ISSN 0032-9452, Journal of Ichthyology, 2012, Vol. 52, No. 2, pp. 160–171. © Pleiades Publishing, Ltd., 2012.
Original Russian Text © A.V. Gushchin, Khallagi Ould Mokhamad Fall, 2012, published in Voprosy Ikhtiologii, 2012, Vol. 52, No. 2, pp. 195–206.

Ichthyofauna of Littoral of the Gulf Arguin, Mauritania[1]

A. V. Gushchin[a] and Khallagi Ould Mokhamad Fall[b]

[a]*Atlantic branch of P.P. Shirshov Institute of Oceanology of Russian Academy of Sciences, Kaliningrad, Russia*
[b]*Mauritanian Institute for Oceanographic Research and Fisheries (IMROP), Mauritania*
e-mail: Poseidon-47@rambler.ru

Received May 10, 2011

Abstract—According to the materials of 2000–2004, in littoral of the gulf Arguin (at the coast of Northern Africa) dwell 91 fish species. Fish young, accumulating 97.9–99.7% of ichthyofauna, endure main cycle of development in the zone of littoral, use it for pasture and as a shelter. Five types of littoral are distinguished in the gulf. Ichthyofauna composition of different littoral types has significant similarity, but differs essentially from ichthyofauna of open ocean littoral. The role of the gulf Arguin, taking into consideration its dimensions, is unique in reproduction, biodiversity maintenance and existence of numerous fish species (including fishery species) of Northern Africa.

Keywords: Mauritania, gulf Arguin, ichthyofauna, littotal, fish young, distribution.

DOI: 10.1134/S0032945212010055

The aim of the investigation is to verify species composition of ichthyofauna, distribution and seasonal dynamic of fish size in the zone of littoral of the gulf Arguin (Mauritania) which plays an important role in industrial fishery reserve and biodiversity maintenance of oceanic water of Northern Africa.

MATERIAL AND METHODS

The materials for the present article were collected in 2000–2004 during 19 expeditions of SRV "Amrique" of Mauritanian Institute for Oceanographic Research and Fisheries (IMROP). The materials were sampled at 13 standard stations (Fig. 1) in the most typical zones of littoral of the gulf Arguin. Fish catches were regularly conducted at each station. Hydrochemical parameters, bottom decline, extent of ground surfacing with weeds and sea grass, type of tide coercion were determined also. These parameters were used for typification of gulf littoral by means of claster analysis.

Sweep-net with wings length of 19 m (18 mm cell) and 4 m sack of doubled net (16 mm cell) was used for fish catch. General length of sweep-net horizontal opening was 42 m, wall height of 2.5 m on the wings and 3 m in the sack. Sweep-net was poured out parallel the coast at the distance of 20–25 m depending on the depth then it was taken onto the coast. All caught fish was determined up to species, measured up to 1mm (full length TL), weighed up to 0.01 g and fixed with 6% formalin for following processing. Species determination of young in early stages was fulfilled with the method of standard series selection. 20822 specimens of 91 fish species were inspected in total.

Data analysis was developed by the stations that were grouped according to allocated littoral types. The degree of ichthyofauna similarity for different littoral types was determined with the help of Chekanovsky-Sorensen coefficient (Pesenko 1982): $CC = 2c/(a + b) \times 100$, where a—is number of species found only on type A stations; b—is number of species found only on type B stations; c—is number of species common for the stations of both types.

RESULTS

Environmental conditions of the gulf Arguin water area. The gulf Arguin is enormous shallows of 12.6 square kilometers with the average depth of 2.5 m. Abnormal half-daily flood tide with the amplitude of 1.2–2.0 m is observed in the gulf. The gulf is separated from the ocean by the rock bar with the depths of 1.5–2.5 m that reduces surf influence of the ocean. A part of the gulf area is covered with sea grasses. The researchers (Bernikov, 1969; Fedoseev, 1976; Alexeev et al., 2002) distinguish two hydroclimatic periods in the water of Mauritania: cold season in January–April and warm season in August–September. Transition periods with abnormal hydroclimatic situation are observed between these seasons.

In cold season (January–April) surface water temperature increases southward of the cape Timiris and eastward the interior of the gulf. Cold water of Canary upwelling of low salinity penetrates the gulf to the south-east of the Cape Blanc. Water masses in the south (19°20′N, 16°55′W) are connected with advec-

[1] The article was translated by the authors.

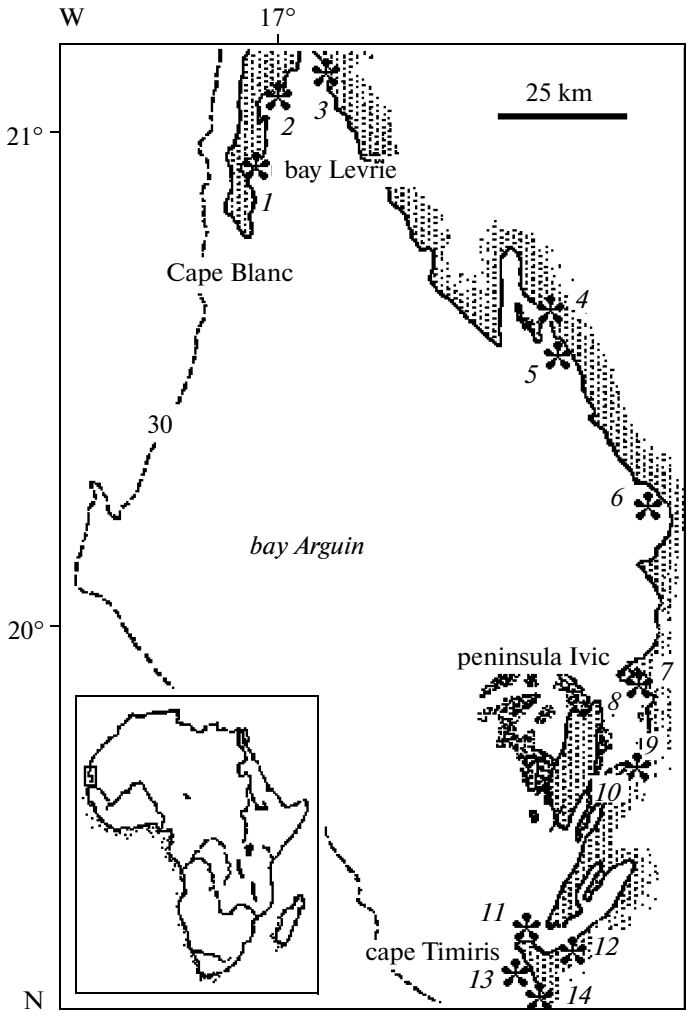

Fig. 1. Standard stations positions on littoral of the gulf Arguin (Mauritania): *1*—bay Levrie; *2*—bay Etoile; *3*—bay Archimedes; *4*—Northern Arguin; *5*—Southern Arguin; *6*—bay Tanudert; *7*—Northern Ivic; *8*—Southern Ivic; *9*—Northern Sereny; *10*—Southern Sereny; *11*—bay of St. Jane, north; *12*—bay of St. Jane, south; *13*—Northern Jraif; *14*—Southern Jraif.

tion of warm oceanic water (Fig. 2). Salinity in the gulf increases from the west to the east due to water evaporation on the shallows. Maximal water salinity (39.2‰) was marked in the bay St. Jane. General current scheme, created by method of dynamic heights, shows oceanic water way into the gulf in the region of 19°55′–20°35′N. Part of oceanic water turns northward and forms water cycle in the bay Levrie, another part of water deviates from the eastern direction to the south-eastern and southern directions owing to peculiarities of underwater relief and coastal line. Flow of water transformed in the gulf Arquin occurs in the region between 19°45′N and the cape Timiris. Directions and speed of the currents between the islands and in the bays depend on flow tides activity.

In warm season (August–September) the intensity of Canary upwelling decreases at the minimum. Surface temperature increases from 22.5 to 28.5°C southward. Surface water salinity increases from the west to the east due to heavy evaporation and reaches its maximum (>40‰) in the straits between the islands Tirda, in the strait Sereny and in the bays Arguin and St. Jane. General currents scheme is similar to cold season scheme (Fig. 2).

Ichthyofauna according to littoral types. Littoral ichthyofauna of the gulf Arguin includes 91 fish species (Table 1). Prevalence of young fish in the catches is specific ichthyocene peculiarity of gulf littoral. Young of the most neritic fish species, typical for shelf water of Mauritania, Morocco and Senegal, occur here. Grown-up, mature fish consist only 0.3–2.1%, except the period of mullet (Mugilidae) and sardinella—*Sardinella maderensis* migration when these fish come off shore for spawning in big schools.

The group of background species is another specific peculiarity of ichthyofauna in the gulf Arguin. These species occur in small quantities in water areas of all littoral types. Background species group consists

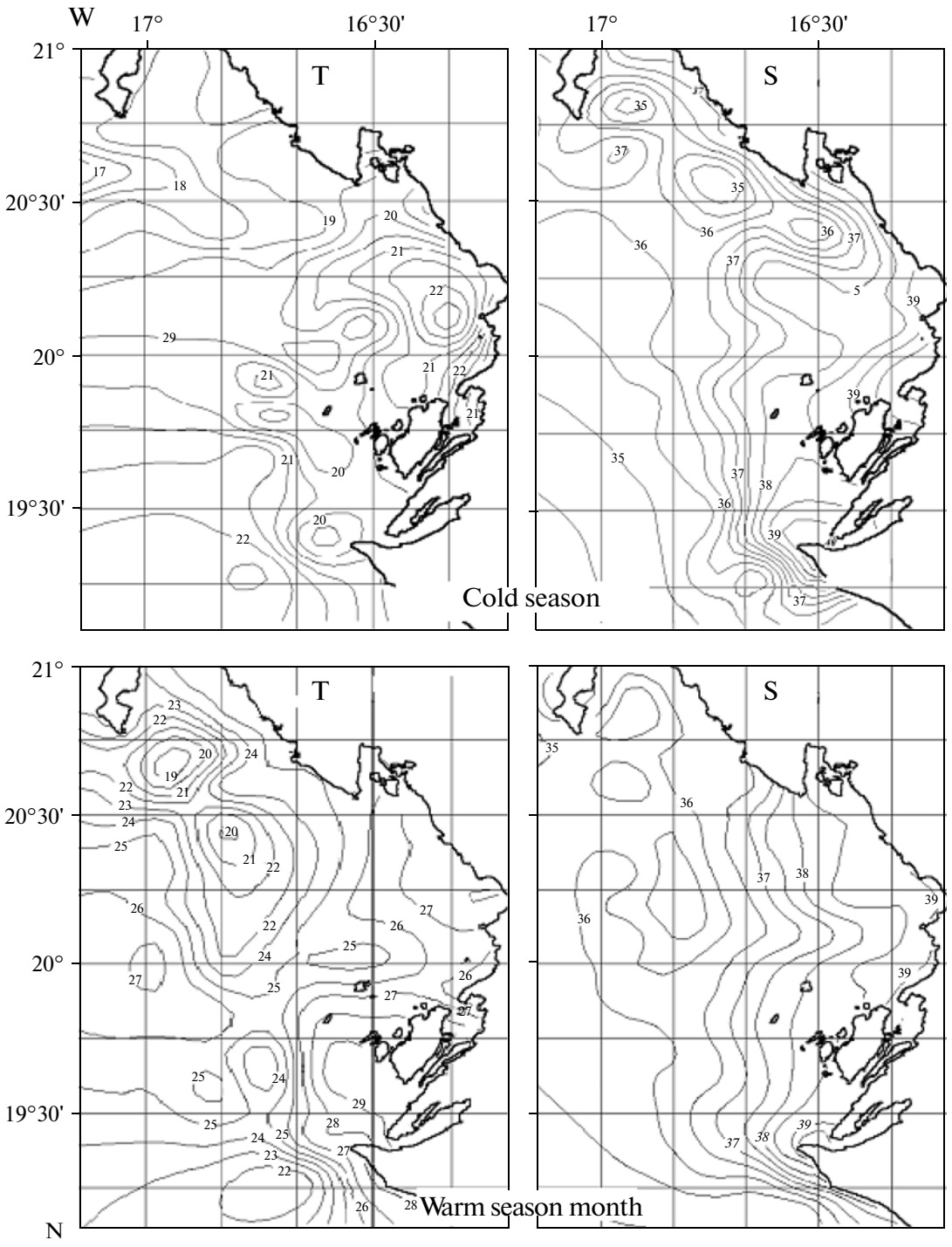

Fig. 2. Temperature (T) and water salinity (S‰) distribution in cold and warm seasons in the gulf Arguin (Mauritania).

of *Arius parkii, Atherina presbyter, Chelon labrosus, Dicentrarchus punctatus, Diplodus bellottii, D. sargus, Eucinostomus melanopterus, Lithognathus mormyrus, Liza dumerili, Mugil capurrii, M. cephalus, Pomadasys perotaei, Sardinella maderensis, Solea senegalensis.* The highest size was observed of *L. dumerili* (4421 sp.), *S. maderensis* (3489 sp.), *D. punctatus* (2363 sp.), *A. presbyter* (1550 sp.). Size of *S. maderensis* and *A. presbyter* was decreased owing to rather large cell, therefore young passed through the sweep-net.

Five types of littoral were distinguished in the gulf depending on environmental conditions, currents, surf influence, coastal morphology, ground surfacing with sea weeds and macrophytes. For correlation these

Table 1. Ichthyofauna composition according to littoral types of the gulf Arguin (*n*—number of caught specimens; *LT*—specimen average length, mm)

No.	Species	Littoral types												*n*
		type 1		type 2		type 3		type 4		type 5		type 6		
		n	*TL*	*n*	*TL*	*n*	*TL*	*n*	*TL*	*n*	*TL*	*n*	*TL*	
1	*Albula vulpes*									1	233.0	1	242.0	2
2	*Alectis alexandrinus*	2	417.5											2
3	*Argyrosomus regius*							6	137.6					6
4	*Arius heudeloti*	21	60.3					5	181.7	2	421.0			28
5	*A. parkii*	4	177.5	13	191.3	1	455.0	2	223.5	2	242.0			22
6	*Atherina lopeziana*	7	39.0			9	70.4							16
7	*A. presbyter*	653	26.1	35	66.2	218	129.3	7	65.3	637	31.9			1550
8	*Batrachoides liberiensis*									1	105.0			1
9	*Belone* sp.					5	304.0			2	385.5			7
10	*Bodianus speciosus*									1	90.0			1
11	*Brachydeuterus auritus*			37	83.1			15	78.3			7	81.1	59
12	*Branchiostegus semifasciatus*									10	63.0			10
13	*Campogramma glaycos*			2	245.0			22	185.6					24
14	*Caranx crysos*							1	71.0	1	21.0			2
15	*C. hippos*											2	50.0	2
16	*Chelon labrosus*	44	23.5	47	26.4	24	84.8	31	94.5	1	254.0			147
17	*Chloroscombrus chrysurus*	58	67.4			1	61.0	17	200.6	31	61.3			107
18	*Citharichthys stampfilii*	8	98.4			1	153.0							9
19	*Coris julis*									24	97.0			24
20	*Cynoglossus senegalensis*	4	51.3			3	133.7			2	213.0			9
21	*Decapterus rhonchus*	101	126.0					26	217.0	2	35.0	10	72.0	139
22	*Dentex canariensis*	1	138.0					1	215.0	1	142.0			3
23	*Dicentrarchus punctatus*	354	43.1	394	47.4	364	126.8	752	102.4	499	75.1			2363
24	*Dicologoglossa cuneata*	2	86.5	1	165.0	1	100.0			1	206.0			5
25	*Diplodus bellottii*	132	55.4	21	18.0	49	79.2	169	127.4	9	67.0	8	71.4	388
26	*D. sargus*	185	26.4	8	105.5	89	158.3	31	85.1	499	29.5	1	228.0	813
27	*Ephippion guttifer*	2	445.0			1	93.0			17	99.6			20
28	*Epinephelus aeneus*	4	63.0							3	110.3			7
29	*E. caninus*							100	104.8					100
30	*Engraulis encrasicolus*							24	48.3	16	43.6			40

Table 1. (Contd.)

No.	Species	Littoral types*												*n*
		1		2		3		4		5		6		
		n	*TL*	*n*	*TL*	*n*	*TL*	*n*	*TL*	*n*	*TL*	*n*	*TL*	
31	*Ethmalosa fimbriata*	23	71.5	11	59.1			223	79.4	21	52.3			278
32	*Eucinostomus melanopterus*	484	66.5	65	71.9	287	96.6	11	120.2	262	54.8	1	154.0	1110
33	*Fistularia tabacaria*					8	108.3			12	378.6			20
34	*Galeoides decadactylus*	5	171.4					70	136.7	53	68.2			128
35	Gobiidae gen. spp.	29	60.2			7	107.3			15	55.4			51
36	*Halobatrachus didactylus*	1	49.0							1	62.0			2
37	*Lagocephalus laevigatus*	1	260.0	3	19.0	1	285.0			1	150.0	1	150.0	7
38	*Leptocharias smithii*	3	645.0					2	491.5	2	341.0			7
39	*Lichia amia*	1	645.0			1	100.0							2
40	*Lithognathus mormyrus*	489	38.0	45	54.6	98	92.7	14	115.2	944	42.8	5	52.0	1595
41	*Liza dumerili*	704	78.8	423	60.7	2390	70.6	108	193.5	796	80.4			4421
42	*Mugil capurrii*	527	21.1	24	68.3	435	124.5	42	169.6	94	124.0			1122
43	*M. cephalus*	9	44.4	49	131.0	1	179.0	4	55.5	16	54.4	12	84.3	91
44	*Mycteroperca rubra*	12	91.7							12	91.7			24
45	*Nicholsina usta*	1	103.0			1	103.0			19	52.4			21
46	*Pagellus bellottii*	1	103.0			26	147.7							27
47	*Paragaleus pectoralis*					2	544.0							2
48	*Parapristipoma octolineatum*							2	262.0					2
49	*Pegusa lascaris*	1	58.0											1
50	*P. triophthalmus*	1	53.0	1	58.0	3	131.0							5
51	*Pomadasys incisus*	18	66.4			6	123.3	15	91.2	127	21.8			166
52	*P. jubelini*	1	93.0	6	32.8			4	108.5	102	28.1	2	71.5	115
53	*P. perotaei*	21	67.2	13	55.2	10	95.5	2	69.0	77	68.1	12	68.2	135
54	*P. rogeri*	60	50.2			277	71.7	4	115.3	630	92.9	6	86.2	977
55	*Pomatomus saltatrix*			4	54.0	4	54.8	27	224.9	17	68.3			52
56	*Psettodes belcheri*	12	181.9					1	159.0	5	242.2			18
57	*P. bennetti*									1	340.0			1
58	*Pseudotolithus senegalensis*									1	789.0			1
59	*Remora remora*									1	190.0			1
60	*Rhinobatos rhinobatos*					2	313.5	5	407.2	3	256.0			10
61	*Rhizoprionodon acutus*	1	343.0							2	366.0			3
62	*Sardinella aurita*	2	66.5							1	117.0			3
63	*S. maderensis*	2121	28.1	92	74.8	63	118.6	185	79.0	1028	58.9			3489
64	*Sarpa salpa*									1	148.0			1
65	*Scarus hoefleri*									1	146.0			1
66	*Sciaena umbra*									1	213.0	1	125.0	2

Table 1. (Contd.)

No.	Species	Littoral types*												*n*
		1		2		3		4		5		6		
		n	*TL*	*n*	*TL*	*n*	*TL*	*n*	*TL*	*n*	*TL*	*n*	*TL*	
67	*Scomberomorus tritor*					3	81.7	1	468.0	6	110.2			10
68	*Serranus scriba*					1	110.0			27	103.6	2	66.0	30
69	*Smaris macrophtalmus*					2	116.5							2
70	*Solea senegalensis*	38	101.2	2	119.0	51	143.1	9	166.7	3	137.0			103
71	*S. vulgaris*	5	88.0							4	95.5			9
72	*Sparisoma rubipinne*									2	200.0			2
73	*Sparus aurata*			48	150.0	4	140.5	1	247.0	22	156.0			75
74	*S. caeruleostictus*					2	40.0							2
75	*Sphoeroides spengleri*	3	55.0			20	143.3			62	66.8			85
76	*Sphyraena sphyraena*	1	137.0			1	56.0							2
77	*Spicara spicara*					1	141.0							1
78	*Spondyliosoma cantharus*					7	83.6			5	93.0			12
79	*Stephanolepis hispidus*	7	53.0			6	72.0			27	77.9			40
80	*Syacium micrurum*	5	70.6	1	110.0					1	140.0			7
81	*Symphodus tinca*					17	154.1			30	29.1			47
82	*Synaptura lusitanica*					2	114.5	2	253.0	5	114.2			9
83	*Syngnathus* sp.	1	140.0											1
84	*Tilapia guineensis*	2	120.0			26	177.5			3	89.7			31
85	*Torpedo torpedo*	1	105.0					1	105.0					2
86	*Trachinotus goreensis*									11	105.2			11
87	*T. ovatus*	2	88.0			34	66.4	6	134.0	424	56.3	11	63.7	477
88	*T. teraia*									12	118.5			12
89	*Trachurus trachurus*									1	86.0			1
90	*Umbrina canariensis*	6	277.7			3	108.3			41	126.5	3	115.7	53
91	*Zanobatus schoenleinii*									1	310.0			1
	Total	6181		1345		4568		1948		6695		85		20822
	Species total	53		24		48		39		71		17		91
	% of adult species	0.5		0.3		0.9		2.1		0.5		0.6		

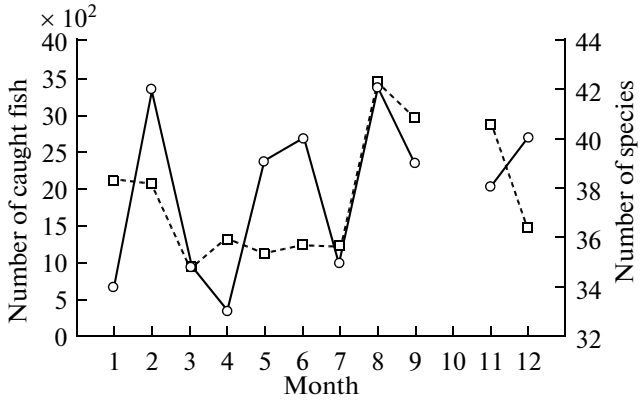

Fig. 3. Seasonal dynamic of young fish community in the gulf Arguin, Mauritania: (—)—number of species, (- - -)—number of caught fish.

types of littoral were compared with littoral of open ocean coast in the region of the cape Timiris (marked as type 6).

Type 1—littoral of open coast inside the gulf Arguin (Fig. 1: stations 5, 11, 13). Sand bank is exposed to the influence of not so strong surf, ground slopes. Strong flow tide current is absent. Bottom ground can be surfaced with sea grass and macrophytes. This type of littoral takes the first place in littoral zone of the gulf considering number of species (71) and fish size (6695 sp.) in the catches. *S. maderensis* (1028 sp.), *L. mormyrus* (944 sp.), *L. dumerili* (796 sp.), *A. presbyter* (637 sp.) have the highest size here.

Type 2—littoral of deep channels with sharp change of depths and very strong flow current alongside the coast (Fig. 1: stations 4, 7, 8). Sea grass and macrophytes are absent. This type of littoral takes the second place considering number of species (53) and fish size (6181 sp.) in the catches. *S. maderensis* (2121 sp.), *L. dumerili* (704 sp.), *A. presbyter* (653 sp.), *M. capurrii* (704 sp.) have the most size.

Type 3—littoral of inner bays is shut from the winds and the surf, with sloping bank and sea grass growths (Fig. 1: stations 9, 10, 12). This type of littoral takes the third place considering number of species (48) and fish size (4568 sp.) in the catches. *L. dumerili* (2390 sp.), *M. capurrii* (435 sp.), *D. punctatus* (364 sp.) prevailed in the catches.

Type 4—littoral of open coast in the north, inside the gulf Arguin, is under the influence of upwelling water (Fig. 1: stations 1, 3). Sea grass and macrophytes are absent. This type of littoral takes the forth place considering number of species (39) and fish size (1948 sp.) in the catches. The most size belongs to *D. punctatus* (752 sp.), *Ethmalosa fimbriati* (223 sp.), *S. maderensis* (185 sp.).

Type 5—littoral of the bay Etoile (Fig. 1: station 2). Sloping bottom is covered with sea weeds and macrophytes, strong flow tide current. This type of littoral takes the fifth place considering number of species (24) and fish size (1345 sp.) in the catches. The most size belongs to *L. dumerili* (423 sp.), *D. punctatus* (394 sp.), *S. maderensis* (92 sp.)

Type 6—littoral of open ocean coast outside the bounderies of the gulf Arguin with strong surf and abrupt bottom (Fig.: station 14). Littoral of this type is the most poor in species number (17) and size of caught fish (85 sp.), though we should take this appraisal rather cautiously. Strong, continuous ocean surf disturbed to conduct the investigations in this place. We succeeded to fulfill observations on this station only four times during the whole period of the investigations. The biggest size had *P. perotaei* (12 sp.), *M. cephalus* (12 sp.).

Ichthyofauna according to the seasons. Alterations in composition and size of littoral ichthyofauna can be easily observed according to the seasons (Fig. 3, Table 2). Number of background fish species is rather constant on months during the year and observed fluctuations of species number (33–42 species) occurred owing to catch of rear species.

The highest fish size is observed in August–November. Observations were not conducted in October because of yearly vessel maintenance. 2869–3423 fish specimens were caught in August–November. High size of *L. dumerili* was marked in August and *S. maderensis* in September–October.

Several species distinguish seasonal dynamic of size, most of them belong to background species: *Chloroscombrus chrysurus, D. punctatus, Diplodus bellottii, D. sargus, E. melanopterus, L. mormyrus, L. dumerili, M. capurrii, S. maderensis* (Table 2). Another fish group: *Chelon labrosus, Decapterus rhonchus, Galeoides decadactylus, P. perotaei, Pomadasys rogeri, Psettodes belcheri, S. senegalensis, Sphaeroides spengleri, Trachinotus ovatus, Umbrina canariensis* are encountered practically in all seasons, but at lesser size. Other species are met episodically, but sometimes big number of these species might occur in the catch. For example, more than 100 specimens of *Epinephelus caninus* were caught in November, more than 200 specimens of *E. fimbriata* in September and more than 100 specimens of *Pomadasys incisus* in January. Quite possible, the catches were connected to spawning cycle of these species and catching equipment selectivity.

DISCUSSION

Species composition of ichthyofauna in the gulf Arguin differs greatly according to the data of different authors. Chlibanov and co-authors (Chlibanov et al., 1982) marked 54 fish species, Sevrni-Reyssac and Forges (Sevrni-Reyssac, de Forges, 1985)—10 species, Jager (Jager, 1993)—40 species. The differences have appeared owing to usage of different methods, catching equipment and also different places of catch. Season of catch is of great significance. Samplings in

Table 2. Seasonal dynamic of littoral ichthyofauna of the gulf Arguin (*n*—number of specimens, *TL*—average length, mm)

No.	Species	Months												total	
		1	2	3	4	5	6	7	8	9	10	11	12	*n*	*TL*
1	*Albula vulpes*								2					2	223.0
2	*Alectis alexandrinus*					2								2	417.5
3	*Argyrosomus regius*					4	2							6	137.6
4	*Arius heudeloti*		2	12	2	5	4			3				28	103.7
5	*A. parkii*		1					14	2	3		1	1	22	208.3
6	*Atherina lopeziana*		4			5	7							16	56.0
7	*A. presbyter*	351	259	125	67	8	7	34	198	167	1	196	137	1550	32.4
8	*Batrachoides liberiensis*			1										1	106.0
9	*Belone* sp.	2					5							7	342.0
10	*Bodianus speciosus*		1											1	90.0
11	*Brachydeuterus auritus*								15			44		59	82.7
12	*Branchiostegus semifasciatus*		10											10	63.0
13	*Campogramma glaycos*					17	3	2		2				24	56.9
14	*Caranx crysos*							1	1					2	59.0
15	*C. hippos*									2				2	50.0
16	*Chelon labrosus*	8	1	5				6	56	3	11	36	21	147	36.6
17	*Chloroscombrus chrysurus*	1	8	4	14	37	7	11	13	6		5	1	107	70.0
18	*Citharichthys stampfilii*	3	1			2		1				2		9	103.5
19	*Coris julis*						13		11					24	98.0
20	*Cynoglossus senegalensis*	1	2		3	2						1		9	71.0
21	*Decapterus rhonchus*	100	3	1	1	1	13		9	10		1		139	45.0
22	*Dentex canariensis*	1			1					1				3	71.7
23	*Dicentrarchus punctatus*	153	323	148	218	200	301	63	282	201	93	281	100	2363	61.9
24	*Dicologoglossa cuneata*	2					3							5	128.8
25	*Diplodus bellottii*	1	14	33	6	75	69	42	52	75	2	18	1	388	62.6
26	*D. sargus*	8	9	187	29	99	120	64	203	11		75	8	813	32.0
27	*Engraulis encrasicolus*			26			14							40	17.5
28	*Ephippion guttifer*			4			2	6	1			6	1	20	86.2
29	*Epinephelus aeneus*			1	1			2		2			1	7	83.3

Table 2. (Contd.)

No.	Species	Months												Total	
		1	2	3	4	5	6	7	8	9	10	11	12	*n*	*TL*
30	*E. caninus*											100		100	104.8
31	*Ethmalosa fimbriata*	5	6		1	24	4			228			10	278	75.6
32	*Eucinostomus melanopterus*	140	79	29	41	60	108	10	11	53		299	280	1110	63.0
33	*Fistularia tabacaria*	11	3	4			2							20	210.3
34	*Galeoides decadactylus*		11	13	16	23	7	12	4	13		22	7	128	56.5
35	*Gobius* sp.	2		3	4			5	1	15		11	10	51	69.1
36	*Halobatrachus didactylus*							1				1		2	55.5
37	*Lagocephalus laevigatus*					2	2		3					7	95.0
38	*Leptocharias smithii*		1	3	1			1		1				7	237.9
39	*Lichia amia*			1					1					2	352.0
40	*Lithognathus mormyrus*	452	182	127	100	59	123	11	77	17		253	194	1595	42.7
41	*Liza dumerili*	390	438	90	710	273	203	74	1252	166	12	601	212	4421	76.5
42	*Mugil capurrii*	118	73	5	31	41	27	63	435	285	7	29	8	1122	65.2
43	*M. cephalus*	15	1	8	3	7	56						1	91	18.4
44	*Mycteroperca rubra*								9			9	6	24	91.7
45	*Nicholsina usta*		1						12	2		6		21	55.0
46	*Pagellus bellottii*			1					26					27	24.4
47	*Paragaleus pectoralis*								2					2	544.0
48	*Parapristipoma octolineatum*								2					2	53.0
49	*Pegusa lascaris*									1				1	58.0
50	*P. triophthalmus*							1		3			1	5	68.2
51	*Pomadasys incisus*	110			4	8	25					5	14	166	47.5
52	*P. jubelini*	3	34		1	5		66		2			4	115	31.2
53	*P. perotaei*	3		4	4	1		4		38		80	1	135	67.8
54	*P. rogeri*	51	471	20	1	60	7			61		34	272	977	77.6
55	*Pomatomus saltatrix*	1	6	1				17	21	3		2	1	52	79.2
56	*Psettodes belcheri*	2	3	2	1	2	1	1	2	1			3	18	204.6
57	*P. bennetti*			1										1	400.0
58	*Pseudotolithus senegalensis*							1						1	789.0
59	*Remora remora*		1											1	130.0
60	*Rhinobatos rhinobatos*	1	1	1		1					1	3	2	10	390.9

Table 2. (Contd.)

No.	Species	Months												Total	
		1	2	3	4	5	6	7	8	9	10	11	12	*n*	*TL*
61	*Rhizoprionodon acutus*					1		2						3	358.3
62	*Sardinella aurita*						1						2	3	83.3
63	*S. maderensis*	67	35	65	20	57	43	631	328	1453	54	650	86	3489	40.5
64	*Sarpa salpa*						1							1	148.0
65	*Scarus hoefleri*												1	1	146.0
66	*Sciaena umbra*								2					2	125.0
67	*Scomberomorus tritor*					2		2	3	3				10	90.6
68	*Serranus scriba*		1				2	1	5			13	8	30	101.3
69	*Smaris macrophtalmus*					2								2	107.0
70	*Solea senegalensis*	9	4	2	4	5	2	17	15	23		9	13	103	102.2
71	*S. vulgaris*				1	2		4					2	9	91.3
72	*Sparisoma rubipinne*			2										2	294.0
73	*Sparus aurata*		1	1	1	1	23		48					75	154.5
74	*S. caeruleostictus*								2					2	40.0
75	*Sphoeroides spengleri*	41	7	2	1		1	4	2	11		16		85	74.5
76	*Sphyraena sphyraena*								1			1		2	137.0
77	*Spicara spicara*		1											1	67.0
78	*Spondyliosoma cantharus*					7	4		1					12	11.6
79	*Stephanolepis hispidus*	3	2							6		15	14	40	72.6
80	*Syacium micrurum*		2				2						3	7	50.4
81	*Symphodus tinca*				17				16			13	1	47	66.2
82	*Synaptura lusitanica*	1				1	1		1	1			4	9	154.9
83	*Syngnathus* sp.									1				1	140.0
84	*Tilapia guineensis*	2	14				2			10			3	31	176.0
85	*Torpedo torpedo*		1									1		2	105.0
86	*Trachinotus goreensis*		9		2									11	105.2
87	*T. ovatus*	48	25			19	2	11	289	58		17	8	477	56.7
88	*T. teraia*				2							10		12	118.5
89	*Trachurus trachurus*												1	1	86.0
90	*Umbrina canariensis*			1	5	7	5	19	7	5		3	1	53	142.3
91	*Zanobatus schoenleinii*					1								1	496.0
	Total	2106	2051	933	1313	1128	1224	1204	3423	2946	181	2869	1444	20822	

Table 3. Degree of ichthyofauna similarity of different littoral types in the gulf Arguin (by Chekanovsky-Sorensen coefficient)

Littoral types	Species number	Littoral types					
		type 2	type 5	type 3	type 4	type 1	type 6
2	53		51.9	67.3	56.2	68.3	34.3
5	24	51.9		52.8	63.5	53.2	43.9
3	48	67.3	52.8		52.9	59.3	33.8
4	39	56.2	63.5	52.9		60.5	39.3
1	71	68.3	53.2	59.3	60.5		34.5
6	17	34.3	43.9	33.8	39.3	34.5	

2000–2004 were organized considering above mentioned shortcomings. The investigations showed that 91 fish species dwelled in littoral of the gulf. In each trip 19 fish species were always present: *C. chrysurus, D. punctatus, D. bellottii, D. sargus, E. melanopterus, L. mormyrus, L. dumerili, M. capurrii, S. maderensis, C. labrosus, D. rhonchus, G. decadactylus, P. perotaei, P. rogeri, P. belcheri, S. senegalensis, S. spengleri, T. ovatus, U. canariensis.* These species occurred in the catches for the most part of the year and they determined dynamic of fish size (Tables 1 and 2). Catch data allow distinguish two peaks of fish size: in August–November and January–February. The largest number of fish species was caught in February, June, August and December, the least in March (Fig. 3).

Most of fish species caught in littoral are typical for ichthyofauna of coastal shelf of Mauritania (Fischer et al., 1981; Megret, Ly, 1986; Froese, Parly, 2010). Two species, *Nicholsina usta* and *Tilapia guineensis*, are the exceptions which are encountered in coastal water of Mauritania only in the gulf Arguin. *N. usta* was found in the gulf Arguin for the first time in 1986 (Gushchin, Girardin, 2000). The species was described for coastal water from Senegal to Gabon by Randall (Randall, 1990). Specimens of various dimensions and different stages of maturity occurred in our catches. This fact enables us to suggest that separate, self reproducing population of this species dwells in the gulf. The second species, caught in March 1983 for the first time, was distinguished as *Sarotherodon melanoteron heudelotii.* Under this name the species was mentioned in the article of Sevrni-Reyssac and Forges (Sevrni-Reyssac, de Forges, 1985). Later doctor van den Audenaerde (Thys van den Audenaerde, personal communication), who our specimens had been handed to, distinguished them as *Tilapia guineensis.* Typical dwelling places of *T. guineensis* are the rivers and fresh water sea areas close to river estuaries from Senegal to Angola (Teugels, van den Audenaerde, 1992). In our case we observe self reproducing population of *T. guineensis* isolated from Senegal region with the open ocean. This population inhabits the zone with increased salinity (up to 40‰) in the south of the gulf Arguin.

Probably, number of fish species encountered the gulf Arguin can be replenished with the representatives of family Gobeiidae. Species composition of Gobeiidae and their size remain hardly investigated due to peculiarities of inhabitance in the rocks and thus impossibility to conduct catches in these places with sweep-net.

Ichthyofauna analysis of different littoral types by means of Chekanovsky-Sorensen coefficient (Table 3) showed sufficiently high degree of similarity. Background group of fish species are distinguished and the species *A. presbyter, C. labrosus, D. punctatus, D. bellottii, D. sargus, E. melanopterus, L. mormyrus, L. dumerili, M. capurrii, M. cephalus, P. perotaei, S. maderensis, S. senegalensis* are encountered in all types of littoral. All these species have high size. They are typical for ichthyofauna of the gulf and ensure mutual similarity. Considering littoral types, the most similarity possesses ichthyofauna of open coast in the south of the gulf (type 1), littorals of the channels (type 2) and the bays in the south of the gulf (type 3). Ichthyofauna of open coast in the north of the gulf (type 4) has much similarity with ichthyofauna of littoral in the bay Etoile. Thus we can divide ichthyofauna of the gulf in two groups: the northern group (the bay Levrie) under the influence of upwelling and the southern group (the rest of the gulf) under the influence of transformed water of the gulf. The most distinguishing features possesses ichthyofauna of open coast littoral (type 6) that differs from ichthyofauna of other littoral types in the gulf Arguin.

CONCLUSIONS

Littoral ichthyofauna of the gulf Arguin is represented with fish young (97.9–99.7% of catches) and includes 91 species from 78 genders and 41 families. 19 fish species from above mentioned number occurred everywhere in all littoral types during the most time of the year. Background group of littoral fish species are formed with these species. Seasonal dynamic of size is determined by limited number of species: *A. presbyter, C. labrosus, D. punctatus, D. bellottii, D. sargus, E. melanopterus, L. mormyrus, L. dumerili, M. capurrii, M. cephalus, P. perotaei, S. maderensis.* Two peaks of fish size are observed in

August–November (warm season) and January–February (cold season). The largest number of fish species was caught in February, June, August and December, the least in March.

The most distinguishing features of species composition are marked in ichthyofauna of the northern and the southern regions of the gulf and in ichthyofauna of open coast. Practically all fish species of the gulf are typical for coastal water of Morocco and Mauritania, and only two species do not encounter in surrounding water. These are *Nicholsina usta* and *Tilapia guineensis* which form separate, self reproducing populations in the southern part of the gulf Arguin.

The conducted investigations show that littoral of the gulf Arguin is the place for concentration of young fish which endure main cycle of development in the zone of littoral, use it for pasture and as a shelter. Taking into consideration its dimensions, the role of the gulf Arguin is unique in reproduction, biodiversity maintenance and existence of numerous fish species (including fishery species) of Northern Africa.

THANKS

We thank research workers of Mauritanian Institute for Oceanographic Research and Fisheries (IMROP) and the crew of SRV "Amrique" for their help in sampling material and express our thanks especially to the director of IMROP Mika Diop for possibility of conducting research works, doctor Thys van den Audenaerde (Royal Museum for Central Africa, Belgium) for determination of *T. guineensis* and doctor Balushkin A.V. (Zoological Institute of Russian Academy of Sciences) for precious notes.

REFERENCES

Alexeev, S., Ould El Mahfoudh, M., Bambaye, H., and Goutchine, A., Régime Hydrologique Saisonnier Dans le Banc d'Arguin Pour la Période de 2000 à 2001, in *5-éme Groupe de Travail IMROP sur L'évaluation des Stocks et des Pécheries Décembre 2002,* FAO-IMROP: Nouadhibou, 2002, 14 p.

Bernikov, R.G., Seasonal Variation of Temperature and Water Salinity in the Area of the Cape Blanc until Saint-Louis, in *Tr. AtlantNIRO: Rybopromyslovye raiony zapadnogo poberezh'ya Afriki* (Transactions of AtlantNIRO: Fishing Area of Western Coasts of Africa), 1969, issue 22, pp. 13–29.

Chlibanov, V., Ly, B., and Diabate, M., Résultates des Travaux de Echerches Effectués par Chalutages Dans ls Baie du Lévrier er à l'est du Banc d'Arguin en 1980–81, *Bull. Cent. Nat. Recher. Océanogr. et Péches, Nouadhibou*, 1982, vol. 10 (1), pp. 49–79.

FAO Species Identification Sheets for Fishery Purposes, Eastern Central Atlantic; Fishing Area 34, 47 (Part), Fischer, W., Bianchi, G., Scott ,W.B., Eds., Rome: FAO, 1981, vol. 1–7.

Fedoseev, A.F., Horizontal Geostrophic Circulation of Surface Waters on Atlantic Shelf in Africa, in *Tr. AtlantNIRO: Okeanologicheskie issledovaniya v Atlanticheskom okeane* (Transactions of AtlantNIRO: Oceanologic Studies in the Atlantic Ocean), 1976, issue 63, pp. 72–80.

FishBase. World Wide Web Electronic Publication, Froese, R. and Pauly, D., Eds., 2010. Version (05/2010). http://www.fishbase.org

Gushchin, A.V. and Zhirarden, M.O., About Finding of *Nicholsina usta* on the Banc d'Arguin, *Vopr. Ikhtiol.*, 2000, vol. 40, no. 1, pp. 103–107.

Jager, Z., The Distribution and Abundance of Young Fish in the Banc d'Arguin, Mauritania, *Hydrobiologia*, 1993, vol. 258, pp. 185–196.

Megreth, J. and Ly, B., *Les Poisons de Mer de Mauritanie,* CNROP.: Mauritanie, 1986, 213 p.

Pesenko, Yu.A., *Printsipy i metody kolichestvennogo analiza v faunisticheskikh issledovaniyakh* (Principles and Methods of Quantitative Analysis in Faunistic Studies), Moscow: Nauka, 1982, 284 p.

Randall, J.E., Scaridae, in *Check-List of the Fishes of the Eastern Atlantic*, Quéro J.C., et al., Eds., Portugal: JNICT, 1990, pp. 883–887.

Sevrni-Reyssac, J. and De Forges, B.R., Particularité de la Faune Ichtyologique Dans un Milieu Sursalé du Parc National du Banc d'Arguin (Mauritanie), *Océanogr. Trop.*, 1985, vol. 20 (1), pp. 85–90.

Teugels, G.G., Thys van den Audenaerde. Cichlidae, in *Faune des Poissons D'eaux Douces et Saumétres D'Afrique de l'Ouest. Faune Tropicale núm 28. Musée Royal de l'Afrique Centrale. Tervuren, Belgique*, Levéque, C., et al., Eds., Paris, 1992, pp. 714–779.