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LESSEPSIAN FISHES AT THE BOTTOM TRAWL FISHERY IN THE BABADILLIMANI BIGTH, NORTHEASTERN MEDITERRANEAN COAST OF TURKEY

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This study was carried out in Babadillimani Bight from May 1999 to April 2000. A total of 16 Lessepsian fish species (*Apogonichthyoides pharaonis, Cynoglossus sinusarabici, Etrumeus teres, Leiognathus klunzingeri, Lagocephalus spadiceus, Lagocephalus suezensis, Pempheris vanicolensis, Sargocentron rubrum, Saurida undosquamis, Siganus luridus, Siganus rivulatus, Sillago sihama Sphyraena chrysotaenia, Stephanolepis diaspros, Upeneus moluccensis* and *Upeneus pori*) were identified from monthly trawl sampling. Monthly mean Catch Per Unit Effort values of Lessepsian fish species ranged from 2.47kg/h (June) to 24.81kg/h (August), and the proportion of them in total catch were calculated as 23.68%, 19.15%, 18.98% and 36.91% on spring, summer, autumn and winter, respectively. Overall mean CPUE was calculated as 7.47kg/h and mean percentage of Lessepsian fish species in total catch was estimated as 26.69% for one-year sampling period. When the distribution of Lessepsian fish species in deep layers are taking into consideration, it was presented that Lessepsian fish both in catch and number species were gradually decrease from shallow to deeper waters. 77.91% of total Lessepsian fish was caught from 0-50m depth layer, 17.01% from 50-100m depth layer, and 5.08% from water deeper than 100m.

Lessepsian Fish – Babadillimani Bight – Northeastern Mediterranean – bottom trawl catch composition

Հետազոտությունը կատարվել է Բաբադիլիմանի Բայթի մոտ (Թուրքիայի հյուսիս-արևելյան միջերկրածովյան ափ) 1999թ. մայիսից՝ 2000թ. ապրիլը: Հետազոտված է լեսեփսիոն ձկների ընդամենը 16 տեսակ (*Apogonichthyoides pharaonis, Cynoglossus sinusarabici, Etrumeus teres, Leiognathus klunzingeri, Lagocephalus spadiceus, Lagocephalus suezensis, Pempheris vanicolensis, Sargocentron rubrum, Saurida undosquamis, Siganus luridus, Siganus rivulatus, Sillago sihama Sphyraena chrysotaenia, Stephanolepis diaspros, Upeneus moluccensis* և *Upeneus pori*) ձկնորսության ամենամյա նմուշների ընտրանիից: Ուսումնասիրել են լեսեփսիոն ձկների բաշխումը խոր ջրերում: Ցույց է տրվել, որ ինչպես այդ ձկների որսը, այնպես էլ տեսակների թիվն աստիճանաբար նվազում են սակավաջրից մինչև խորը ջրերը: Ընդ որում, լեսեփսիոն ձկների ընդհանուր քանակի 77,91 % որսվել էր 0-50 մ խորության վրա, 17.01 %՝ 50-100 մ խորության վրա և 5.08%՝ 100 մ խորը ջրերից:

Լեսեփսիոն ձկներ – Բաբադիլիմանի Բայթ – Թուրքիայի հյուսիսարևելյան միջերկրածովյան ափ – հատակի ձկնորսացանցով ձկնորսություն

Исследование проводили в Бабадиллимани Байт (северо-восточное средиземноморское побережье Турции) с мая 1999 по апрель 2000 года. Изучено всего 16 видов лессеп-

сионных рыб (*Apogonichthyoides pharaonis, Cynoglossus sinusarabici, Etrumeus teres, Leiognathus klunzingeri, Lagocephalus spadiceus, Lagocephalus suezensis, Pempheris vanicolensis, Sargocentron rubrum, Saurida undosquamis, Siganus luridus, Siganus rivulatus, Sillago sihama Sphyraena chrysotaenia, Stephanolepis diaspros, Upeneus moluccensis* and *Upeneus pori*) из образцов ежемесячной выборки трала. Изучено распределение видов лессепсионных рыб в глубоводных слоях. Показано, что как их улов, так и число видов, постепенно понижались от мелкводья до глубоких вод. При этом, 77.91 % от общего количества лессепсионных рыб было выловлено на уровне 0-50 м глубины, 17.01 % – на уовне 50-100 м глубины, и 5.08 % из вод глубже 100 м.

Лессепсионные рыбы – Бабадиллимани Байт – северо-восточное средиземноморье Турции – улов донного трала

After the opening of the Suez Canal between the Red Sea and the Mediterranean basins in 1869, many marine organisms from phytoplankton to fishes have been migrating between the Red Sea and Mediterranean. This phenomenon was termed Lessepsian migration by Por [17]. According to Ben-Tuvia [4], firstly *Aterinomorus lacunosus* was recorded by Tillier [18] 33 years after opening of the canal, and now nearly 89 Lessepsian fish species were reported from Mediterranean [6,12,13]. Lessepsian migration affected eastern Mediterranean fish communities. The Lessepsian migration was positively affected by the construction of Aswan Dam in 1969 [16]. Before the construction of the Aswan Dam, water of Nile River was a natural barrier for the Lessepsian migration, low salinity because of freshwater runoff by Nile River. There have been changing and interactions in the Mediterranean ecosystem because of continuing migration from Red Sea to eastern Mediterranean [5]. Some Lessepsian fish species (e.g. *Leiognathus klunzingeri, Upeneus moluccensis, U. pori, Siganus rivulatus, Saurida undosquamis*) successfully settled/colonized and some of the species compose of a main component of commercial fisheries in the eastern Mediterranean coasts [4, 7, 8].

The first Lessepsian fish was reported by Erazi [10] from Turkish waters. After that, many authors reported new Lessepsian fish species and up until now total number of Lessepsian fish species reached to 55 [11].

Although over 89 Lessepsian fish species have been reported from the eastern Mediterranean very little is known about the effects of these alien species on the area. In addition despite its long history, and contrary to the western Mediterranean basin, the entire area lacks long term fishery monitoring and similar studies in different localities [2].

In this study, monthly species composition, CPUE values, and proportion of Lessepsian fishes in total catch were analyzed by monthly bottom trawl survey in Babadillimani Bight is a small bight located on the western extension of the Mersin Bay.

Materials and methods. This study was carried out in Babadillimani Bight (33°23´36´´-33°32´57´´N; 36°07´00´´-36°09´39´´E) located in the western extension of the Mersin Bay, northeastern Mediterranean (fig. 1). Sampling was conducted at monthly interval using a commercial bottom trawl net from May 1999 to April 2000. Fishes were caught from 0-50m, 50-100m and 100m>depth layers by using typical Mediterranean bottom trawl net in 22mm (knot to knot) cod end mesh size, and tow duration was restricted with 1 hour. A total of 36 hauls were analyzed during the sampling period. Samples were preserved in 4% formaldehyde solution buffered by borax. In the laboratory, species identification was made by using the reference given by GOLANI *et al.* [11]. Total weight of each species was measured to the nearest 1g. Using this data, CPUE values and proportion of Lessepsian fish in whole catch were calculated.

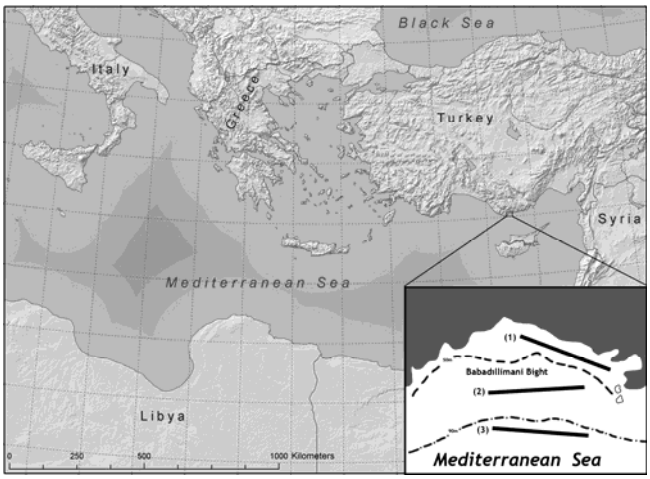

Fig. 1. Study area and sampling stations in Babadillimani Bight, northeastern Mediterranean coast of Turkey ((1) Station I: 0-50m; (2) Station II: 50-100m and (3) Station III: 100m>depth layers)

CPUE value was calculated using $a=D^* h^* X_2$ equation [14]. In this equation; a= Total dredged area by bottom trawl (km^2), D= Length of dredged area (m), h= Length of the buoy mouth of a trawl-net (m) and X_2= Opening rate of buoy mouth: evaluated at 0.5.

The most abundant 10 species in total catch were considered as main catch recommended by Bingel [5] for this purpose, elasmobranches and other organisms except fish were not evaluated in this point.

Monthly sea surface temperature and salinity measured by YSI 6-Series multi-parameter instrument. In order to analyze differences among stations in temperature and salinity, One-Way ANOVA was performed ($p>0.01$). The relationship between total catch and Lessepsian fish catch was estimated using linear regression analyzes and in order to analyze the relationship is statistically important or not, t-test was performed ($p>0.01$).

Monthly sea surface temperature and salinity changes were given in fig. 2. Because of there were not detected any differences among stations in temperature and salinity, (One-Way ANOVA, $p>0.05$), monthly mean values were used for analysis. During the study period, lowest mean sea surface temperature measured in March at 15.52°C. The temperature value was increased gradually after March and the value reached the highest in August at 29.66°C. After August the temperature value decreased gradually with the coming of autumn (fig. 2).

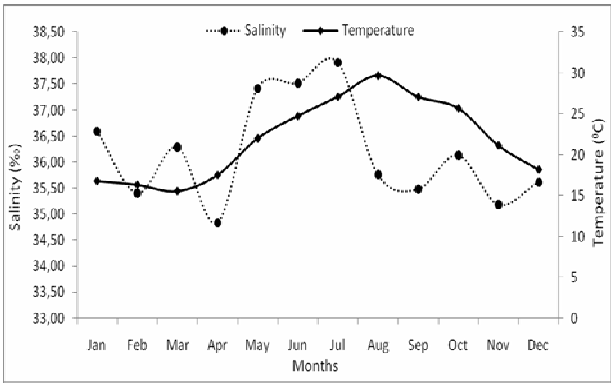

Fig. 2. Monthly changes of sea surface temperature and salinity

When considered sea surface salinity the lowest value measured as 34.83‰ following the coolest month (April). After April, sea surface salinity was increased coincide with increasing temperature and reached the highest value in July at 37.92‰. After July, sea surface salinity changes were untidy and the level ranged from 35.5 to 36.1‰.

Results and Discussion. A total of 96 teleost fish species belonging to 46 families were caught during study period. Lessepsian fish species represented 16 species belonging to 13 families among the total fish fauna as follows; *Apogonichthyoides pharaonis, Cynoglossus sinusarabici, Etrumeus teres, Leiognathus klunzingeri, Lagocephalus spadiceus, Lagocephalus suezensis, Pempheris vanicolensis, Sargocentron rubrum, Saurida undosquamis, Siganus luridus, Siganus rivulatus, Sillago sihama Sphyraena chrysotaenia, Stephanolepis diaspros, Upeneus moluccensis* and *Upeneus pori. C. sinusarabici, S. undosquamis, U. moluccensis* and *U. pori* were presented all months in the study period. *L. klunzingeri* was one of the most abundant species was caught in all months, except June. *S. diaspros* was caught during 10 months, except February and May. On the contrary, *L. spadiceus* and *L. suezensis* were caught only in November; *S. chrysotaenia* was presented in January and August; *E. teres* was caught in February, August, October and November; *A. pharaonis* was presented in February, June, October, November and December.

Monthly changes in number of Lessepsian fish species was represented in fig. 3. As can be seen the figure, the lowest number of the species almost presented in station III, moreover there was not detected any species in July. The highest value was presented in station I, except two months (January and April). Number of species was equal in March and October in station I and station II. When consider monthly value in number of species, the lowest value was presented in May with 5 species and the highest one was October and November with 8 species. There were not presented any systematic changes on number of species in studied months.

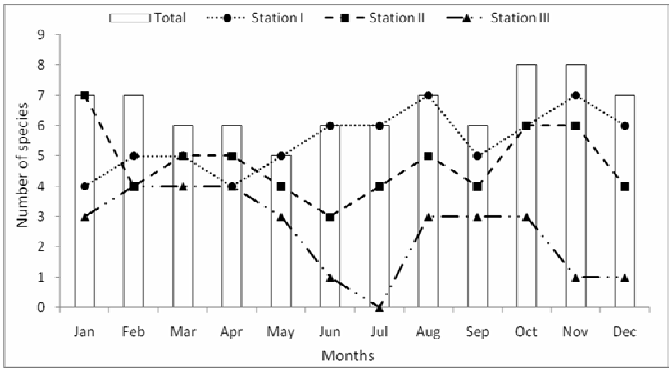

Fig. 3. Monthly changes in number of Lessepsian fish species

During the study period, the lowest total catch value was presented in March with 33.02 kg/h and the highest value was in August with the value of 308.56kg/h (fig. 4). The lowest CPUE value was 11.01 kg/h in March and the highest one was 102.86 kg/h in August and the mean value was estimated at 31.05 kg/h during the study period. Same trend presented for monthly changes of mean CPUE value of Lessepsian fish, the value ranged from 2.47kg/h (in June) to 24.81kg/h (in August), and overall mean CPUE was calculated at 7.47kg/h. Lessepsian fishes consisted of 23.68%, 19.15%, 18.98% and 36.91% in total catch on spring, summer, autumn and winter, respectively, and mean proportion was calculated as 26.69% for whole sampling period.

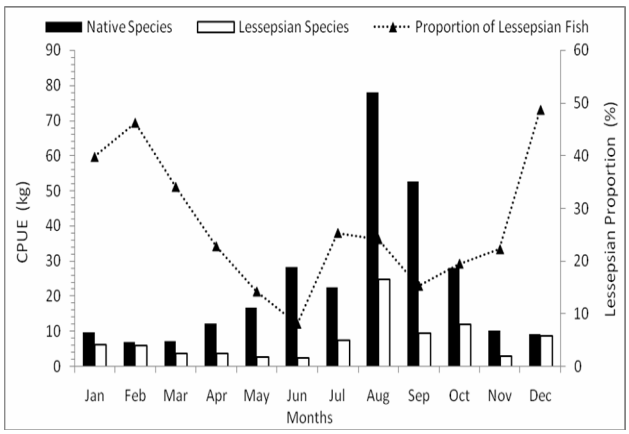

Fig. 4. Monthly changes of CPUE values of native and Lessepsian Fishes

When the consideration of proportion of Lessepsian fishes in total catch, the lowest percentage was presented in June (8.01%) and the highest one was presented in December (48.75%) (fig. 4). Generally the highest proportions were detected during the months of winter and spring. This value was decreased gradually after spring and the lowest values were presented the months in summer and autumn.

According to stations, monthly changes of Lessepsian fishes in CPUE were presented in fig. 5. As can be seen the figure, the highest CPUE value was gained from station I (0-50 m depth ranges). Except in August, CPUE value in 50-100 m depth range (station II) was higher than that of waters deeper than 100 m > depth (Station III). 77.91 % total of Lessepsian fish yield was obtained from Station I, 17.01 % from Station II and 5.08 % from Station III. Proportion of Lessepsian fish catch obtained from Station I ranged from 52.11 % (March) to 94.00 % (October). The highest and the lowest Lessepsian fish catches were presented in August and June, respectively. The profiles of monthly changes in mean Lessepsian fish CPUE value showed great similarity with between CPUE value changes in station I (fig. 5).

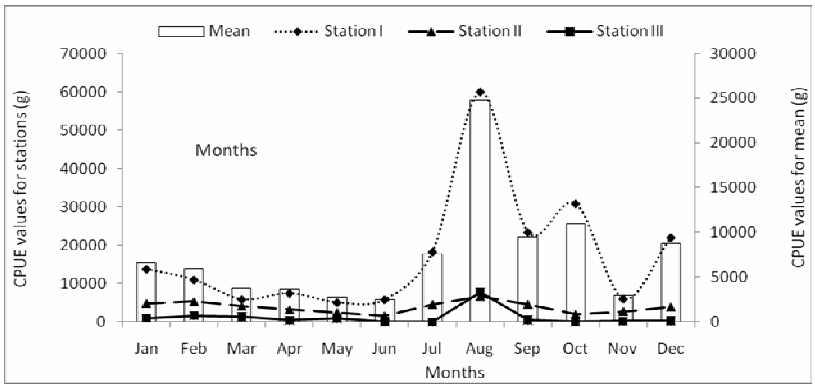

Fig. 5. Monthly changes of CPUE value of Lessepsian Fishes in stations

The relationship between mean total CPUE value and Lessepsian fishes CPUE value was represented in fig. 6. As can be seen figure, It was determined that there has been a positive and linear relationship between the total catch and value of the Lessepsian

fish catch which has been statistically significant ($p>0.01$). According to this relationship, the Lessepsian CPUE increased parallel to the increasing mean total CPUE during the study period.

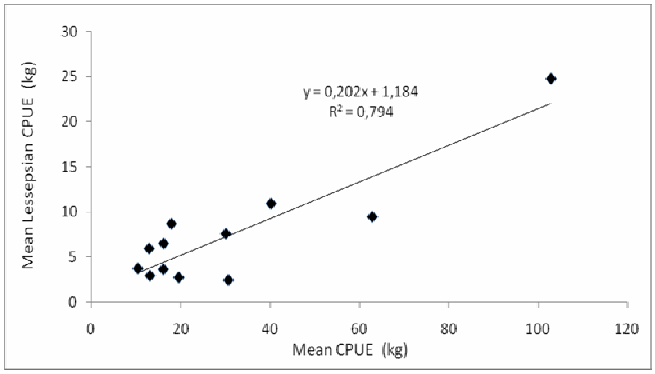

Fig. 6. Relationship between mean total CPUE and Lessepsian fish CPUE values

Monthly changes of Lessepsian fish species proportion in main catch was listed in tabl. 1. As can be seen the tab. 1, 4 Lessepsian fish species were represented in the most abundant 10 species (main catch). The proportion of Lessepsian fishes in main catch ranged from 4.9% in June to 47.58% in December. The most abundant species *S. undosquamis* represented in main catch with in all sampled months, *U. pori* was in main catch generally the coolest months, except August, in contrast *U. moluccensis* was in main catch the hottest months, except December. Other species belonging to main catch is *L. klunzingeri* was main component of main catch on 6 months.

Table 1. Monthly changes of Lessepsian Fishes proportion in main catch (rank of the fish in main catch in parenthesis)

Months	***S. undosquamis***	***U. moluccensis***	***U. pori***	***L. klunzingeri***
January	12.23 (3)	-	22.13 (1)	3.47 (7)
February	19.54 (1)	-	19.29 (2)	5.24 (5)
March	21.53 (1)	-	7.25 (4)	3.66 (10)
April	13.22 (2)	-	7.89 (4)	-
May	7.52 (4)	-	-	-
June	4.90 (5)	-	-	-
July	22.59 (1)	1.38 (10)	-	-
August	8.81 (2)	3.72 (9)	4.34 (7)	6.59 (3)
September	5.35 (5)	4.71 (6)	-	4.62 (7)
October	9.30 (2)	15.81 (1)	-	3.04 (9)
November	17.32 (1)	-	-	-
December	11.66 (2)	3.79 (6)	32.13 (1)	-

Proportion of Lessepsian fish species were estimated as 21.84%, 21.31%, 21.36% and 44.89% in total catch on spring, summer, autumn and winter, respectively, and the mean value was calculated as 26.69% for all months. Proportion of Lessepsian fish in summer were reported as 62% for İskenderun Bay, as 34% for Mersin Bay and as 27% for coastal area between İncekum and Anamur where can be representative for studied area. Indeed there were big similarity between presented value (26.69%) in this study and the value (27%) reported by Gücü *et al.* [15]. Generally Lessepsian fish abundance

in the eastern Mediterranean gradually decreases from east to western coasts [8, 11]. The values given by Gücü *et al.* (1994) support this finding. Babadillimani Bight is western extend of Mersin Bay, therefore the lowest proportion of Lessepsian fish in the study area was not surprise compared to values reported by Gücü *et al.* [15].

The highest total fish catch was obtained in August. At the same month, the highest Lessepsian catch was presented from station III. On the other hand, when the lowest catch was caught in June, there was not obtained any Lessepsian fish species from station III. It can be claim that same as reported by previous studies Lessepsian fish preferred to inhabiting shallow waters in Babadillimani Bight. However, if the catch reaches high level, Lessepsian fish distribution can be extent from shallow waters to deep one. Likewise, Watanabe *et al.* [17, 18] reported that, when Japanese Sardine has high annual catch value, because of carrying capacity, spawning ground where normally coastal areas, can be extent to oceanic deep waters.

Some of Lessepsian fish species (*E.teres*, *S.undosquamis, U.moluccensis, U. pori*, *S. chrysotaenia*, *S. shima*, *S. rivulatus* and *S. luridus*) presented in this study are commercially important species [3]. According to this finding, half of the Lessepsian fish species have economically important.

Some Lessepsian fish species were reported consist of main catch in previous studies. *S. undosquamis* [4, 7, 9], *U. moluccensis* [4, 7, 15], *U. pori* [4, 7, 9], *L. klunzingeri* [4, 7, 9] and *S. rivulatus* [4]. It can be claim that there were great similarity species compositions in main catch among this study and previous studies.

Lessepsian fish generally inhabits shallow and warm coastal area in the eastern Mediterranean [3]. Similarly almost the highest catch and CPUE value were presented from station I which located on 0-50m depth layer. Both most of Lessepsian catch and number of species were obtained from shallow waters (Station I). Indeed, Many author reported that, Lessepsian species generally distributes shallow waters [4, 9, 17]. BenYami and Glaser [5] also indicated that, in shallow water bottom trawl operations Lessepsian fish catch is one of the main components of catch; while Lessepsian fish abundance decreases with increasing dept.

However, there was not find any positive correlation between sea surface temperature and catch. On the contrary, surprisingly the highest Lessepsian fish catch was obtained during the months detected low sea surface temperature and salinity.

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