

DIVERSITY, HABITATS AND SEASONAL DISTRIBUTION OF FISH IN THREE PROTECTORATES OF SOUTHERN SINAI ON THE RED SEA, EGYPT

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التنوع البيئي والتوزيع الموسمي للأسماك في المحميات الطبيعية الثلاث - بجنوب سيناء، جنوب سيناء - البحر الأحمر - مصر

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يمثل هذا البحث - المحاولة الأولى - لدراسة التنوع البيئي والموسمي لأسماك المياه الساحلية في ١٣ قطاع من المحميات الثلاث رأس محمد - نبق - أبو جالوم بجنوب سيناء على البحر الأحمر في مصر والتي تمثل عدة بيئات مختلفة - وذلك في الفترة من سبتمبر ١٩٩٤ إلى يوليو ١٩٩٥ . وقد وُجد أن رأس محمد هي المنطقة الوحيدة في البحر الأحمر التي تمثل ثلاث بيئات مختلفة وهي البيئة الرملية، الصخرية والشعاب المرجانية، بينما تمثل كل من محمية نبق وأبو جالوم البيئة الرملية والصخرية والبيئة الصخرية والشعاب المرجانية على التوالي.

وقد أوضحت الدراسة أن هذه المحميات الثلاث تحتوي على ١٨٠ نوعاً من الأسماك تنتمي إلى ١٠٧ جنساً، ٥٥ عائلة، ٢٠ تحت رتبة، ١٥ رتبة وطائفتين. تضم محمية رأس محمد ١٧١ نوع من المجموع الكلي للأسماك (حوالي ٩٥% من الأسماك التي سجلت في المناطق الثلاث)، بينما يوجد في كل من أبو جالوم ونبق ٥١، ٤٦ نوع يمثلون حوالي ٢٨% و٢٦% من المجموع الكلي للأسماك، على التوالي.

ومن ناحية أخرى فقد أثبتت الدراسة أن محمية رأس محمد تحتوي على ١٩ عائلة من أنواع الأسماك ذات القيمة الاقتصادية العالية، بينما تحتوي كل من محمية نبق وأبو جالوم على أنواع تنتمي إلى ١٠ عائلات فقط لكل منهما، كما أثبتت الدراسة أيضاً أن التوزيع الموسمي للأسماك يختلف اختلافاً متبايناً بين معظم عائلات الأسماك، حيث سجلت أعلى نسبة خلال فصل الربيع (٦٩%)، وأدناها سجلت خلال فصل الخريف (١٩%)، بينما وجد أن ١٢ عائلة فقط تمثل العائلات الممتلئة في جميع فصول السنة وهي :

Belonidae, Holocentridae, Mugilidae, Mullidae, Labridae, Scaridae, Acanthuridae, Siganidae, Balistidae and Scorpionidae.

بينهم ٩ عائلات ذات قيمة اقتصادية.

أوضحت النتائج أن محمية رأس محمد - رغم مساحتها الصغيرة - تُعتبر واحدة من أغنى المناطق على الإطلاق في التنوع السمكي، ليس فقط على مستوى المحميات الأخرى (نبق - أبو جالوم) ولكن بالنسبة لمناطق عديدة أخرى مماثلة لها في مصر.

Key Words : Fish diversity, Habitats, Seasonal distribution, Southern Sinai, Protectorates, Red Sea, Egypt.

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ABSTRACT

The present investigation is an attempt to study the diversity, habitats and seasonal distribution of fish of inshore water at thirteen sites of the three Protectorates (Ras Muhammed, Nabq and Abou Galoum) of Southern Sinai on the Red Sea in Egypt.

The study revealed that Ras Muhammed embodies three habitats: sandy shore-rocky flat – coral reefs whereas the other two areas, Nabq and Abou Galoum are formed of sandy shore – rocky flat and rocky flat – coral reefs, respectively. The study revealed that 180 fish species belonging to 107 genera, 55 families, 20 suborders, 15 orders and 2 classes are represented in the three sites. Among these 171 fish species (about 95% of the total recorded species) were recorded only in Ras Muhammed, whereas 51 and 46 fish species (about 28% and 26% of the total recorded species) recorded from Abou Galoum and Nabq, respectively. Nineteen families which are economically important were recorded in Ras Muhammed, whereas Nabq and Abou Galoum had 10 families, each. The seasonal distribution of fish species indicated that 12 families are available during all seasons of the year (Serranidae, Labridae, Scaridae, Acanthuridae, Siganidae and Balistidae), 9 of these families included fish species of economic importance. This shows that Ras Muhammed is of the richest in fish diversity compared to the other sites studied.

INTRODUCTION

The Red Sea is a flooded valley that can be described as a young ocean. It is considered rich in fish species (about 800 species; 17% are endemic) [1].

Many studies on the oceanography and biological features of the Red Sea were undertaken [2, 3, 4, 5, 6]. The fishes of the Red Sea were amongst the earliest to be studied and named in a modern scientific fashion. A large number of species were described [7, 8, 9]. Attempts have also been made to give a comprehensive account of the identification and occurrence of the Red Sea fish species [10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22]. The coral reef fishes of the Red Sea were extensively studied. Gohar and Mazhar [16] and Comapagno [26] reported a detailed account of the shark fauna of the Red Sea. Studies were carried out on the fish mangals of Southern Sinai, in the Gulf of Aqaba [1, 27, 28, 29].

Knowledge on the fish fauna of Southern Sinai Protectorates is incomplete. Ras Muhammed has developed as an attractive diving site due to its biological richness. Thus a thoroughly study of its fauna is necessary. The present investigation aims to study the fish diversity, habitats, their seasonal distribution and status, as well as their economic importance. Data from Ras Muhammed Protectorate is compared to Nabq and Abu Galoum Protectorates, of the Southern Sinai of Egypt.

MATERIAL AND METHODS

The Protectorates of Southern Sinai: Ras Muhammed, Nabq and Abou Galoum were seasonally visited between September 1994 to July 1995. Thirteen sites were selected for fish collection, representing the major types of habitats (Figs. 1-3). These sites were:

1-Ras Muhammed: Yollanda Beach, Aqaba Beach, Marsa Burayka, Eel Garden sites and the Old Key which represents the Gulf of the Suez side.

2-Nabq from south to north (in the Gulf of Aqaba): El-Gharqana, Marsa Abou Zabad, El-Ruwaysia, El-Monqata and Ras El-Tantor sites.

3-Abu Galoum (in the Gulf of Aqaba): Ras Abou Galoum, Al-Qardoud and the Rangers Station sites.

The collection sites include 3 major habitats: sandy shores, rocky flat and coral reef:

Sandy Shores are found along the eastern coast of the Gulf of Suez at Ras Muhammed and in the lagoons surrounded by mangroves at Ras Muhammed and Nabq Protected Areas (Figs. 1 and 2). The bottom of sandy shores is about 1m depth, and extends more or less, for about 600m seaward. Water movements over this flat affect sedimentation where coarser sediments are deposited in areas with greater movement; whereas, finer particles remain suspended and settle down in the quiet edges. This sandy flat may be interrupted in some places by patches of seaweeds and sea grass of the species, *Halophila stipulacea* [6].

Rocky flats are found in Yollanda beach at Ras Muhammed, Ras El-Tantour at Nabq and Ras Abou Galoum (Figs. 1-3). The bottom is formed of flat rock covered by seaweeds. Rocky flats are formed of dead corals exposed to sun through the low water level during low tide and dragged by water current movement to form large flat areas interrupted in many places by sand depressions. There are many scattered groups of boulders and small rocks in some places. Such type of shore is suitable for many types of vegetation especially sea grasses such as: *Thalassodendron ciliatum*, *Halophila ovalis* and *Halodule uninervis* [6]. Such dense vegetation offers suitable anchorage for many organisms to inhabit and/or to visit rocky areas for food and shelter.

Coral reefs are found in Yollanda beach, Aqaba beach and Marsa Burayka at Ras Muhammed and Ras Abou Galoum Protected Areas (Figs 1 and 3). A fringing reef environment on the Aqaba Gulf consists mainly of shallow reef

flats which extend in some places up to 50m., as encountered in Abou Galoum. Such reef flat is called "reef table" as it extends seaward sloping gently towards the open sea. It is characterized by rocks, boulders and dead corals and sometimes embodies caves and crevices connected to the open water. These caves and crevices provide ideal shelter for fauna and flora. The rough surface of this reef permits the growth of seaweeds and sea grasses. Such as, *Thalassodendron ciliatum*, *Halophila stipulacea*, *H ovalis* and *Halodule uninervis* [6]. Which are considered the main food for many invertebrate species and fishes. The reef flat extends into a reef crest, with small growths of corals facing the waves and setting the tip of the reef wall which stands vertically to depths reaching 70m in Ras Muhammed area. The reef wall in some areas slopes gently towards the open water. The bottom in front of this reef wall is formed mainly of sand interrupted with coral patches which may represent the shelter and feeding grounds for many species of marine organisms.

Fish specimens were collected from shallow waters and coral reef. Gill nets were used to collect the coral reef fishes. Small demersal fishes of sandy shores were collected by a seine net (1 mm mesh size). Subtidal fishes were collected by lines and from the commercial catch. Underwater observations of fishes and habitat description were recorded using snorkelling. Underwater photographs were taken using 35mm underwater camera. Many of the collected fresh samples were photographed, and some were immediately preserved in 10% formalin-sea water. Some fishes were kept in an ice tank and taken to the Egyptian Environment Affairs Agency (EEAA) Research Laboratory, in Sharm El-Sheikh, where the coloured fishes were photographed and preserved either in 70% alcohol or/and diluted Bouin's fixative (1:1) or in 12% formalin with phenol and glycerol (8% of each) to preserve their colour. They were then transported to the Department of Zoology, Faculty of Science, Ain Shams University in Cairo, for identification.

At the laboratory, fish specimens were measured and identified according to the morphometric characters and meristic counts of each species using the standard texts [30, 31, 32, 33]. Complete lists of the recorded fish species were prepared.

RESULTS

Fish diversity

The total number of fish species, recorded from the Red Sea at the three Protectorates of Southern Sinai, was 180 species; belonging to 107 genera, 55 families, 20 suborders, 15 orders and 2 classes (Tables 1-3). Among these species, the bony fishes are the most abundant species (174 species representing 97%) whereas, the cartilaginous fishes are only 6 species (representing 3%).

Order Perciformes was highly represented in these areas. It included 135 species belonging to 29 families and 5 suborders, whereas the remaining fourteen orders included 15 suborders and 25 families. The latter families included only 45 species. Moreover, families Serranidae, Labridae, Scaridae, Acanthuridae, Siganidae and Balastidae were widely distributed in the three protected areas (Tables 2 and 3). From 55 recorded families, Serranidae had the maximum number of species (18 species), followed by Pomacentridae and Labridae (13 and 12 species) respectively, then Chaetodontidae (10 species) (Table 3).

The recorded data showed that Ras Muhammed area has the highest number of fish species; counting 171 species (representing 95% of the total recorded species). 51 species were collected from Abou Galoum (representing 28%), only 46 species (representing 26%) of the total species were recorded from Nabq (Table 3).

The most abundant fishes in Ras Muhammed belong to 13 families: Holocentridae, Chaetodontidae, Lutjanidae, Labridae, Lethrinidae, Mullidae, Pomacentridae, Scaridae, Serranidae, Sparidae, Acanthuridae, Siganidae and Balistidae. Moreover, Ras Muhammed is dominated by the coral reef fishes such as morays (Muraenidae), barracudas (Sphyraenidae), butterfly fishes (Chaetodontidae), goatfishes (Mullidae), damselfishes (Pomacentridae), snappers (Lutjanidae), damselfishes (Pomacentridae), snappers (Lutjanidae), emperors (Lethrinidae), parrotfishes (Scaridae), groupers (Serranidae), sea-brems (Sparidae) and surgeonfishes (Acanthuridae). Fishes of the sandy shore were restricted to this habitat, and dominated by the tooth carp, *Aphanius dispar* (Cyprinodontidae) (Table 3).

Nineteen families including economically important species were represented in Ras Muhammed. Ten families, Syndontidae, Mugilidae (*Mugil cephalus*), Lutjanidae, Haemulidae, Lethrinidae, Mullidae, Scaridae, Serranidae,

Sparidae and Acanthuridae are of high economic importance. Three families, Labridae, Pomacentridae and Siganidae have a moderate economic importance. Six families have a minor economic importance. These are Hemiramphidae, Holocentridae, Atherinidae, Kyphosidae, Soleidae and Bothidae (Table 3).

Fishes of Nabq are mainly represented by sand and mangrove types fishes which are dominated by *Aphanius dispar* (Cyprinodontidae), *Crenimugil crenilabis* and *Mugil cephalus* (Mugilidae). The latter species is abundant in the mangroves. *Acanthopagrus bifasciatus* and *Rhabdosargus haffara* (Sparidae), *Gnatholepis anjerensis* and *Istigobius ornatus* (Gobiidae), and juveniles of some fishes such as *Bothus pantherinus*, (Bothidae) and *Arothron hispidus* (Tetraodontidae) were encountered. The most common coral reef fishes in Nabq area belong to Muraenidae (*Siderea picta*), Acanthuridae and Scaridae (*Scarus cyanescens*, *S. frenatus*, *S. genazonatus*, *S. ghobban* and *S. gibbus*).

On the other hand, fishes inhabiting rocky bottoms are dominated by *Bodianus axillaris*, *Cheilinus diagraphmus* and *Thalassoma purpureum* (Labridae) (Table 3).

The abundant fishes in Nabq area belonged to 5 families: Cyprinodontidae, Labridae (*Bodianus axillaris*, *Cheilinus diagraphmus* and *Thalassoma purpureum*) Monodactylidae, Scaridae and Siganidae (*Siganus luridus* and *S. rivulatus*) (Table 3).

Five families; Acanthuridae, Mugilidae, Scaridae, Serranidae (*Anthias squamipinnis*, *A. teaniatus* and *Cephalopholis argus*) and Sparidae (*Acanthopagrus bifasciatus*, *Diplodus noct* and *Rhabdosargus haffara*, are of high economic importance. Families Labridae and Siganidae include species with moderate economic importance. On the other hand, three families include species of minor economic importance such as: Kyphosidae (*Kyphosus vaigiensis*), Monodactylidae and Bothidae.

The common fish species recorded in Abou Galoum are coral reef fishes such as groupers, *Anthias squamipinnis*, *A. teaniatus*, *Cephalopholis miniata*, *Epinephelus chlorostigma*, *E. microdon*, *E. tauvina*, *Plectropomus truncatus* (Serranidae); butterfly fishes (Chaetodontidae), parrotfishes, *Scarus frenatus*, *S. genazonatus* and *S. ghobban* (Scaridae) and surgeonfishes (Acanthuridae).

Fish species belonging to 7 families: Chaetodontidae, Labridae (*Bodianus axillaris* and *Thalassoma purpureum*),

Mullidae (*Mulloides flavolineatus*, *Parupeus cinnabarinus* and *P. cyclostomus*), Scaridae, Serranidae, Siganidae and Acanthuridae, was abundant (Table 3).

Fishes of high economic importance were represented in Abou Galoum by species belonging to Lutjanidae (*Lutjanus bohar*), Lethrinidae (*Lithrinus lentijan*, *L. mahsena*, *L. elongatus* and *Monotaxis grandoculis*), Mullidae, Scaridae, Serranidae and Acanthuridae. Whereas, families Labridae and Siganidae included species with a moderate economic importance. Families Hemiramphidae, Holocentridae and Mondactylidae had species with minor economic importance (Table 3).

Fish habitats

Some fish species were restricted to one type of habitat and others were collected from more than one type of habitat. Fishes inhabiting coral reefs (Table 3), were the most dominant (about 71%), followed by those of rocky flat habitat (about 24%), then the sandy shore fishes (about 21%). Whereas, the lowest number of species was recorded from the mangrove habitat (about 12%).

The coral reef habitat was the richest as far as fish diversity is concerned, (126 species). The common species in this habitat belonged to the families: Carcharhinidae, Muraenidae, Belonidae, Holocentridae, Sphyraenidae, Chaetodontidae, Lutjanidae, Lethrinidae, Pomacentridae, Scaridae, Serranidae, Acanthuridae, Tetraodontidae and Scorpaenidae. However, other species such as labrids, siganids, carangids and haemulids were frequently seen in this habitat.

25 species were represented in the sandt shore; the most common were the cyprinodonts, *Aphanius dispar*; the gobies, *Gnatholepis anjerensis* and *istigobius ornatus*; the mullet, *Crenimugil crenilabis*, in addition to the juveniles of some coral reef fish species such as *Arothron diadematus*, *A. hispidus* and *A. stellatus* (Tetraodontidae).

Fish species dwelling rocky habitat are 24 species belonging to the families: Muraenidae, Mugilidae, Kyphosidae, Labridae, Pomacentridae, Sparidae, Acanthuridae and Tetraodontidae.

Trophic levels

Carnivores, such as sharks, groupers, snappers, carangids and barracudas are the most abundant on reefs. Herbivore and coral grazers were the next largest group of fishes. They

belonged to Acanthuridae, Scaridae, Pomacentridae, Chaetodontidae, Ostraciidae and Tetraodontidae. Some species such as mullets are detritus. Only a few fishes mainly small, schooling fishes such as Atherinidae, were zooplankton feeders.

Seasonal distribution

In summer (June, July, August) the recorded fishes were 52 species belonging to 39 genera, 23 families 7 suborders and 6 orders. Only 34 species were recorded during autumn (September, October, November) belonging to 29 genera, 22 families, 9 suborders and 8 orders (Table 4). In winter (December, January, February) the recorded species were 76, belonging to 56 genera, 32 families, 10 suborders and 11 orders. In spring (March, April May) 125 species were recorded, belonging to 77 genera, 45 families, 20 suborders and 14 orders. The highest number of species was recorded in spring followed by those in winter and then in summer. Whereas autumn had the lowest record. 11 families were recorded in all seasons; these were Belonidae, Holocentridae, Mugilidae, Chaetodontidae, Mullidae, Scaridae, Serranidae, Sparidae, Siganidae, Acanthuridae and Scorpaenidae. Species of economic importance belong to seven of these families (Table 3).

DISCUSSION

The ichthyofauna of the Egyptian Red Sea is represented by a number of species, the majority are of Indo-Pacific origin. Few species seem to have migrated from the Mediterranean Sea through Suez Canal [5, 11]. Fouda [1] showed that the richness and diversity of fish species in the Red Sea in general and in particular the Gulf of both Aqaba and Suez may be attributed to the diverse coastal habitats distributed along more than 2000 km of Red Sea coast. Edwards and Head [34] reported that nutrients and well oxygenation, are conditions that attain the Aqaba Gulf its famous biodiversity especially in fish diversity. In the present investigation, the high diversity of fish species is not only attributed to the great variety of the nutrients and oxygenation but also to the great diversity in the habitats formed of sandy shores, rocky flats and especially the coral. Coral reefs include corals, areas of sand, various caves and crevices, areas of algae and dead corals resembling those of rocky habitat, as well as shallow and deep water zones progressing across the reef. All these

factors enrich the fish diversity in these areas.

The recent report of NBU [5] on fish fauna of the Red Sea from Egyptian waters mentioned that class Chondrichthyes includes one subclass which contains 13 families, 23 genera and 39 species. The number of shark species is 26 while rays and other batoids include 13 species. One family Carcharhinidae comprises the highest number of species, i.e. 18 species of the most specialized modern sharks of today. Compagno [26] pointed out that The shark fauna of the Red Sea is remarkably depauperate, with 3 orders, 10 families and only 29 species. In the present investigation, the cartilaginous fish had representative in the three protected areas belonging to, 2 orders, 4 families, 5 genera and 6 species. The family Rhinobatidae (one species) was encountered in the three Protectorates. Three species of the family Charcharhinidae; *Carcharhinus melanopterus*, *C. plumbeus* and *Triaenodon obesus*, were identified. Gohar and Mazhar [16] and Compagno [26] found that the whitetip reef shark, *Triaenodon obesus*, preferred to live in the coral reefs. Whereas, the blacktip reef shark, *C. melanopterus* was common in shallow waters of coral reefs. This was also evident in Ras Muhammed and Abou Galoum. Furthermore, the sand shark, *C. plumbeus* which is recently recorded in the Northern Red Sea, is usually found near the bottoms in the sandy and muddy bays [26]. In the present study, this species was collected in Ras Muhammed, dwelling in front of the reef wall.

There are four groups of major economic importance including species of groupers, sea-breams and tunas, and other of minor economic importance of species belonging to 22 families [5]. The results of the present investigation indicate that the three protected areas are rich in fish species (50 fish species) of highly economic importance belonging to families, such as Mugilidae, Haemulidae, Lethrinidae, Lutjanidae, Mullidae, Scaridae and Serranidae, Whereas, the moderate and minor economically important species were 42 belonging to 10 families.

In the present investigation 18 species belonging to 5 genera of family Serranidae were recorded in Ras Muhammed Protectorate, among them 7 species were from Abou Galoum, and 3 species from Nabq. Ghorab et al. [20] studied the family Serranidae in Gulf of Suez and El-Ghardaqa, and identified 16 species belonging to 3 genera.

Fishelson [3] described several faunal communities

including fishes in shallow sublittoral areas in the Red Sea. Among them was *Istiblennius rivulatus* and *Salaria fasciatus* collected from the intertidal rocks and mangrove areas. The latter species was collected by the author from reef flat of heavy algal cover, in Nabq. *Conger cinereus* was recorded in the sandy bays of the Red Sea and among the mangroves [3]. In the present study this species was found in caves in rocky shores in Ras Muhammed and Nabq. However [29] showed that this species was not found in the mangrove areas of both Ras Muhammed and Nabq.

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Table 1 : Number of species genera, families, suborders and orders recorded in different localities.

Locality	Species	Genera	Families	Suborders	Orders
Ras Muhammed	171	101	51	18	15
Nabq	46	34	22	12	9
Abou-Galoum	51	31	18	7	6

Table 2 : Occurrence of species belonging to classes, orders, suborders and families in three Protectorates , in South Sinai.
RM : Ras Muhammed , N : Nabq , AG : Abou Galoum

I - CLASS : CHONDRICHTHYES					
Order	Suborder	Family	Localities		
			RM	N	AG
Squaliformes.		Charcharhinidae	*		*
Rajiformes		Dasyatidae	*		
		Rhinobatidae	*		
Torpediniformes		Torpedinidae	*		
II - CLASS : OSTEICHTHYES					
Order	Suborder	Family	Localities		
			RM	N	AG
Anguilliformes	Anguilloidei	Muraenidae	*	*	
		Congridae	*	*	
Myctophiformes		Synodontidae	*		
Beloniformes.		Belonidae		*	*
		Hemiramphidae	*		*
Cyprinodontiformes	Cyprinodontoidei	Cyprinodontidae	*	*	
Gasterosteiformes	Aulostomidai	Fistulariidae	*		
	Syngnathoidei	Syngnathidae		*	
Beryciformes	Berycoidei	Holocentridae	*		*
Mugiliformes	Mugiloidei	Mugilidae	*	*	
	Sphyraenoidei	Sphyraenidae	*		
	Atherinoidei	Atherinidae	*		

Perciformes	Percoidei	Theraponidae	*		
		Serranidae	*	*	*
		Grammistidae	*		*
		Priacanthidae	*		
		Carangidae	*		*
		Lutjanidae	*		*
		Gerridae	*	*	
		Sparidae	*	*	
		Pempheridae	*		
		Ephippidae	*		
		Kyphosidae	*	*	
		Mullidae	*		*
		Monodactylidae		*	*
		Chaetodontidae	*		*
		Pomacentridae	*		
		Cirrhitidae	*		
		Labridae	*	*	*
		Scaridae	*	*	*
		Pomacanthidae	*		
		Caesonidae	*		
		Haemulidae	*		
Lethrinidae	*		*		
Pseudochromatidae	*	*			
Pleisopidae	*				
Psettodidae	*				
	Echeneioidei	Echeneidae	*		
	Blennioidei	Blenniidae		*	
	Gobioidei	Gobiidae	*	*	
	Acanthuroidei	Acanthuridae	*	*	*
		Siganidae	*	*	*
Tetraodontiformes	Balistoidei	Balistidae	*	*	*
		Ostraciidae	*		
	Tetraodontoidei	Diodontidae	*		
		Tetraodontidae	*	*	
Pleuronectiformes	Pleuronectoidei	Bothidae	*	*	
	Soleoidei	Soleidae	*		
Scorpaeniformes	Scorpaenoidei	Scorpaenidae	*	*	
	Platycephaloidei	Platycephalidae	*		
Lophiiformes	Batrachoidei	Batrachoididae	*		*

Table 3 : List of families, species, habitats, seasonal distribution and status (St) of fishes inhabiting the three Protectorates of South Sinai .

(*) : Families with species of minor economic importance.

(*) : Families with species of moderate economic importance.

(**): Families with species of highly economic importance.

(+) : rare. (++) : frequent. (+++) : common. (++++): very common

(R.M) : Ras Muhammed (N): Nabq (AG): Abou Galoum

Family / Species	Habitats	L (cm)	Localities			Seasons				St
			RM	N	AG	S	A	W	S	
Carcharhinidae										
<i>Carcharhinus melanopterus</i>	along edge of reef	70	*		*		*	*	*	+++
<i>C. plumbeus</i>	subtidal water in front of reef wall	90	*					*		++
<i>Triaenodon obesus</i>	reef dwelling	83	*					*		++
Dasyatidae										
<i>Taeniura lymna</i>	hides in sand patches	57	*				*		*	++
Rhinobatidae										
<i>Rhinobatus djidensis</i>	deep water	43	*	*	*				*	+
Torpedinidae										
<i>Torpedo marmorata</i>	sluggish buried in sand & mud	50	*					*		+
Muraenidae										
<i>Echidna nebulosa</i>	shallow water in crevices of reefs	80	*					*		+
<i>Gymnothorax flavimarginatus</i>	crevices caves of corals	91	*	*				*		+
<i>G. javanicus</i>	crevices in reefs & rocks	96	*						*	++
<i>Siderea griesea</i>	crevices in reefs, rocks & corals	52	*	*				*		++
<i>S. picta</i>	shallow water in rocky shore	90	*					*	*	+++
Congridae										
<i>Conger cinereus</i>	caves in rocky shores	15 2	*	*				*		++
***Synodontidae										
<i>Saurida undosquamis</i>	on muddy bottom	45	*						*	++
<i>Synodus variegatus</i>	sandy bottom in deep water	25	*					*		++
Belonidae										
<i>Tylosurus choram</i>	on flats	97		*	*	*	*	*	*	+++
*Hemiramphidae										
<i>Hemiramphus far</i>	school fish in shallow water	67	*			*		*	*	+++
<i>Hyporhamphus gambarur</i>	school fish in shallow water	30	*		*			*		++
Cyprinodontidae										
<i>Aphanius dispar</i>	sandy shores mangroves	8	*	*					*	+++
Fistularidae										
<i>Fistularia commersonii</i>	around reefs & on grass beds	62	*						*	+++
Syngnathidae										
<i>Trachyrhamphus bicoarctatus</i>	on algal or seagrass bottoms	35		*					*	++
*Holocentridae										
<i>Adioryx diadema</i>	shallow dead reef areas	16	*		*				*	+++
<i>Myripristis murdjan</i>	shallow dead reef areas	30	*			*		*	*	+++
<i>Neoniphon sammara</i>	coral reefs & sandy bottoms	28	*			*	*	*	*	++
<i>Sargocentron rubrum</i>	shallow dead reef areas	33	*			*				++
<i>S. spiniferum</i>	coral reef & rocks	45	*					*		++
***Mugilidae										
<i>Crenimugil crenilabis</i>	small schools over sea bed, between roots of mangroves	40		*			*	*	*	+++
<i>Mugil cephalus</i>	between roots of mangroves	61	*	*		*	*			+++

Ephippidae <i>Platax orbicularis</i>	coral reef	40	*				*			++
*Kyphosidae <i>Kyphosus cinerascens</i>	shallow water in rocks or on reef	76	*					*	*	++
<i>K. vaigiensis</i>	rocky habitats & coral reef	60	*	*		*		*	*	+++
***Mullidae <i>Mulloides flavolineatus</i>	coastal water & near coral reefs	40	*		*		*			++
<i>M. vanicolensis</i>	sandy & muddy bottoms	38	*			*	*		*	+++
<i>Parupeneus cinnabarinus</i>	silty sand bottom or seagrass	30	*		*			*		+
<i>P. cyclostomus</i>	coral reefs	50	*		*			*	*	++++
<i>P. forsskali</i>	sandy bottoms between corals	28	*						*	++
<i>P. macronema</i>	muddy -sand bottoms	30	*			*				+
<i>P. rubescens</i>	over silty sand bottoms	30	*				*			+
*Monodactylidae <i>Monodactylus argenteus</i>	schools over silty reefs	25		*	*	*		*		++
Chaetodontidae <i>Chaetodon auriga</i>	coral reefs	23	*		*					+++
<i>C. austriacus</i>	coral reefs	14	*		*					+++
<i>C. fasciatus</i>	coral reefs	22	*		*	*	*	*	*	+++
<i>C. lineolatus</i>	coral reefs	30	*		*				*	++
<i>C. melannotus</i>	coral reefs	15	*		*	*			*	++
<i>C. paucifasciatus</i>	coral reefs	14	*		*				*	++
<i>C. semilarvatus</i>	coral reefs	23	*		*				*	++
<i>Heniochus diphreutes</i>	shallow water	25	*		*				*	++
<i>H. intermedius</i>	coral reefs	20	*		*				*	+++
<i>Megaprotodon trifascialis</i>	coral reefs	17	*						*	+++
**Pomacentridae <i>Abudefduf saxatilis</i>	coral reefs & sandy areas	23	*			*	*		*	+++
<i>A. sexfasciatus</i>	coral reefs & sandy areas	19	*						*	+++
<i>A. sordidus</i>	exposed rocky shore	22	*						*	++
<i>Amphiprion bicinctus</i>	shallow water in anemones	11	*						*	+++
<i>Amblyglyphidodon flavilatus</i>	branching corals	9	*						*	+++
<i>Chromis dimidiata</i>	shallow water, over reef heads	9	*						*	+
<i>Dascyllus aruanus</i>	branching corals	8	*						*	++
<i>D. trimaculatus</i>	around coral reefs	14	*						*	+++
<i>Paraglyphidodon melas</i>	coral reefs	18	*					*	*	++
<i>Plectroglyphidodon leucozona</i>	reef flat	12	*			*				++
<i>Pomacentrus albicaudatus</i>	around coral heads	6	*						*	+++
<i>P. aquilus</i>	branching corals & coral reefs	10	*					*		++
<i>P. sulfureus</i>	coral reefs	10	*						*	+++
Cirrhitidae <i>Oxycirrhites typus</i>	on black corals	13	*					*		+
<i>Paracirrhites forsteri</i>	between corals & rocks	23	*			*				++
**Labridae <i>Anampsis caeruleopunctatus</i>	on rocky bottoms	42	*			*			*	+
<i>Bodianus axillaris</i>	on rocky bottoms	21	*	*	*	*			*	++
<i>B. anthioides</i>	in caves of rocks and coral	20	*						*	++
<i>Cheilinus lunulatus</i>	seagrass bed, coral reef, rocky bottom	50	*					*	*	++
<i>C. digrammus</i>	coral reef & rocky habitats	30	*	*		*				++
<i>Coris aygula</i>	rocks & corals	60	*			*				++
<i>Gomphosus caeruleus</i>	seagrass & between corals	26	*					*		+
<i>Halichoeres hortulanus</i>	coral reefs	27	*							++
<i>Hologymnosus annulatus</i>	coral reefs	40	*			*				++
<i>Labroides dimidiatus</i>	reefs & tidal pools	11	*						*	++
<i>Thalassoma klunzingeri</i>	reefs & tidal pools	20	*			*		*	*	+++
<i>T. purpurium</i>	rocky shore	43	*	*	*	*		*	*	+++

***Scaridae										
<i>Hipposcarus harid</i>	sandy areas near coral reefs	75	*			*	*		*	+++
<i>Scarus cyanescens</i>	coral reefs	50	*	*					*	+
<i>S. frenatus</i>	around coral reefs	47		*	*	*			*	++
<i>S. ferrugineus</i>	coral reefs	41	*						*	++
<i>S. genazonatus</i>	coral reefs	31	*	*	*		*			+
<i>S. ghobban</i>	around coral reefs	64	*	*	*	*		*	*	+++
<i>S. gibbus</i>	around coral reefs	70	*	*					*	++
<i>S. psittacus</i>	lagoons, creeks & coral reefs	30	*			*	*		*	+++
<i>S. russelii</i>	shallow water	30	*					*		+
Pomacanthidae										
<i>Genicanthus caudovittatus</i>	deep water in coral reefs	25	*						*	++
<i>Pomacanthus imperator</i>	outer coral reefs	40	*						*	++
<i>P. maculosus</i>	coral reefs	50	*						*	+
<i>Pygoplites diacanthus</i>	coral reefs	25	*						*	++
Caesionidae										
<i>Caesio lunaris</i>	schools around coral reefs	30	*						*	+++
<i>C. striatus</i>	schools around coral reefs	18	*						*	+++
<i>C. suevicus</i>	schools around coral reefs	25	*						*	+++
***Haemulidae										
<i>Plectorhynchus gaterinus</i>	edges of reefs & sandy bays	41	*			*		*	*	++
***Lethrinidae										
<i>Lithrinus crocineus</i>	deep coral reef habitats	40	*						*	+
<i>L. lentjan</i>	coral reefs	50	*		*			*	*	+++
<i>L. mahsena</i>	coral reefs	65	*		*			*	*	+++
<i>L. mahsenoides</i>	coral reefs	42	*			*		*	*	++++
<i>L. nebulosus</i>	coral reefs & in sandy areas	87	*			*		*	*	+++
<i>L. xanthochilus</i>	around coral reefs	60	*						*	++
<i>L. elongatus</i>	coral reefs	82	*		*				*	+++
<i>Monotaxis grandoculis</i>	edges of reefs close to open water	76	*		*	*		*	*	+++
Pseudochromatidae										
<i>Pseudochromis fridmani</i>	vertical rocks	6.3	*	*					*	+++
Plesiopidae										
<i>Callopleysiops altivelis</i>	holes in reefs	16	*					*		+
Psettodidae										
<i>Psettodes arumei</i>	sandy bottom or seagrass	62	*						*	+
Echeneidae										
<i>Echeneis naucrates</i>	coral reef attached to hosts	70	*						*	+
Blenniidae										
<i>Istiblennius andamannensis</i>	reef flat	15		*					*	+++
<i>Salarias fasciatus</i>	reef flat of heavy algal cover	14		*					*	+++
Gobiidae										
<i>Gnatholepis anjerensis</i>	sandy bottoms & mangroves	8	*	*					*	+++
<i>Istigobius ornatus</i>	sandy bottoms	10	*	*					*	++
<i>Cryptocentrus sp.</i>	cracks of RM in autumn only	8	*				*			+
***Acanthuridae										
<i>Acanthurus nigricans</i>	around reef & rocky areas	40	*	*	*				*	++++
<i>A. nigrofuscus</i>	around reefs	14	*	*	*	*	*	*	*	+++
<i>A. Sohal</i>	in vicinity of rocks & reefs	27	*	*	*	*	*	*	*	+++
<i>Ctenochaetus striatus</i>	around coral reef	28	*	*	*				*	+++
<i>Naso lituratus</i>	small schools above sea bed	41	*	*	*				*	+++
<i>N. unicornis</i>	shallow water	70	*	*	*			*	*	++
<i>Zebrasoma veliferum</i>	close to reefs on reef wall	40	*	*	*	*	*	*	*	+++

Sphyraenidae										
<i>Sphyraena barracuda</i>	shallow water on sandy bottoms	96	*			*			*	+++
<i>S. forsteri</i>	on & around coral reefs	60	*				*			++
*Atherinidae										
<i>Atherinomorus lacunosus</i>	schools in sandy areas	13	*						*	+++
Theraponidae										
<i>Terapon jerbua</i>	inshore water	30	*			*	*			++
***Serranidae										
<i>Anthias squamipinnis</i>	coral areas	15	*	*	*			*	*	++++
<i>A. teaniatus</i>	coral areas	18	*	*	*			*	*	++
<i>Cephalopholis argus</i>	on dead corals	50	*	*		*	*	*	*	+++
<i>C. hemistiktos</i>	coral reefs	25	*			*		*	*	+++
<i>C. miniata</i>	coral reefs	40	*		*	*		*	*	+++
<i>C. oligosticta</i>	on dead reefs	27	*			*		*	*	++
<i>C. rogae</i>	caves of reefs	60	*			*		*	*	+++
<i>C. sexmaculata</i>	caves of reefs	50	*					*	*	++
<i>Epinephelus areolatus</i>	in turbid water in grass beds or silty sand bottoms	45	*				*		*	+++
<i>E. chlorostigma</i>	coral reefs in deep water	75	*		*			*	*	++
<i>E. fasciatus</i>	shallow water	35	*			*		*	*	++++
<i>E. fuscoguttatus</i>	coral reefs in deep water	90	*					*	*	+++
<i>E. hexagonatus</i>	coral reefs & lagoons	45	*			*				++
<i>E. microdon</i>	coral reefs	90	*		*	*		*	*	+++
<i>E. summana</i>	on reefs in lagoons	52	*					*	*	++
<i>E. tauvina</i>	coral reefs & shallow water	70	*		*	*	*	*	*	++++
<i>Plectropomus truncatus</i>	coral reefs	52	*		*			*	*	++
<i>Variola louti</i>	deep coral reefs	81	*			*		*	*	+++
Grammistidae										
<i>Grammistes sexlineatus</i>	corals & crevices of rocks	28	*		*			*		+
Priacanthidae										
<i>Priacanthus hamrur</i>	near coral reefs	40	*					*	*	++
<i>P. orentus</i>	coral reefs	40	*						*	+
Carangidae										
<i>Carangoides bajad</i>	small groups in coral reefs	53	*				*			++
<i>C. chrysophrys</i>	coral reef close to open water	41	*		*			*		++
***Lutjanidae										
<i>Lutjanus bohar</i>	exposed deep outer reefs	92	*		*				*	++
<i>L. ehrenbergi</i>	mangrove-shallow bays with grass	40	*				*	*	*	+++
<i>L. fulviflammus</i>	sandy bottoms	30	*						*	+++
<i>L. kasmira</i>	deep water between rocks	34	*						*	++
Gerreidae										
<i>Gerres acinaces</i>	sandy bays and reef areas	38	*			*				++
<i>G. oyena</i>	sandy bottoms	25	*	*			*		*	+++
***Sparidae										
<i>Acanthopagrus bifasciatus</i>	sandy bottoms, around coral reefs	50	*	*		*	*	*	*	+++
<i>Argyrops spinifer</i>	between rocks & coral reefs	65	*					*	*	++
<i>Diplodus noct</i>	along exposed rocky shore	25	*	*						+++
<i>D. sargus</i>	rocky shallow coastal water	25	*					*		++
<i>Pagellus affinis</i>	rocky crevices	20	*							++
<i>Pterogymnus laniarins</i>	dead coral exposed shore	25	*			*				++
<i>Rhabdosargus haffara</i>	sandy & muddy areas	40	*	*			*			++
<i>R. sarba</i>	shallow water on sandy bottoms	40	*			*		*		++
Pempherididae										
<i>Pempheris vanicolensis</i>	around coral heads	18	*						*	+++

<i>Z. xanthurum</i>	close to deep water & reefs	22		*					*	+++
**Siganidae										
<i>Siganus argenteus</i>	rocky bottoms & dead corals	37	*		*	*			*	++
<i>S. luridus</i>	shallow water & rock flat	30	*	*	*	*	*	*	*	++++
<i>S. rivulatus</i>	in reefs & in weedy bays	40	*	*	*			*	*	+++
<i>S. stellatus</i>	coral reefs feed on sea weeds	40	*		*			*	*	++
Balistidae										
<i>Pseudobalistes fuscus</i>	shallow water in eel grass beds	55	*	*	*				*	++
<i>Rhinecanthus assasi</i>	under stones in crevices	38	*			*		*	*	+++
<i>Sufflamen albicaudatus</i>	rocky shores sandy lagoons	45	*	*	*				*	+++
Ostraciidae										
<i>Ostracion cubicus</i>	seagrass beds & coral reefs	45	*				*			++
Diodontidae										
<i>Diodon Hystrix</i>	shallow water over grass beds or sandy flat	65	*					*	*	+++
Tetraodontidae										
<i>Arothron diadematus</i>	rocky & coral reefs in caves	26	*				*		*	++
<i>A. hispidus</i>	around reefs, youngs in mangroves	21	*	*			*			+++
<i>A. stellatus</i>	in small caves in rocks corals	54	*						*	++
*Bothidae										
<i>Bothus pantherinus</i>	buried in sandy patches juveniles in mangroves	35	*	*					*	++
*Soleidae										
<i>Pardachirus marmoratus</i>	shallow water buried in sand	26	*					*	*	++
Scorpaenidae										
<i>Dendrochirus brachypterus</i>	in rocky crevices & coral reefs	15	*					*		+
<i>Pterois radiata</i>	coral reefs	20	*					*		+
<i>P. volitans</i>	reef dwelling & in mangrove	38	*	*		*	*	*	*	++
<i>Scorpaenopsis diabolus</i>	rocky & sand bottoms	30	*					*		+
<i>Synanceia verrucosa</i>	buried in sand bottoms	30	*					*	*	+
Platycephalidae										
<i>Papilloculiceps longiceps</i>	coral reefs	46	*						*	+
Batrachoididae										
<i>Batrachus sp</i>	coral reefs	36	*		*				*	+

Table 4: Seasonal abundance of species, genera, families and orders recorded from South Sinai Protected Areas.

Seasons	Species	Genera	Families	Orders
Summer	52	40	23	6
Autumn	34	30	22	8
Winter	76	56	32	11
Spring	125	80	45	15