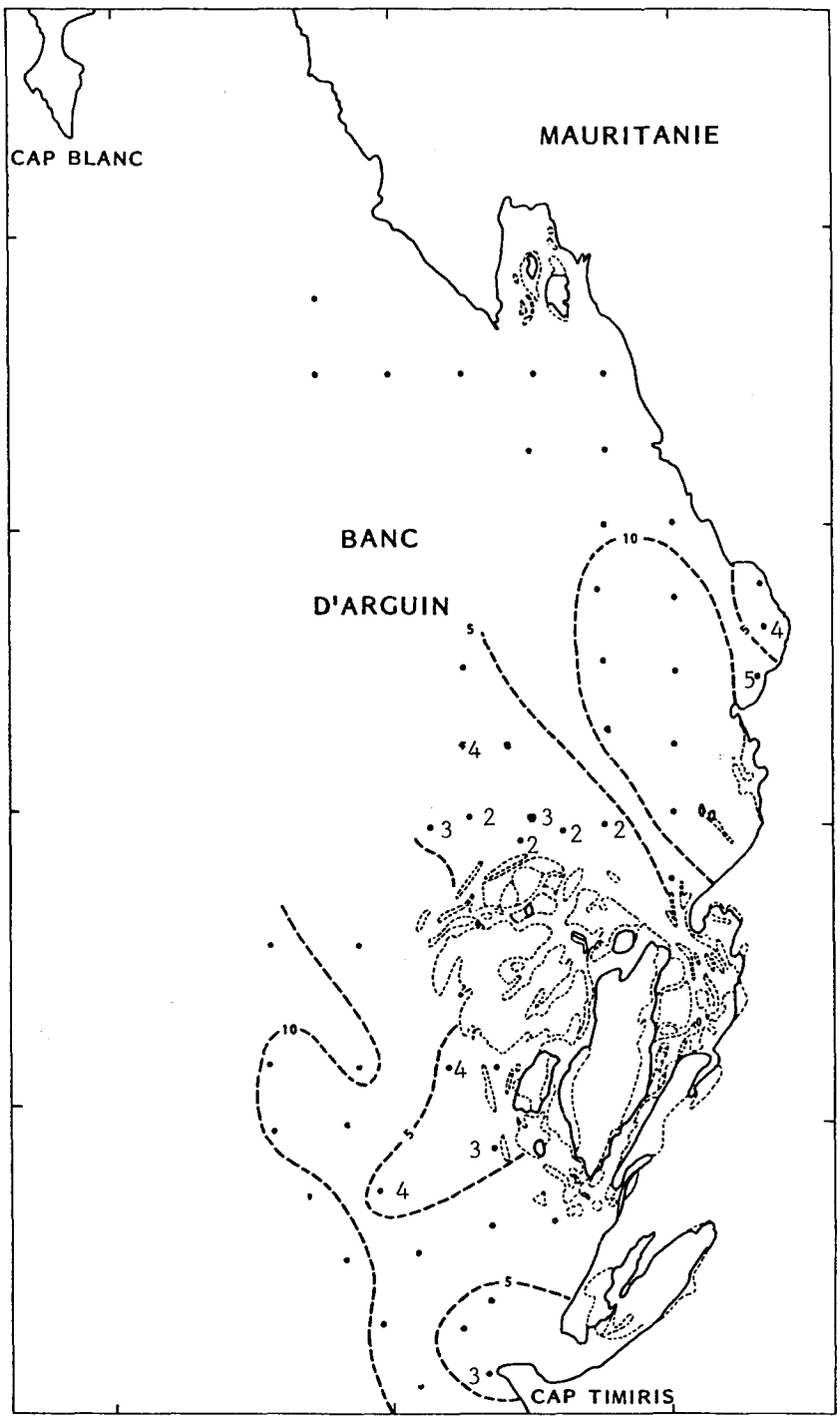

Fig. 3. Distribution of the station clusters on the Banc d'Arguin in September 1988. The figures denote the cluster to which the stations belong, stations without figure belong to cluster 1. The dashed lines denote the 5 and 10 m isobaths.

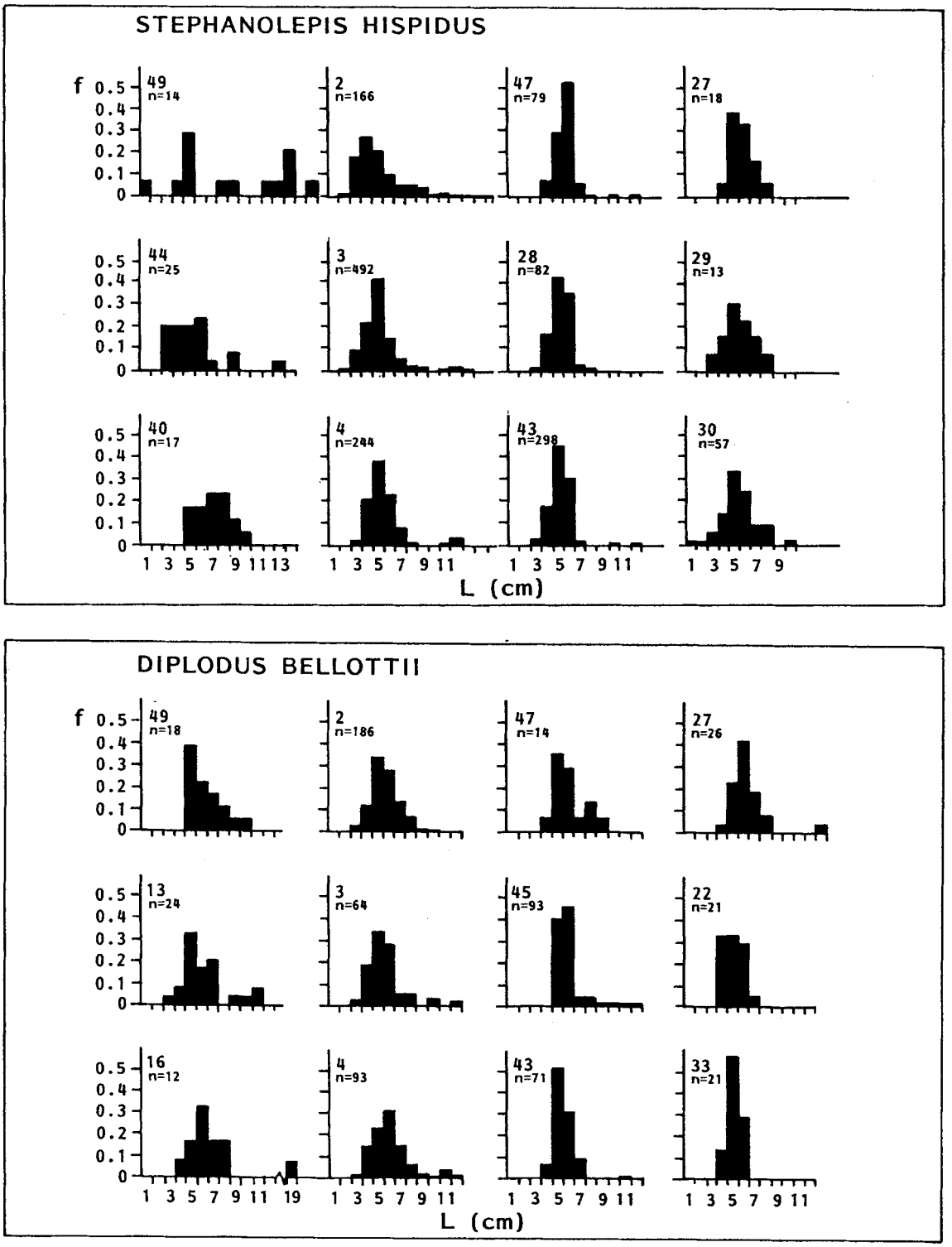

Fig. 4. Length-frequency distributions of *Stephanolepis hispidus* (top) and *Diplodus bellottii* (bottom) on the Banc d'Arguin in September 1988. Only stations with more than 10 individuals of the species are shown.

Schrieken (1989) who collected 19 fish species, and 10 species of prawns. The higher number found in this study is probably caused by the larger area covered in the survey of September 1988, including a wider depth range.

The observed numerical dominance of juvenile *S. hispidus*, *D. bellottii* and gobiids in the area north of Tidra in this study, is in good agreement with the results of Campredon & Schrieken (1989). The most striking differences between our results in September 1988 and those of Campredon & Schrieken (October 1985) are that the latter caught higher numbers of prawns, much smaller numbers of *S. hispidus*, and no *D. bellottii*. Remarkable is also their record in October 1985 of 13–18 *Ephippion guttiferum* on seagrass beds, whereas we only caught single individuals of this species on depths between 3 and 9 m. These differences are hard to explain.

Most of the relationships between number of species, *Ln* (number of individuals) and *Ln* (mean length) on one hand, and depth, temperature and salinity on the other hand were statistically significant. But highest significance was found for the correlations with depth. This might indicate that the shallow parts of the Banc d'Arguin are important as a habitat for large numbers of small fish. Of these small individuals, more than 50% are juveniles of *S. hispidus* and *D. bellottii*. Moreover, the locations shallower than 5 m appear to be very rich in species. The smaller number of species at the deeper locations may have been caused by a lower gear-efficiency in deeper water. The absence of small individuals in the catches at the deeper locations can not be explained by this factor, since these fish are expected to be efficiently captured by a 2 m beam trawl (cf. Kuipers, 1975). In shallow water (1–2 m), the observed large quantities of fish may even be underestimated because of reduced gear-efficiency due to disturbance effects of the boat; this effect is more important for larger fish (Kuipers, 1975). Furthermore, experiments by Gray & Bell (1986) showed that on seagrass beds, 30% less species and 85% less individuals were obtained by trawling during day-time, compared to poisoning by rotenon. Although specific data on the efficiency of the beam trawl used in this study for the fish species present on the Banc d'Arguin are lacking, it is concluded that depth is an important explanatory factor for the observed differences in abundance of young fish. Temperature and salinity apparently play a less important role in structuring the fish biocenosis.

Cluster analysis

The first cluster is a very diverse group of locations, which have their low catches in common. The second and third cluster do not differ substantially, except that cluster 2 has a slightly higher species diversity and a higher abundance of *D. bellottii* than cluster 3. All locations in cluster 2 and 3 have depths shallower than 5 m. The mean length of the fish has an average of 6.0 cm in these clusters.

Related with depth is the presence of seagrasses. It is known that on the Banc d'Arguin up to a depth of about 5 m, enough light can penetrate the water column to allow growth of a seagrass vegetation. Seagrasses were shown to be present northwest of Tidra, and near Cap Tafarit (Wolff & Smit, 1990; Nienhuis, 1990). From our own observations, seagrass appeared to be present as bycatch at the locations northwest of Tidra, and near Tanoudert.

The presence of seagrasses may be an important explanation for the observed species diversity, and for the abundance of juvenile fish at the locations shallower than 5 m, as reflected in the clusters 2 and 3. Unfortunately, the vegetation bycatch in the trawl was not recorded accurately enough to be able to test this hypothesis.

S. hispidus is known to be a direct consumer of seagrass (Sevrin-Reyssac, 1983). Other species may use the vegetation for shelter.

The species composition at site 48 ressembles the 'sciaenid community' as characterised by Longhurst & Pauly (1986), occurring in tropical waters on soft bottoms above the thermocline, consisting of *Pomadasys* sp., *Galeoides decadactylus*, *Pseudotolithus typus*, *Arius* sp., and *Cynoglossus goreensis*.

An important part of the Banc d'Arguin could not be sampled during this survey. Due to the timing of the survey, this study offers a picture of the demersal nectonic populations by the end of the warm season. This paper suggests the function of the Banc d'Arguin as a nursery for some fish species, especially *S. hispidus* and *D. bellottii*, and for *Sepia* species. More study is required to assess the importance of the Banc d'Arguin in the lifecycle of other fish species, those of commercial value included.

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