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Distribution and occurrence of Red Sea fish at the Turkish Mediterranean coast-northern Cilician basin

Ali C. GUCU, Ferit BINGEL, Dursun AVSAR and Nilgun UYSAL

Middle East Technical University, Institute of Marine Sciences, Erdemli, ICEL, Turkey

Six new species of Red Sea fish were identified and added to the already known 20 Red Sea species recorded along the Anatolian coast. The occurrence, distribution and contribution of fourteen Red Sea species to the trawl fishery were studied. The meristic and morphometric characteristics of these species (including 95% confidence limits) were determined.

INTRODUCTION

Changes in the environment by human interference may have diverse effects on individuals occupying a certain geographical area (ELTON, 1958). Indeed, an important environmental impact has been encountered starting from late 19th century and continuing to this date, in the eastern Mediterranean by the opening of the Suez Canal and the construction of the Aswan Reservoir.

The removal of the geographical barrier has induced the immigration and emigration between the two water bodies (Red Sea and Mediterranean Sea) following the opening of the Suez Canal. Until recently, there was another barrier namely the hydrological gradient formed by the fresh water discharges of the River Nile in front of the Mediterranean end of the Canal. After the construction of the Aswan Reservoir, the fresh water influence of the Nile has been modified and has eventually decreased, in such a quantity that the immigration and emigration procedure was positively affected (DE VLAMING, 1971; OREN, 1970; BEN-YAMI and GLASSER, 1974). The Mediterranean Sea, which hosts about 550 fish species, omitting the adjacent parts of the Atlantic Ocean and the Black Sea (Tortonese, 1964), has been invaded by the Red Sea fish species. To the local eastern Mediterranean fish fauna, 36 Red Sea origin fish species (BEN-TUVIA 1966, 1978) were added with time. These species have spread along the Asiatic coast northward and then west towards the Aegean Islands. For example in 1952, there were no *Saurida undosquamis* (Lizard fish) in the Mersin bay. But, in 1956, these fish were common in the same trawling grounds (BEN-TUVIA, 1978). Although Lizard fish were not found during the surveys carried out in the Bay of Iskenderun in July 1955 by AKYUZ (1957), 14 different Indo-Pacific species had been already found at that time.

Later on, the number of species invading the northern Cilician Basin and their contribution to the fishery have increased with ever increasing spreading pattern. While the immigration and emigration processes were well monitored along the Israeli-Lebanese coast (Ben-Tuvia, 1962, 1966, 1973, 1977, 1978; Ben-Yami and Glaser, 1974 and the references cited therein), knowledge for the adjacent Anatolian

coast is not sufficient. In the present study, utilizing the available data, a preliminary report is given in order to fill the gap to some extent, with respect to the westward spreading of Red Sea originated fish species along the Anatolian coast.

MATERIAL AND METHODS

The present study was mainly based on the samples collected along the coastline from Iskenderun in the east to Cape of Anamur in the west (Fig. 1). Most of the material was collected during cruises, carried out in autumn 1983, spring and autumn 1984, spring 1989 at depths not exceeding 100 meters.

The coastline covered was divided in three sub-regions to observe the spreading route of the immigrant fishes. The sub-regions were:

i) Iskenderun bay
ii) Mersin bay
iii) The coastal strip between Incekum Cape and Anamur

The fish samples were sorted, weighed and the percentage of Red Sea species (Osteichtyes) calculated.

The trawl net used was a Mediterranean type of commercial gear which is most suitable for soft grounds. The mesh size in the cod end is 28 mm stretched.

Additionally, samples collected in and around IMS - METU (Institute of Marine Sciences - Middle East Technical University) harbour by gill and entangling nets were also examined.

The meristic and morphometric characteristics could be obtained for a small number of individuals. These morphometric characteristics examined, were the following ratios:

- Total length / Body depth
- Body depth / Head length
- Total length / Head length
- Head length / Eye diameter

Rays on dorsal and ventral sides, the scales on the lateral line and the rakers on the first gill arch were counted. The counts of the scales and the gill rakers were made on the left hand side of the fish. Rudimentary gill raker were not taken into account. Spines on the fins are designated by Roman numerals, whereas soft rays represented by Arabic ones, and the two are separated by a slash (/) in the following. The forward pointing spine in the front of the dorsal fin or the anal fin is designated by Roman numerals and separated from the numeral of the dorsal or the anal fin by a plus (+).

The 95% confidence limits of the body proportions were calculated for a sample size of more than 5 individuals.

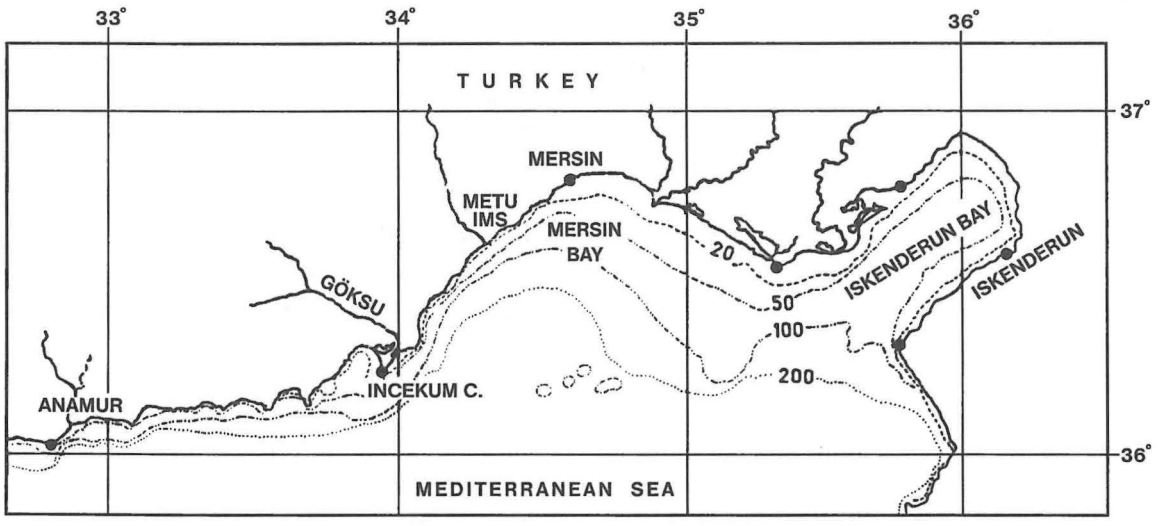

Fig. 1. Study area in the northern Cilician Basin.

The abbreviations used are as follows:

A : Number of anal fin rays
BD : Body depth
D1 : Number of the first dorsal fin rays
D2 : Number of the second dorsal fin rays
ED : Eye diameter
GR : Number of gill rakers
HL : Head length of fish
LL : Number of scales on lateral line
n : Sample size
TL : Total length
V : Number of ventral fin rays

RESULTS

The species names are given following HUREU and MONOD (1979).

Family: **Apogonidae**

Apogon nigripinnis CUVIER, 1828

D1: VII, D2: I/8-10, A: II/8-9, V: I/5, LL: 22-27, GR: 12-13
n = 38, ranging 41-90 mm.

TL/BD: 3.29 ± 0.11 TL/HL: 2.94 ± 0.06
BD/HL: 0.90 ± 0.03 HL/ED: 4.00 ± 0.11

This small fish was caught between Iskenderun and Anamur in the sublittoral zone. It is easily distinguished from relative species, *Apogon imberbis,* by the presence of a black spot on the side which is encircled by a white circle and dark bars on the body.

The occurrence periods of this fish in the study region are given in Tables 1-5. From these tables, it is seen that this fish may be well distributed in the region. Its percentage in the catch per unit effort figures indicate that there is a decrease in the abundance of *A. nigripinnis* towards the west (Table 5), in agreement with the colonization route given by BEN-TUVIA (1983).

Family: **Atherinidae**

Pranesus pinquis (LACEPEDE) 1803

D1: VI, D2: I/9-10, A: II/11-12, V: I/5, LL: 37-42, GR: 26
n = 3, ranging 81-131 mm.

TL/BD: 5.63 TL/HL: 4.31
BD/HL: 0.77 HL/ED: 2.77

This pelagic species was caught by stationary nets in IMS-METU harbour. Unfortunately, the regional distribution and quantification could not be figured out.

Family: **Callionymidae**

Callionymus filamentosus VALENCIENNES, 1837

D1: IV, D2: 9, A: 9, V: I/5
n = 13, ranging 84-160 mm.

TL/BD: 11.11± 0.89 TL/HL: 5.52 ± 0.25
BD/HL: 0.50 ± 0.04 HL/ED: 3.62 ± 0.29

This demersal fish was common at all depths (0 - 100 m) of the region studyed. Relative species (e.g. *Callionymus risso* and *C. pusillus*) of the same family was given by AKSIRAY (1954). In the present study, only *C. filamentosus* was caught. The occurrence of this fish in the study region and periods are given in Tables 1-5. From these tables, it is observed that *C. filamentosus* is well distributed in the region. The decreasing percentage of this fish in the catch per unit effort values (Table 5), coincide with the westward spreading trend of immigrants (BEN-TUVIA, 1983).

Family: **Carangidae**

Selar djeddaba (FORSSKAL, 1775)

D1: I-VIII, D2: I/24, A: II+I/19, V: I/5, LL: 79, GR: 39
n = 1, 235 mm

TL/BD: 3.67 TL/HL: 4.52
BD/HL: 1.23 HL/ED: 5.30

Only a single specimen was caught by the stationary nets around IMS-METU harbour. This species can be distinguished from relative Mediterranean species by the presence of an adipose membrane, covering the posterior half of the eye and a black spot on the edge of the operculum. Lateral line with scutes is another important feature for the distinction of this species from the native ones.

Family: **Dussumieridae**

Dussumieria acuta VALENCIENNES, 1847

D1: I/18, A: I/13, V: I/7, GR: 45
n = 1, 148 mm

TL/BD: 6.17 TL/HL: 4.35
BD/HL: 0.71 HL/ED: 4.25

One specimen of this inshore-pelagic fish was caught in Iskenderun bay with the bottom trawl net operated at 43 m depth.

Family: **Hemiramphidae**

Hemiramphus far (FORSSKAL, 1775)

D1: 14, A: 12, V: 8, LL: 41, GR: 29
n = 1, 286 mm

TL/BD: 9.53 TL/HL: 2.92
BD/HL: 0.31 HL/ED: 8.91

Single specimen was caught by the stationary nets around IMS-METU harbour.

Family: **Holocentridae**

Holocentrus ruber (FORSSKAL, 1775)

D1: XI/13, A: IV/9, V: I/7, LL: 37-40, GR: 8-9
n = 4, ranging 151-181 mm.

TL/BD: 3.47 TL/HL: 3.34
BD/HL: 0.97 HL/ED: 3.35

Holocentrus ruber is commonly encountered, often in caves, not only along the all three sub-regions, but also all along the Turkish Mediterranean coastline and even occurrence of this species has been reported in Gulf of Izmir (WHITEHEAD 1984, 1986). However, they spend most of their lives within the rock cavities, therefore, sampling could not be possible to estimate their occurrence in quantitative sense.

Family: **Leiognathidae**

Leiognathus klunzingeri (STEINDACHNER, 1898)

D1: VIII/16, A: III/13-14, V: I/5, GR: 15-17
n = 14, ranging 58-106 mm.

TL/BD: 3.09 ± 0.09 TL/HL: 4.44 ± 0.16
BD/HL: 1.44 ± 0.05 HL/ED: 3.04 ± 0.16

During the study period, this species was one of the most common demersal fish in all parts of the region. This small sized fish were commonly caught in shallow waters as also given by SEIGEL (1981).

L. klunzingeri is one of the most widely spreading species within the Red Sea immigrants. In Mersin Bay, four different stocks of *L. klunzingeri* were morphometrically distinguished by Avsar *et al.* (1988). Their occurrence in the northern Levantine extends to Rhodes and few specimens were caught in the Aegean Sea. In addition to this, one specimen was collected from the neighbourhood of Lampedusa, which is near the eastern coast of Tunisia (BEN-TUVIA, 1966). Its abundance decreases towards the west (Table 5). This trend is in good agreement with the westward spreading features of the Red Sea immigrants in the Mediterranean Sea (BEN-TUVIA, 1983).

Family: **Monocanthidae**

Stephanolepis diaspros FRASER-BRUNNER, 1940

D1: I, D2: 25-32, A: 29-31, V: I, GR: 24-27
n = 8, ranging 77-206 mm.

TL/BD: 2.43 ± 0.13 TL/HL: 3.75 ± 0.25
BD/HL: 1.54 ± 0.09 HL/ED: 3.71 ± 0.45

This relatively small sized and rather common demersal fish has no commercial importance. Because of different fishing intensities in the region (BINGEL, 1987), the absolute abundance and catch per unit effort results of the species within the study region may vary remarkably. Higher catch rates may therefore be obtained in areas of less intensive trawl fishery. This may perhaps be one of the reasons why the occurrence of this fish in the study region did not show the westward migration pattern as given by BEN-TUVIA (1983). It could be further stressed that for example higher amounts of Monocotyledon plants (e.g. *Posidonia oceanica*) in the west may favor this fish in comparison to Iskenderun and Mersin bays (Tables 1-5).

Family: **Mullidae**

Upeneus asymmetricus LACHNER, 1954

D1: VII, D2: I/8, A: I/6, V: I/5, LL: 28-35, GR: 22-24
n = 9, ranging 93-148 mm.

TL/BD: 5.60 ± 0.30 TL/HL: 4.39 ± 0.18
BD/HL: 0.79 ± 0.03 HL/ED: 4.82 ± 0.36

This demersal fish is small in comparison to the other members of this family. It can be distinguished from other Mullids by oblique dark bars on the body and its pale fins. The occurrence of this fish in the study region and periods are given in Tables 1-5. As in the previous species (*S. diaspros*), the spatial distribution and/or occurrence of this fish may be influenced by unevenly distributed fishing intensity (relatively higher variance in area and between hauls), resulting in apparent discrepancies in westward spreading (Table 5).

Upeneus moluccensis (BLEEKER, 1855)

D1: VII, D2: I/8, A: I/16, V: I/5, LL: 32-36, GR: 23-27
n = 16, ranging 80-185 mm.

TL/BD: 4.68 ± 0.17 TL/HL: 4.08 ± 0.11
BD/HL: 0.87 ± 0.03 HL/ED: 4.13 ± 0.17

This specie is one of the commercially important demersal Red Sea immigrants. It can be distinguished from other members of the family by the presence of a prominent yellow band from the eye to the base of the caudal fin.

The occurrence of this fish in the study region have nearly the expected pattern affirming the documented westward spreading of Red Sea immigrant fishes (Tables 1-5).

Family: **Pempheridae**

Pempheris vanicolensis (CUVIER, 1831)

D1: V/10, A: III/32, V: I/5, LL: 50-62, GR: 23-27
n = 4, ranging 100-159 mm.

TL/BD: 2.83 TL/HL: 4.27
BD/HL: 1.51 HL/ED: 2.10

This species was distinguished by the dark part on the tip of dorsal fin and the presence of a similar projection on the distal edges of first few anal rays.

Members of this species were commonly observed in small schools, sheltering within the reefs of METU-IMS harbour, therefore they could only be caught by the gill nets and hence information about their quantitative distribution along the studied area could not be estimated.

Family: **Scomberomoridae**

Scomberomorus commerson (LACEPEDE, 1800)

Two specimens were obtained by the gill net in 1981 and identified, but unfortunately these were spoiled. This pelagic fish is now getting commercial importance and is often reported by the local fishermen of the Mersin.

Family: **Siganidae**

Siganus luridus (RUPPEL, 1828)

D1: I+XII-XIII/10, A: VII/9, V: I/3/I, GR: 16-24
n = 3, ranging 113-190 mm.

TL/BD: 4.85 TL/HL: 3.17
BD/HL: 1.53 HL/ED: 3.37

This fish was commonly found in the study region, but in remarkably less quantities than *S. rivulatus*. The occurrence of this fish in the study region was rather variable and it seems that it may have yet uncertain periodicity. The data available at present permits no cogent conclusions (Tables 1-5).

Siganus rivulatus FORSSKAL, 1775

D1: I+XII-XIII/10, A: VII/8-9, V: I/3/I, GR: 21-25
n = 8, ranging 67-233 mm.

TL/BD: 3.52 ± 0.14 TL/HL: 4.63 ± 0.27
BD/HL: 1.32 ± 0.11 HL/ED: 3.54 ± 0.24

This specie is closely related to *S. luridus* but differs by moderately forked caudal fin and horizontal golden lines on brown, olive green body.

The occurrence of this fish in the study region (Tables 1-5), reflects a weak non-ideal spreading pattern for an immigrant fish (BEN-TUVIA, 1983).

Family: **Sillaginidae**

Sillago sihama (FORSSKAL, 1775)

D1: XI, D2: I/20, A: II/20-21, V: I/5, LL: 67-70, GR: 10-13
n = 5, ranging 129-203 mm.

TL/BD: 6.03 TL/HL: 3.99
BD/HL: 0.66 HL/ED: 4.92

This sublittoral fish was caught in shallow coastal waters of Iskenderun and Mersin bays. The occurrence of this fish in the study region and periods are given in Tables 1-5. The available data indicate that this fish has spread in the area reaching only to Incekum cape, which borders the relatively larger continental shelf area of Mersin bay, and acts as a transition from this area to the steep and narrow coastal shelf in the west.

Family: **Sphyraenidae**

Sphyraena chrysotaenia KLUNZINGER, 1884

D1: V, D2: I/9, A: I/9, V: I/5, LL: 74-85, GR: 2
n = 3, ranging 148-214 mm.

TL/BD: 8.13 TL/HL: 3.42
BD/HL: 0.42 HL/ED: 5.61

This inshore-pelagic fish was occasionally caught by bottom trawl net. The occurrence of this fish (on catch per effort basis) in the study region and in the periods are given in Tables 1-5. From Table 5, it could be gathered that its abundance decreases towards the west in agreement with the aforementioned westward spreading pattern.

Family: **Synodontidae**

Saurida undosquamis (RICHARDSON, 1848)

D1: V, D2: I/9, A: I/9, V: I/5, LL: 74-85, GR: 2
n = 14, ranging 132-213 mm.

TL/BD: 8.56 ± 0.44 TL/HL: 4.93 ± 0.06
BD/HL: 0.58 ± 0.03 HL/ED: 5.50 ± 0.24

This most common and commercially important demersal fish was caught in nearly every haul in the studied region and its spreading till Anamur is shown in Tables 1-5.

Considering the unevenly distributed fishing intensity in the region, it could be stressed that this fish is one of the well established immigrants of the Red Sea.

Family: **Tetraodontidae**

Lagocephalus spadiceus (RICHARDSON, 1844)

D1: I/9, A: I/7-8, GR: 12-15
n = 9, ranging 127-152 mm.

TL/BD: 5.40 ± 0.37 TL/HL: 3.79 ± 0.08
BD/HL: 0.71 ± 0.05 HL/ED: 2.88 ± 0.28

This specie is not rare along the Anatolian coast studied. Single specimens were often caught during the cruises and its westward spreading is given in Tables 1-5. In Table 5, it is observed that the abundance of this fish coincides with the decreasing trend of westward spreading.

Family: **Theraponidae**

Pelates quadrilineatus (BLOCH, 1790)

D1: XII/10, A: III/10, V: I/5, LL: 77-86, GR: 37-40 n = 7, ranging 90-110 mm.

TL/BD: 3.90 ± 0.13 TL/HL: 4.06 ± 0.11
BD/HL: 1.04 ± 0.02 HL/ED: 3.58 ± 0.26

This demersal fish was found in shallow coastal waters of the Bay of Iskenderun.

The occurrence of this fish in the study region and in the periods are given in Tables 1-5. This species seems to be rather common in the Bay of Iskenderun. Occasionally, in lesser amounts it was caught in Mersin Bay, while it was not present west of Incekum cape (Table 5).

DISCUSSION AND CONCLUSIONS

First record of immigrant species was given by ERAZI (1943), followed by HAAS and STEINITZ (1947). KOSSWIG (1950) has identified five immigrant species within the Turkish boundaries of Mediterranean waters and the total

Species	A U T U M N 1 9 8 3 Iskenderun (g/h)	Mersin (g/h)	Incekum - Anamur (g/h)
A. nigripinnis	2.9	12.4	3.8
C. flamentosus	250.9	90.7	7.7
D. acuta	-	-	-
L. spadiceus	46.4	11.5	39.5
L. klunzingeri	2942.1	6369.6	464.9
P. quadrilineatus	154.3	3.7	-
S. undosquamis	11959.1	5766.4	8013.6
S. luridus	-	9.0	5.1
S. rivulatus	723.7	48.4	17.5
S. sihama	6.1	38.5	-
S. chrysotaenia	26.4	99.5	-
S. diaspros	1763.9	197.1	3324.4
U. asymmetricus	384.4	17.1	316.8
U. moluccensis	292.1	584.7	228.4

Table 1. Occurrence of Red Sea immigrant fish in the coastal region between Iskenderun and Anamur in autumn 1983

Species	S P R I N G 1 9 8 4 Iskenderun (g/h)	Mersin (g/h)	Incekum - Anamur (g/h)
A. nigripinnis	0.7	50.5	32.0
C. flamentosus	0.2	157.0	4.0
D. acuta	1.8	-	-
L. spadiceus	-	17.0	34.7
L. klunzingeri	784.5	1094.9	964.1
P. quadrilineatus	219.2	-	-
S. undosquamis	6762.5	5022.1	6531.4
S. luridus	-	-	-
S. rivulatus	75.6	-	-
S. sihama	27.0	-	-
S. chrysotaenia	36.8	-	40.0
S. diaspros	10.1	86.1	2429.3
U. asymmetricus	186.2	17.0	172.8
U. moluccensis	646.9	779.1	898.6

Table 2. Occurrence of Red Sea immigrant fish in the coastal region between Iskenderun and Anamur in spring 1984

Table 3. Occurrence of Red Sea immigrant fish in the coastal region between Iskenderun and Anamur in autumn 1984

Species	AUTUMN 1984 Iskenderun (g/h)	Mersin (g/h)	Incekum - Anamur (g/h)
A. nigripinnis	97.4	7.2	2.5
C. flamentosus	297.3	163.1	6.3
D. acuta	-	-	-
L. spadiceus	67.2	42.5	21.3
L. klunzingeri	12861.7	12765.5	3030.5
P. quadrilineatus	1091.8	2.0	-
S. undosquamis	12963.4	6536.8	7247.1
S. luridus	-	48.8	3.1
S. rivulatus	220.4	137.3	35.0
S. sihama	131.2	8.7	-
S. chrysotaenia	33.0	5.7	2.5
S. diaspros	1934.7	358.5	771.4
U. asymmetricus	1080.4	93.1	46.5
U. moluccensis	948.4	2096.3	1557.4

Table 4. Occurrence of Red Sea immigrant fish in the coastal region between Iskenderun and Mersin in autumn 1989

Species	AUTUMN 1989 Iskenderun (g/h)	Mersin (g/h)
A. nigripinnis	6.1	15.0
C. flamentosus	14.0	15.4
D. acuta	-	-
L. spadiceus	-	-
L. klunzingeri	944.3	-
P. quadrilineatus	21.3	-
S. undosquamis	522.3	230.5
S. luridus	-	-
S. rivulatus	-	-
S. sihama	-	0
S. chrysotaenia	26.6	5.8
S. diaspros	19.2	3.8
U. asymmetricus	173.7	35.8
U. moluccensis	66.7	63.2

Table 5. Occurrence of Red Sea immigrant fish in the coastal region between Iskenderun and Anamur. The catch per unit effort figures were combined by each region and the percentage proportion of the Red Sea species were calculated for the periods autumn 1983, spring 1984, autumn 1984 and spring 1989

Species	Iskenderun (%)	Mersin (%)	Incekum - Anamur (%)
A. nigripinnis	0.119	0.070	0.033
C. flamentosus	0.550	0.341	0.014
D. acuta	0.002	-	-
L. spadiceus	0.113	0.060	0.066
L. klunzingeri	18.611	15.757	3.695
P. quadrilineatus	1.618	0.005	-
S. undosquamis	31.995	14.040	16.433
S. luridus	-	0.043	0.006
S. rivulatus	0.908	0.140	0.114
S. sihama	0.183	0.038	-
S. chrysotaenia	0.154	0.103	0.037
S. diaspros	3.630	0.502	4.668
U. asymmetricus	1.577	0.242	0.179
U. moluccensis	2.045	2.734	2.225

number of immigrant species increased to seven. In 1955, with an additional seven new species, recorded number of Red Sea species has been arisen to 14 (AKYUZ, 1957). FOWLER and STEINITZ (1956) and BEN-TUVIA (1953, 1966) have reported three new Red Sea species for the northern Cilician Basin while confirming the occurrence of previously recorded immigrants. Finally, in the edition of WHITEHEAD *et al.* (1984-1986) it has been reported that spreading of twenty Red Sea species (three of which were new for the literature surveyed) have extended to the Mediterranean coast of Turkey.

During the quantitative trawl fishery carried out between 1983-1989, six Red Sea immigrant fish species (Osteichtyes) new for the Anatolian coasts were encountered and quantified. Under the light of new results and the previously published references, an updated (more or less complete) list of Red Sea immigrants (Osteichtyes) found in coastal region of the northern Cilician Basin, were given below:

SPECIES LIST OF RED SEA FISH

Aphanius dispar	(2)
Apogon nigripinnis	(1)
Callionymus flamentosus	(1)
Cynoglossus sinusarabici	(2)
Dussumeria acuta	(1, 2, 3, 4)
Hemiramphus far	(1, 2, 3, 5)
Herklotsichthys punctatus	(4)
Holocentrus ruber	(1, 2, 3, 5)
Istiophorus gladius	(2)
Lagocephalus spadiceus	(1, 3, 4, 5)
Leiognathus klunzingeri	(1, 2, 3, 4, 6)
Parexocoetus mento	(3)
Pelates quadrilineatus	(1)
Pempheris vanicolensis	(1)
Pranesus pinquis	(1, 2, 3, 4, 7)
Saurida undosquamis	(1, 3, 4)
Scomberomorus commerson	(1, 4)
Selar djeddaba	(1)
Siganus luridus	(1, 4)
Siganus rivulatus	(1, 2, 3, 4, 8)
Sillago sihama	(1)
Sphyraena chrysotaenia	(1, 2, 3)
Stephanolepis diaspros	(1, 3, 4, 5)
Trichiurus haumela	(2)
Upeneus asymmetricus	(1, 3, 4)
Upeneus moluccensis	(1, 2, 3, 4, 5)

(1) Found in the present study
(2) Given by AKYUZ (1957)
(3) Given by BEN-TUVIA (1953, 1966)
(4) Given by WHITEHEAD (1984, 1986)
(5) Given by KOSSWIG (1950)
(6) Given by ERAZI (1943)
(7) Given by FOVLER and STEINITZ (1956)
(8) Given by HAAS and STEINITZ (1947)

At present, the total number of Osteichthyes detected amounts to 26 species, some of which has gained economical importance. The diversities of the Red Sea fish in the three subregions during the study period are given separately in Tables 1-5, and the collective data are presented in Table 5.

Quantitative distribution of the immigrant fishes along the study area usually showed a decreasing trend towards west (Iskenderun to Anamur). This was an expected result confirming the general immigration route of the Red Sea species. Surprising result was the contradictory distribution of some species (*Saurida undosquamis, Siganus luridus, Stephanolepis diaspros, Upeneus moluccensis*). *Saurida undosquamis* and *Upeneus moluccensis* are large sized, commercially important species and they formed relatively high portions of the trawl catches which will make them more sensitive against fishing intensities than the other small sized bycatches. Different levels of fishing intensities prevailing along the sub-regions may, therefore, explain the unexpected higher catch per unit effort and percentage of catch values.

Other two, *Siganus luridus* and *Stephanolepis diaspros*, were the only species that were able to reach distant points - both were reported in the Greek coasts (PAPAKONSTANTINOU, 1988). This means that these species can adapt themselves to their new environments quicker than the other immigrants. Therefore, it can be expected that they would establish themselves in the multispecies complex of fish fauna, and their abundance would then be controlled by the carrying capacity of the environment itself, rather than any other factor playing role in the immigration process.

Importance of immigrant species for the Anatolian trawl fishery can be interpreted from

Table 5. *S. undosquamis* and *U. moluccensis* are the most abundant and commercially utilized fish species found nearly in every haul. *U. assymetricus, S. rivulatus* and *S. chrysotaenia* have little commercial importance and these are occasionally caught in the trawl fishery. Although individuals of the Leiognathidae family are consumed in the Indian Ocean region, this small sized tasty fish does not have any commercial value in Turkey.

In summary, it can be stated that 62% of the catch per unit effort consists of Red Sea immigrants in the Bay of Iskenderun, while it was 34% in Mersin Bay and approximately 27% in the coastal strip between Incekum and Anamur Cape. This result is in good agreement with the arguments stating that the number of species invading northern Cilician Basin and their abundance has decreased, with further westward spreading (BEN-TUVIA, 1962, 1966, 1973, 1977, 1978; BEN-YAMI and GLASER, 1974 and the references cited therein). Considering the first records of such fish, for example *S. undosquamis*, in 1956 in the Bay of Mersin (BEN-TUVIA, 1978) and that of *U. moluccensis* in 1955 in the bay of Iskenderun as the beginning of the invasion in commercial scales and the results presented above, it should be expected that the invasion of the fish of Red Sea origin will continue and their importance in the commercial fishery will further increase, not particulary in the case of Osteichtyes, but also generally for the other members of the Pisces.

The studies concerning the lessepsian migration needs to be continued and extended through international cooperation in order to understand the extensive faunal changes in a relatively large area such as the Levantine Sea.

REFERENCES

AKSIRAY, F. 1954. Turkiye deniz baliklari tayin anahtari. I. U. Fen Fak. Hidrobiyol. Arast. Enst. Yay., Sayi 1: 277 pp.

AKYUZ, E. 1957. Observations on the Iskenderun red mullet (*Mullus barbatus*) and its environment. Proc. Gen. Counc. Med., 4: 305-326.

AVSAR, D., F. BINGEL and M. UNSAL. 1988. Application of Mahalanobis distance function for the morphometric separation of Silverbelly (*Leiognathus klunzingeri* Steindachner) stocks in the Gulf of Mersin. Acta Adriat., 29: 153-160.

BEN-TUVIA, A. 1953. Mediterranean fishes of Israel. Bull. Sea Fish. Res. Stn. Haifa, 1-40.

BEN-TUVIA, A. 1962. Collection of fishes from Cyprus. Bull. Res. Coun. Israel, 11 B: 132-145.

BEN-TUVIA, A. 1966. Red Sea fishes recently found in the Mediterranean. Copeia, 2: 254-275.

BEN-TUVIA, A. 1973. Man-made changes in the eastern Mediterranean Sea and their effect on the fishery resources. Mar. Biol., 19: 197-203.

BEN-TUVIA, A. 1977. New records of Red Sea immigrants in the eastern Mediterranean. Cybium, 3 e, Ser., 1: 95-102.

BEN-TUVIA, A. 1978. Immigration of fishes through the Suez Canal. Fish. Bull., 76: 249-255.

BEN-TUVIA, A. 1983. The Mediterranean Sea, B. Biological aspects. In: KETCHUM, B. H., (Edt.) Ecosystems of the world. Estuarine and enclosed seas. Elsevier Scien. Publ., New York, 26, pp. 239-251.

BEN-YAMI, M. and T. GLASER. 1974. The invasion of *Saurida undosquamis* (Richardson) into the Levant Basin - An example of biological effect of interoceanic canals. Fish. Bull., 72: 359-373.

BINGEL, F. 1987. Dogu Akdeniz' de kiyi balikciligi av alanlarinda sayisal balikcilik projesi kesin raporu. (Quantitative fishery on the fishing grounds of the coastal fishery in the eastern Mediterranean - Final report). Project No: 80070011. IMS-METU.

DE VLAMING, V. L. 1971. The effects of food deprivation and salinity changes on reproductive function in the estuarine gobiid fish, *Gillichthys mirabilis*. Biol. Bull., 141: 458-471.

ELTON, C. S. 1958. The ecology of invasion by animals and plants. Mathuen & Co., Ltd. London, 181 pp.

ERAZI, R. A. 1943. *Leiognathus mediterranus* nov sp. C. R. Soc. Turq. Sci. Phys., 10: 49-53.

FOWLER, H.W. and H. STEINITZ. 1956. Fishes from Cyprus, Iran, Iraq, Israel and Oman. Bull. Res. Coun. Israel, 5B: 260-292.

HAAS, G. and H. STEINITZ. 1947. Erythrean fishes on the Mediterranean coast of Palestine Nature (London) 160 (4053), 28.

HUREU, J. C. and TH. MONOD. 1979. Check-list of the fishes of the north-eastern Atlantic and the Mediterranean. UNESCO, vol. I: 683 pp.

KOSSWIG, C. 1950. Erythraische fische im Mittelmeer und an der Grenze der Agais. Syllegomena Biologica. Festschrift kleinschmidt. Leipzig: Akademie Verlag, pp. 203-212.

PAPAKONSTANTINOU, C. 1988. Fauna Graeciae IV. Check-list of marine fishes of Greece. Nat. Cent. Mar. Res. Hellen. Zool. Soc., 257 pp.

OREN, O. H. 1970. The Suez Canal and the Aswan High Dam. Their effect on the Mediterranean. Underwater Sci. Technol. J., 2: 222-229.

SEIGEL, J. A. 1981. Median fin-spine loching in the pony-fishes (Perciformes: Leiognathidae). Copeia, 1: 202-205.

TORTONESE, E. 1964. The main biogeographical features and problems of the Mediterranean fish fauna. Copeia, 1: 98-107.

WHITEHEAD, P. J. P., M. L. BAUCHOT, J. C. HUREAU, J. NIELSEN and E. TORTONESE. 1984-1986. Fishes of the North-eastern Atlantic and the Mediterranean. UNESCO ed., Vol. I, II, III. 1473 pp.

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Raspodjela i pojavljivanje ribe iz Crvenog mora na turskoj obali Sredozemnog mora - sjeverni bazen Kilikije

Ali C. GUCU, Ferit BINGEL, Dursun AVSAR i Nilgun UYSAL

Institut za istraživanje mora, M.E.T.U., Erdemli, Icel, Turska

KRATKI SADRŽAJ

Šest novih vrsta ribe iz Crvenog mora zabilježeno je i dodano listi od 20 već poznatih crvenomorskih riba koje se pojavljuju u sjevernom bazenu Kilikije uzduž obala Anatolije. Vrijednosti ulova po jedinici napora i postotak javljanja četrnaest vrsta riba iz Crvenog mora, ulovljenih tijekom kočarskih istraživanja uzduž sredozemne obale Anatolije (između Iskenderun-a i Anamur-a), dane su po pod-područjima. Tri odabrana pod-područja su zaljevi Iskenderun i Mersin te obalni pojas koji se proteže od rta Incekum do Anamur-a.

Ustanovili smo da se vrijednosti ulova po jedinici napora smanjuju idući od istoka prema zapadu.

Merističke i morfometrijske karakteristike ovih vrsta odredjene su, a izračunate su i 95%-tne razine vjerojatnosti.

Slijedećih šest riba zabilježeno je prvi puta tijekom ovih istraživanja:

Apogon nigripinnis,
Callionymus flamentosus,
Pelates quadrilineatus,
Pempheris vanicolensis,
Selar djeddaba,
Sillago sihama.

Slijede vrste koje su zabilježene tijekom ranijih istraživanja, a koje su dodatno obrađene u ovoj studiji:

Dussumieria acuta,
Hemiramphus far,
Holocentrus ruber,
Lagocephalus spadiceus,
Leiognathus klunzingeri,
Pranesus pinquis,
Saurida undosquamis,
Scomberomorus commerson,
Siganus luridus,
Siganus rivulatus,
Sphyraena chrysotaenia,
Stephanolepis diaspros,
Upeneus asymmetricus,
Upeneus moluccensis.