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# Natural Fish Fry Food of Seven Commercial Species in the Egyptian Mediterranean Water

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**Abstract:** Fry diet and feeding habits of seven marine fish species; *Liza ramada*, *Mugil cephalus*, *Sparus auratus*, *Dicentrarcus labrax*, *Liza aurata*, *Argirosomus regius* and *Solea solea*, collected from fry collection station located at the Mediterranean Sea coast east of Damietta Harbor, were considered. A high diversity of zooplankton species (116 species) was recorded in the Mediterranean water which was make use of for feeding this station during the period of study (July, 2007 – June 2008). These items were considered as the menu which the fish fry is selected as their food. Although fry of each fish species fed on certain items of zooplankton; yet 28 zooplankton items were recorded in the guts of fry of the seven fish species. *Liza ramada* fry were the most diversified species in their food (fed on 19 zooplankton items), and *Mugil cephalus* fry were the most specialized (fed on 8 zooplankton items).Copepodite stages and Nauplii larvae were the most preferable zooplankton items in the diet of the fry of the seven fish species, with percent frequency of occurrence 48.8 and 29.0, respectively. *Gammarus aequicauda* (24.32%) and *Euterpina acutifrons* (17.86%) are preferable for fry of six fish species. *Paracalanus parvus* (28.98%), Cirriped larvae (20.20%), Mysis larvae (19.69%) and Zoea larvae of crab (12.85%) are found in the fry guts of five fish species. One way ANOVA showed a significant correlation among the studied fish fry, where eight zooplankton items were considered as the most preferable zooplankton items for these fry. In conclusion fry of studied fish species fed on selected zooplankton items in their natural habitat.

**Key words:** Fish fry · Diet composition · Feeding habits · Zooplankton · Egyptian Mediterranean coast

## INTRODUCTION

One of the most important influences for the survival of fish fry is the availability of suitable food knowledge of fry feeding behaviour is necessary for understanding of the factors that affect the mortality of the fry in the wild and the subsequent year – class strengths of the adult fish [1].

Feeding strategies of fish fry are complex. Moreover, they depend on the food availability in areas defined by mesoscale hydrographic structures [2]. Some factors, such as the physiological and morphological features of the fry and their innate preferences, play important roles. Perception, recognition, capture, and digestibility of prey influence the apparent selection of food [3, 4].

*Dicentrarcus labrax*, *Sparus auratus, Liza ramada, Liza aurata, Mugil cephalus, Solea solea* and *Argirosomus regius* are the most important cultivated marine fish species in Egypt as well as in some countries along the Mediterranean coast. Egypt, Greece, Israel, Italy, Tunisia and Turkey do most of the estimated 195.3 million tons of the catch. Of these, 130 million tons (66.6%) are caught in Egypt [5], where the previous species are cultivated at the Northern area of Manzala Lake.

The knowledge on the food of fish fry in their natural habitat is very important to know the suitable food during their cultivation and is the main factor for winning of the artificial propagation. Special interest must paid to food of young fish for the successful rearing because poor performance in feeding, cause high mortality and hinder growth of fish fry during their early development both in nature and in aquaculture [6 - 8]. Also, it was suggested that the food availability to fry and their ability to consume it, at the critical time of yolk exhaustion, could be

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an important factor in determining fry survival and fish population dynamics in next year [9].

The goals of this study were to identify the nature of the feeding ecology, as well as the preferable food items used by the fry of the commercial fish in the Egyptian Mediterranean water.

## MATERIALS AND METHODS

Damietta Governorate is the first Egyptian Governorate in the production of fish fry for several reasons: it is an estuarine area where the Damietta branch of the River Nile pours its fresh water which contains large amounts of nutrient salts into the Mediterranean; the water in this area is highly oxygenated which is essential for the aquatic biota; plankton production is high all the year round, all these reasons make the water quality in this area healthy for aquatic organisms [10]. In Egypt fry collection stations are distributed mainly on the Delta coast of the Mediterranean, especially at the outlets of the major agriculture drainage canals, branches of the Nile and the connecting canals of lagoons and lakes to the sea [11]. The functional roles of estuaries and coastal lagoons to fish have been extensively investigated worldwide, in temperate, subtropical and tropical areas [12-17], with a particular focus on their nursery function.

The present study was conducted monthly from July 2007 to June 2008 at a fry collection station located at the Mediterranean Sea coast, east of Damietta Harbor and at the outlet of Barge Canal (Fig. 1 ). Zooplankton samples were collected by filtering 5 Liters of sea water that feed this station through a plankton net of 55 mm mesh-size. The concentrated samples were preserved in 4% neutral buffer formalin. The standing crop of zooplankton was estimated from the average counts of three aliquots (5 ml each).

Fish fry of the studied species were collected by a fine mesh seine net. The average lengths of collected fish fry were 2, 1.5, 2.1, 2.5, 3, 2.8 and 3 cm and mean weights 0.075, 0.031, 0.071, 0.155, 0.225, 0.477 and 0.201 g for *Dicentrarcus labrax, Sparus auratus, Liza ramada, Liza aurata, Mugil cephalus, Argirosomus regius* and *Solea solea,* respectively. Fish fry were preserved in situ in 4% formalin. In laboratory, fry were dissected and their guts content were examined, each dietary item was identified to the lowest taxonomic level as possible and counted under a research microscope. zooplankton species in the water and in the fry guts were identified following standard taxonomic references [18-24]. A total of 350 guts were inspected, 50 guts / each fish species. Empty guts were excluded from calculations.

The frequency of occurrence reflectes the percentage number of fish predators which utilized that prey and percentage composition means percentage of individuals of each prey item eaten by each fish, were calculated according [25, 26].

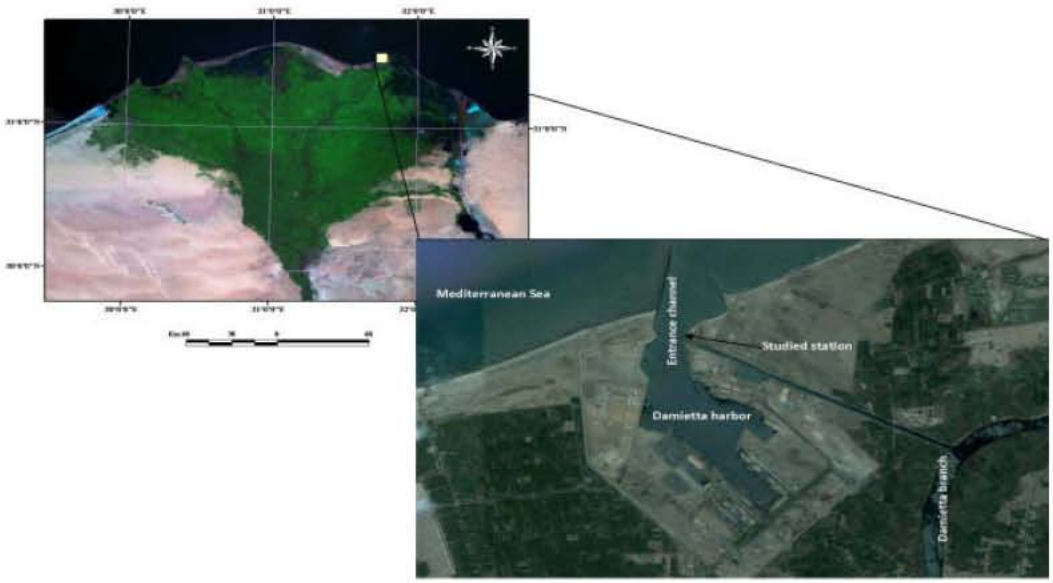


Fig. 1: Location of the sampling station

## RESULTS

Fry of the seven studied fish species are arranged according to the size of catch in the studied fry collection station: *Liza ramada* (32%), *Mugil cephalus* (20%), *Sparus auratus* (17%), *Dicentrarcus labrax* (13%) *Liza aurata* (9%), *Argirosomus regius* (8%) and *Solea solea* (1%). These fry appeared in the catch during different months (Fig. 2), whereas, *Mugil cephalus* appeared during August to December and peacked during September. *Liza aurata* from October to March with a peaked during January. *Liza ramada* (November -April and the maximum catch were recorded in February), *Sparus auratus* (January - April with a peak during February and March). Very small percentage of *Solea solea* was collected through February to May. *Dicentrarcus labrax were* collected between March and June with a peak during May. *Argirosomus regius* were collected during May, June and July, where-as the most catch was recorded during June.

Wide varieties of zooplankton species (116 species) were recorded in the Mediterranean water entered the fry collection station during the period of study, with annual average 175x$10^3$ organisms/$m^3$ (Table 1). These items were the menu which the fish fry of the studied fish species selected for their food. The main beak of zooplankton abundance was recorded during February (1222x$10^3$ Organisms/$m^3$), another two small beaks were recorded during May and June (639 x $10^3$ and 507 x $10^3$ Organisms/$m^3$, respectively), Copepodite stages and nauplii larvae represented an average of 7 and 57%. respectively of total zooplankton during the study period.

Although the fry of each fish species fed on some of these zooplankton items; 28 zooplankton items represented the food for the fry of the seven fish species (Table 2).

About 13 zooplankton items were recorded in the guts of *Dicentrarcus labrax* fry. Copepodite stages represented the highest frequency where it occurred in 41.38 % of the guts examined and it composed

Table 1: Annual average counts (Organisms/m3) of zooplankton species in the water enter the fry collection station

| Species | Average | Species | Average |
|---|---|---|---|
| **Protozoa** | | *Trichocerca cylindrica* (Imhof) | 1184 |
| *Arcella* sp (1) | 428 | Metamorphosis of rotifers | 148 |
| *Assulina* sp | 505 | **Nematoda** | |
| *Centropyxis* sp | 1 | *Alcimus* sp | 18 |
| *Difflugia* sp | 35 | *Anonchus sp.* | 164 |
| *Nebela* sp | 29 | *Dorylaimus sp.* | 159 |
| *Plagiophyla* sp | 17 | *Ethmolaimus* sp | 4 |
| *Plagiopyxis* sp | 289 | **Copepods** | |
| *Trochaminia* sp | 32 | *Acanthocyclops americanus* (Mar.) (3) | 13 |
| *Amphileptus pleurosigma* (Stokes) | 15 | *Acartia clausi* (Giesbr.) (4) | 68 |
| *Glaucoma* sp | 1 | *A. grani* (G.O.Sars) | 1 |
| *Paramecium* sp | 62 | *A. latisetosa* (Kricz.) | 1 |
| *Stentor polymorphus* (Mull.) | 25 | *Canthocamptus gracilis* (Sars) | 310 |
| *Vasicola ciliata* (Tatem) | 34 | *Centropages kroyeri* (Giesbr.) (5) | 52 |
| *Adelosina elegans* (Williamson) | 68 | *Ergasilus sieboldi* (Nordmann) | 791 |
| *Bolivina inflata* (Heron-Allen and Earland) | 85 | *Euterpina acutifrons* (Claus) (6) | 550 |
| *Discorbis* sp | 33 | *Halicyclops magniceps* (Lilljeborg) (7) | 19 |
| *Laticarinia* sp. | 62 | *Horsiella brevicornis* (Van Douwe) | 17 |
| *Nodosaria* sp. (2) | 61 | *Mesochra rapiens* (Schmeil) | 162 |
| *Nonion boueanum* (d'Orbig.) | 19 | *Microsetella norvegica* (Boeck) (8) | 368 |
| *Quinqueloculina* sp | 645 | *Nitocera lacustris* (Schmank.) | 660 |
| *Spirillina limbata* (Brady) | 85 | *Oithona nana* (Giesbr.) (9) | 7281 |
| *Eutintinnus lusus* -undae (Entz) | 9 | *O. plumifera* (Baird) | 862 |
| *Favella adriatica* (Imhof. andBdt.) | 94 | *Onychocamptus mohammed* (Blanch. andRich) | 258 |
| *F. ehrenbergii (*Clap. and Lahm.) | 978 | *Paracalanus parvus* (Claus) (10) | 666 |
| *F. markusovszkyi* (Dad.) | 67 | *Tachidius discipes* (Giesbrecht) (11) | 78 |
| F. serrata (Mob.) | 458 | Nauplii larvae (12) | 99243 |
| *Helicostomella subulata* (Ehr.) | 12697 | Copepodite stages (13) | 12912 |
| *Leprotintinnus nordqvisti* (Brand.) | 236 | **Cladocera** | |
| *Metacylis mediterranean* (Mereschk.) | 321 | *Bosmina longirostris* (O. F. M.) (14) | 53 |
| *Tintinnopsis beroidea* (Entz) | 1032 | *Daphnia catawba (Coker)* (15) | 6 |
| *T. bilietschlii* (Dad.) | 318 | *Evaden lergestina* | 33 |
| *T. campanula* (Ehr.) | 1917 | *Ilyocryptus spinifer* (Herrick) | 1 |
| *T. cylindrica* (Dad.) | 265 | *Moina macrocarpa* (Strans) (16) | 2 |
| *T. lobiancoi* (Dad.) | 319 | *Podon intermedius* (Lilljeborg) | 106 |

Table 1: Continued

| | | | |
|---|---|---|---|
| *T. tocantinensis* (Kof. andCamp) | 120 | **Ostracoda** | |
| *Stenosemella nivalis* (Meun.) | 395 | *Candona* sp | 338 |
| *S. steini* (Jorg.) | 160 | *Cyprea* sp | 134 |
| *S. ventricosa* (Clap. and Lachm.) | 655 | **Amphipoda** | |
| *Undella hyale*na | 17 | *Elasmopus pectinicrus* (Bate) (18) | 4 |
| **Cnidaria** | | *Gammarus aequicauda.* (Martynov.) (19) | 401 |
| *Ectopleura dumortieri* (Van.Beneden) | 15 | *Hyperia* sp | 1 |
| Medusa of Obelia spp. | 51 | **Decapoda** | |
| **Rotifers** | | *Leptomysis mediterranea* (G.O.Sar.) (20) | 1 |
| *Anuraeopsis fissa* (Gosse) | 201 | *Mysis oculata* (Loven) (21) | 3 |
| *Ascomorpha saltans* (Bartsch) | 859 | Mysis larvae (26) | 171 |
| *Asplanchna priodonta* (Gosse) | 15 | Zoea larvae of crab (24) | 2 |
| *Brachionus angularis* (Gosse) (28) | 102 | **Isopoda** | |
| *B. baylyi* (Sudzuki and Timms) (28) | 204 | *Sphaeroma sp.* (27) | 6 |
| *B. calyciflorus* (Pallas) (28) | 139 | **Cumacaea** | |
| *B. furculatus* (Rousselet) (28) | 5 | *Diastylis* sp. (17) | 4 |
| *B. plicatilis* (Muller) (28) | 7059 | **Chaetognatha** | |
| *B. urceolaris* (Muller) (28) | 1492 | *Sagitta friderici* (R.Z.) | 60 |
| *Keratella cochlearis* (Gosse) | 366 | **Polychaeta** | |
| *K. serrulata* (Her.) | 19 | Polychaete larvae | 4253 |
| *K. tecta* (Gosse) | 19 | **Cirripidia** | |
| *K. valga* (Her.) | 52 | Cirriped larvae (22) | 1258 |
| *Lepedella sp.* | 28 | Cyprius larvae (23) | 223 |
| *Monostyla lunaris* (Ehr.) | 51 | **Mollusca** | |
| *Polyarthra vulgaris* (Carlin) | 19 | *Lamellibranch veliger* (25) | 8046 |
| *Proales daphnicola* (Thompson) | 15 | *Limacina inflata* (d'Orb.) | 137 |
| *P. fallaciosa* (Wulfert) | 21 | Ascidian larvae | 101 |
| *Synchaeta oblonga* (Ehr.) | 51 | Crustacean eggs | 47 |
| *S. okai* (Sudzuki) | 465 | Fish eggs | 10 |
| *S. pectinata* (Ehr.) | 52 | | |

Note: Numbers represented in this table between ( ), used as abbreviations in all figures.

Table 2: Correlations between the abundance of preferable zooplankton items and the fry of the seven fish species

| | Fish species | | | | | | |
|---|---|---|---|---|---|---|---|
| Zooplankton items | D.l. | S.a. | L.r. | L.a. | M.c. | A.r. | S.s. |
| *Arcella sp* | 0.422(*) | 0.582(**) | 0.488(*) | 0.077 | -0.17 | -0.254 | 0.244 |
| *Nodosaria* sp. | -0.107 | -0.08 | 0.565(**) | 0.355 | -0.191 | -0.137 | -0.096 |
| *Acanthocyclops americanus* (Mar.) | -0.088 | -0.076 | 0.428(*) | 0.33 | -0.157 | -0.113 | -0.092 |
| *Acartia clausi* (Giesbr.) | -0.085 | -0.08 | -0.122 | 0.124 | 0.091 | -0.082 | 0.151 |
| *Centropages kroyeri* (Giesbr.) | -0.153 | -0.202 | -0.286 | -0.287 | 0.374 | 0.041 | -0.249 |
| *Euterpina acutifrons* (Claus) | 0.104 | 0.116 | 0.191 | 0.387 | -0.191 | -0.184 | 0.068 |
| *Halicyclops magniceps* (Lilljeborg) | -0.127 | -0.142 | 0.352 | 0.334 | -0.139 | -0.163 | -0.174 |
| *Microsetella norvegica* (Boeck) | 0.121 | 0.09 | -0.159 | -0.213 | -0.12 | 0.066 | 0.040 |
| *Oithona nana* (Giesbr.) | -0.219 | -0.255 | -0.238 | -0.187 | -0.009 | 0.357 | -0.237 |
| *Paracalanus parvus* (Claus) | -0.041 | -0.065 | -0.026 | -0.262 | -0.207 | 0.421(*) | -0.015 |
| *Tachidius discipes* (Giesbrecht) | 0.14 | -0.018 | -0.011 | 0.291 | -0.142 | -0.102 | -0.070 |
| Nauplii larvae | 0.106 | 0.181 | -0.249 | -0.326 | -0.263 | 0.488(*) | 0.270 |
| Copepodite stages | -0.166 | -0.134 | -0.296 | -0.312 | -0.215 | 0.411(*) | 0.144 |
| *Bosmina longirostris* (O. F. M.) | -0.022 | -0.022 | 0.008 | 0.095 | 0.387 | -0.283 | -0.172 |
| *Daphnia catawba* (Coker) | 0.546(**) | 0.680(**) | 0.072 | -0.046 | -0.157 | -0.113 | 0.374 |
| *Moina macrocarpa* (Strans) | -0.105 | -0.138 | -0.168 | -0.082 | 0.538(**) | -0.134 | -0.171 |
| *Diastylis* sp. | 0.758(**) | 0.415(*) | -0.007 | -0.086 | -0.157 | -0.113 | 0.374 |
| *Elasmopus pectinicrus (Bate)* | 0.775(**) | 0.783(**) | 0.198 | -0.120 | -0.337 | -0.214 | .691(**) |
| *Gammarus aequicauda.* (Martynov.) | 0.845(**) | 0.854(**) | 0.218 | -0.122 | -0.325 | -0.207 | .735(**) |
| *Leptomysis mediterranea* (G.O.Sar.) | 0.018 | 0.083 | 0.329 | 0.073 | -0.157 | -0.113 | -0.006 |
| *Mysis oculata* (Loven) | 0.018 | 0.083 | 0.329 | 0.073 | -0.157 | -0.113 | -0.006 |
| *Cirriped larvae* | -0.124 | -0.159 | -0.233 | -0.206 | 0.338 | 0.021 | -0.197 |
| *Cyprius larvae* | -0.064 | -0.031 | 0.406(*) | 0.222 | -0.189 | 0.000 | -0.065 |
| Zoea larvae of crab | 0.018 | 0.083 | 0.329 | 0.073 | -0.157 | -0.113 | -0.006 |
| *Lamellibranch* veliger | -0.158 | -0.144 | -0.293 | -0.271 | 0.076 | 0.031 | 0.066 |
| Mysis larvae | 0.007 | 0.078 | 0.397 | 0.098 | -0.177 | -0.127 | -0.012 |
| *Sphaeroma sp.* | 0.883(**) | 0.973(**) | 0.073 | -0.169 | -0.341 | -0.183 | 0.730(**) |
| *Brachionus sp.* | -0.146 | -0.179 | -0.205 | -0.097 | 0.191 | 0.059 | -0.228 |

Note: D.L.= *Dicentrarcus labrax*, S.a.= *Sparus auratus*, L.r.= *Liza ramada*, L.a.= *Liza aurata*, , M.c.= *Mugil cephalus*, A.r.= *Argirosomus regius*, S.s.= *Solea solea*, * Significant at $p<0.05$, ** Significant at $p<0.01$

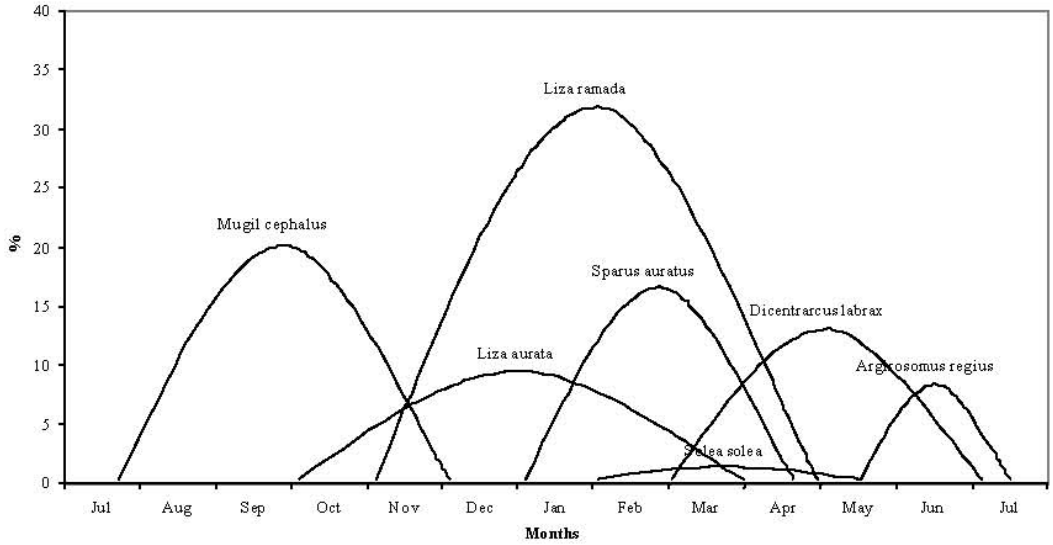


Fig. 2: Time of occurrence and percentage composition of fish fries during the study period

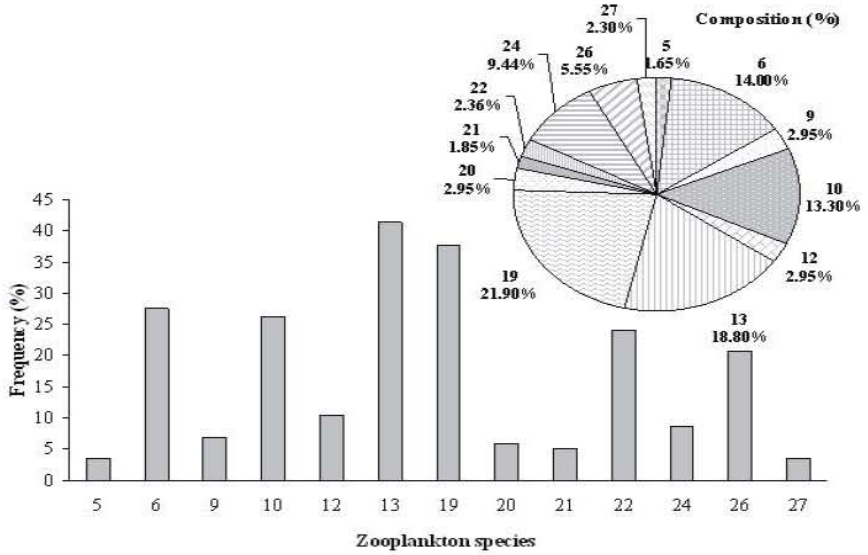


Fig. 3: Percentage frequency of occurrence and percentage composition of zooplankton items in guts of *Dicentrarcus labrax fry*

the second percentage (18.8%) of the *Dicentrarcus labrax* fry diets. In contrast *Gammarus aequicauda* constituted the highest percentage of composition (21.9%) and the second percentage of occurrence (37.8%), as shown in Fig 3.

The diet of *Sparus auratus* fry consisted of 13 items. Copepodite stages and *Paracalanus parvus* were the most important food items, occurred in 70 and 62 % of the stomachs examined and with a percentage composition 31.1 and 28.5 %, respectively (Fig. 4).

*Liza ramada* fry were the most diversified species for food. The diet consisted of 19 zooplankton items. Copepodite stages occurred with a percentage of 78.43%, while *Paracalanus parvus* composed the highest percentage (24.1%) of the diets. *Acanthocyclops americanus*; Nauplii larvae, *Moina macrocarpa*, Cirriped larvae and Cyprius larvae were also preferable for *Liza ramada* fry. They occurred in 27.5, 45.1, 41.3, 31.37 and 29.41% of fry guts and composed 11.0, 15.64, 5.44, 7.35 and 6.03% of fry diets, respectively (Fig. 5).

The diet of *Liza aurata* fry comprised 15 items. Copepodite stages constituted the highest percentage of occurrence (64.71) and composition (30-0). *Acanthocyclops americanus*, *Euterpina acutifrons*,

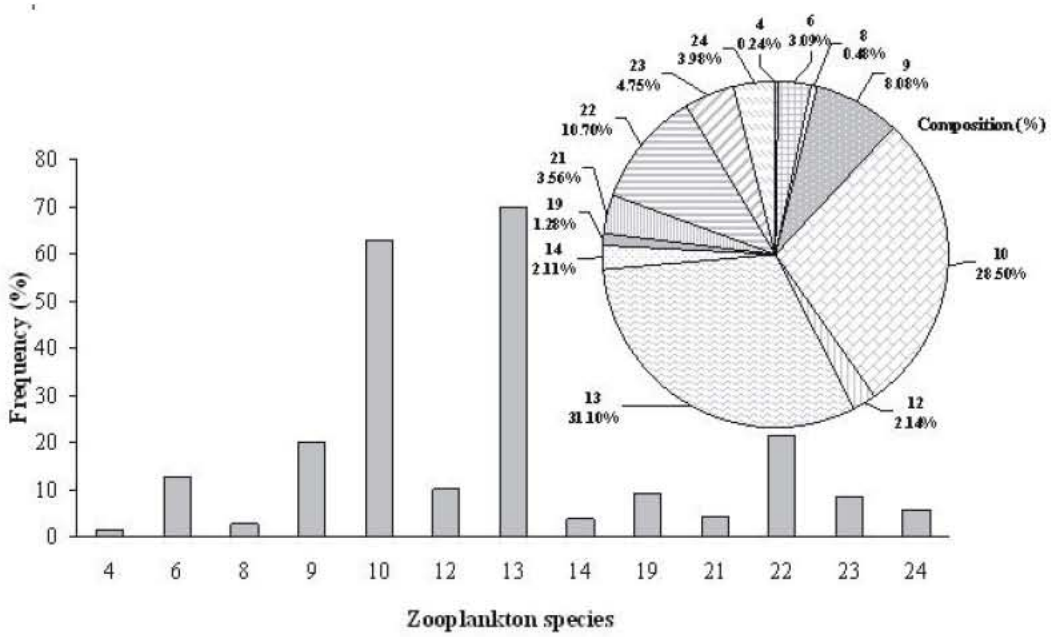


Fig. 4: Percentage frequency of occurrence and percentage composition of zooplankton items in guts *of Sparus auratus fry*

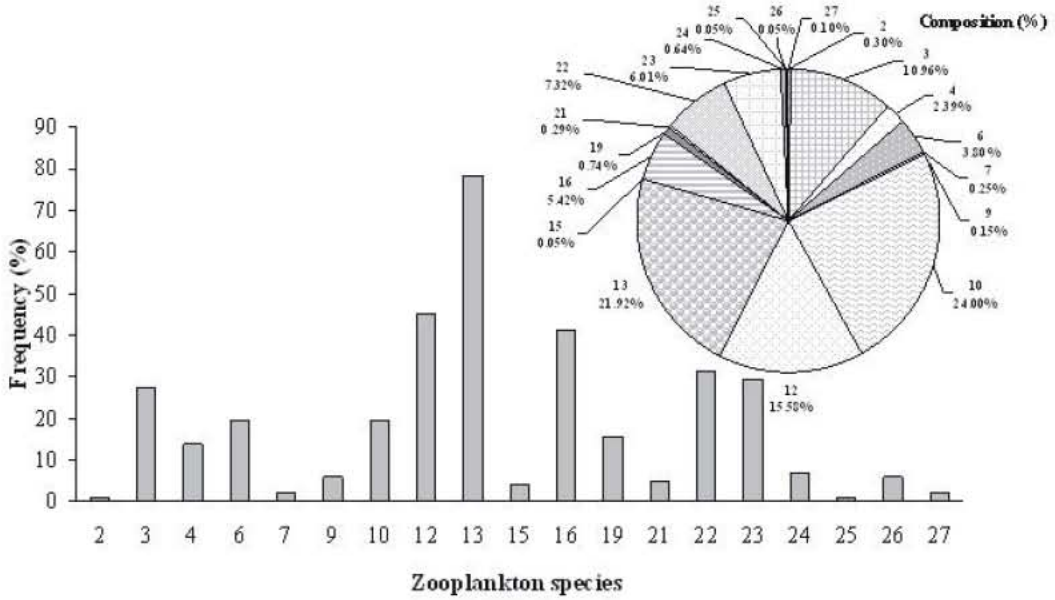


Fig. 5: Percentage frequency of occurrence and percentage composition of zooplankton items in guts of *Liza ramada fry*

*Gammarus aequicauda,* Zoea larvae of crab and Mysis larvae were presented with frequency of 35.29, 27.1, 23.53, 29.41, and 27.1% respectively. Nauplii larvae and Copepodite stages composed about half of fry diets (Fig. 6).

Only 8 zooplankton items were recorded in the guts of *Mugil cphalus* fry. Copepodite stages were recorded in 50% of the examined guts, and composed 42.5% of the diets. Nauplii larvae and *Brachionus* spp. were found in 25% of guts. *Arcella sp, Acanthocyclops americanus, Moina macrocarpa, Gammarus aequicauda* and *Mysis oculata*. were also found in a considerable number (7.143, 13.9, 3.2, 14.29 and 16.5 %, respectively) of the guts (Fig. 7).

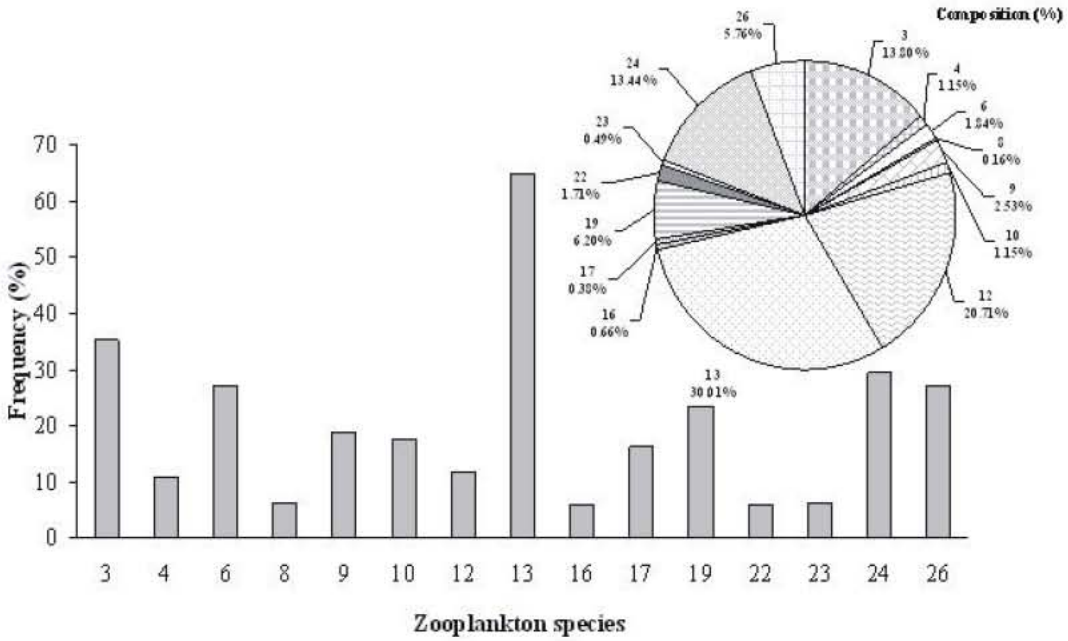


Fig. 6: Percentage frequency of occurrence and percentage composition of zooplankton items in guts of *Liza aurata fry*

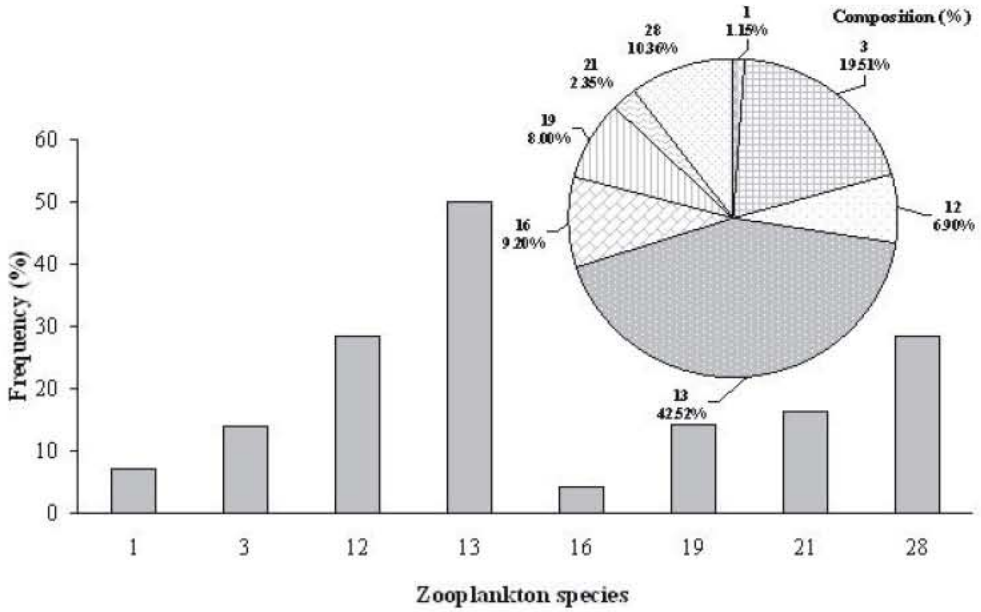


Fig. 7: Percentage frequency of occurrence and percentage composition of zooplankton items in guts of *Mugil cephalus fry*

The diet of *Argirosomus regius* fry consisted of 9 items. The most frequent zooplankton items were *Gammarus aequicauda*. (45.45%) and Mysis larvae (35.6%) which represented high percentage of composition (30.5 and 38.1 %. respectively) of fry diets (Fig. 8).

Nine items were recorded in the guts of *Solea solea* fry, (Fig. 9). Although *Elasmopus pectinicrus* (55.56%), Nauplii larvae (32.2%) and Cyprius larvae (23.4%) were the most frequent, *Elasmopus pectinicrus* composed about 70 % of the diet.

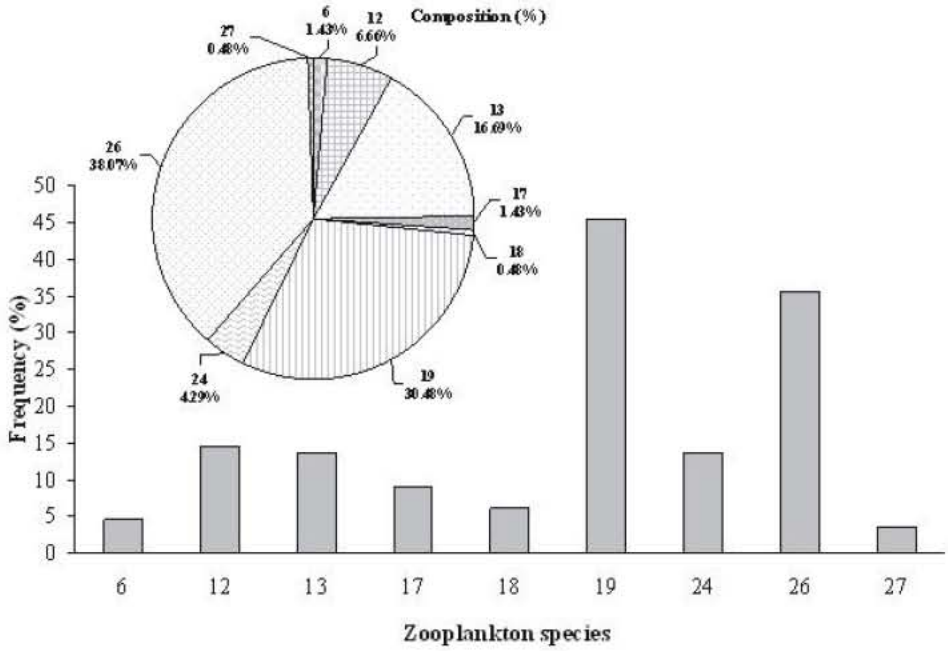


Fig. 8: Percentage frequency of occurrence and percentage composition of zooplankton items in guts of *Argirosomus regius fry*

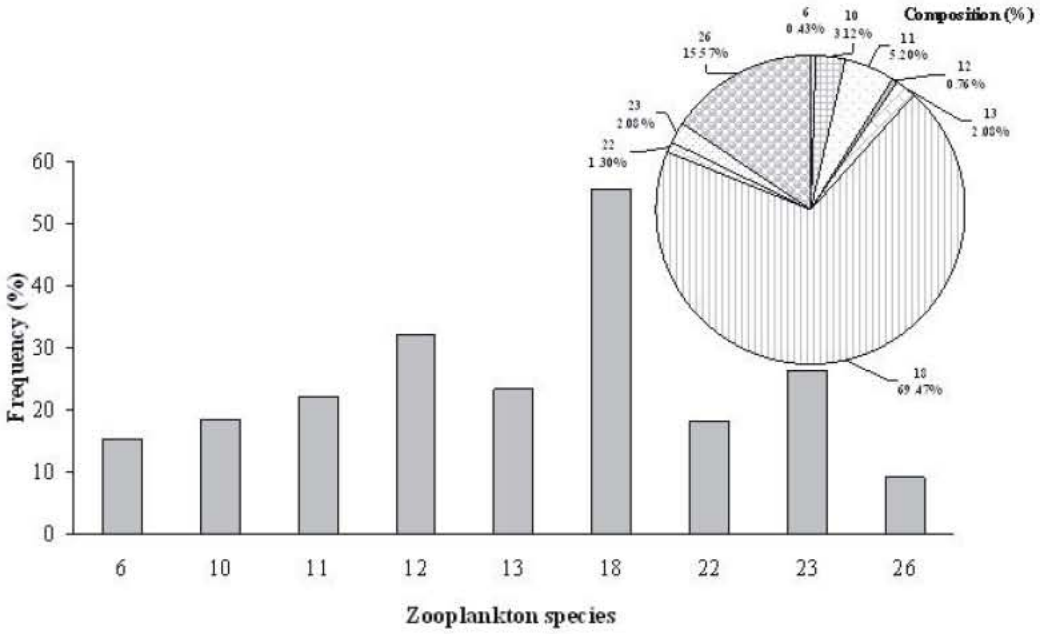


Fig. 9: Percentage frequency of occurrence and percentage composition of zooplankton items in guts of *Solea slolea fry*

Table 3: The most preferable zooplankton items for the studied fish fry

| Zooplankton items | Copepodite stages | *Paracalanus parvus* | *Gammarus aequicauda* | Nauplii larvae | Cirriped larvae | Mysis larvae | *Euterpina acutifrons* | *Zoea larvae of crab* | ANOVA One-way | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | Factor | DF | F-value | Sig. |
| % Noumber of fish species | 48.79 ± 24.22 7 | 28.98 ± 19.23 5 | 24.32 ± 14.38 6 | 21.82 ± 13.64 7 | 20.20 ± 9.37 5 | 19.69 ± 12.35 5 | 17.86 ± 8.84 6 | 12.85 ± 9.74 5 | Zooplankton | 7 | 3.311 | 0.008*** |

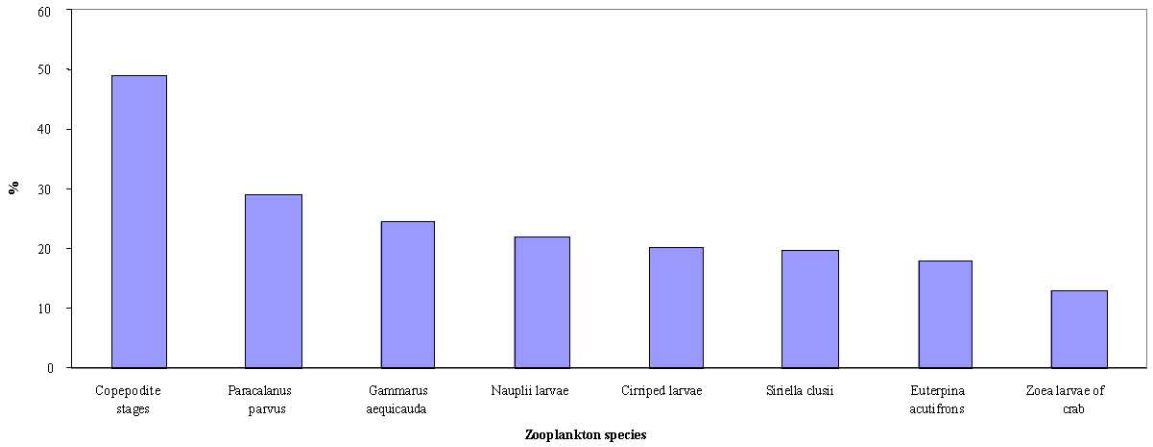


Fig. 10: The most preferable zooplankton items for studied fish species fry

The most 8 preferable zooplankton items of the fry of the seven fish species were arranged according to their frequency of occurrence (Table 3 and Figure 10). Copepodite stages (48.79 %) were the most edible zooplankton item. Copepodite stages and Nauplii larvae (21.82%) were eaten by all fry of fish species. *Gammarus aequicauda.* (24.32%) and *Euterpina acutifrons* (17.86%) are preferable for fry of six fish species. *Paracalanus parvus* (28.98%), Cirriped larvae (20.20%), Mysis larvae (19.69%) and Zoea larvae of crab (12.85%) were recorded in the fry guts of five fish species. One way ANOVA showed a significant correlation among studied fish fry and the eight preferable zooplankton items.

## DISCUSSION

The study of trophic ecology is useful and fundamental to understandthe functional role of the fish within their ecosystems [13, 27]. The water of the fry collection station was highly diversified with available food during study period, where the annual record was 116 zooplankton species; Diversity has always been used as an index of ecosystem well-being with species rich communities being healthier than those poor in species [28]. All species found in the guts of these fry were found in the water of the Mediterranean sea during this study, but with different correlations, for example Copepodite stages, the main prey was represented by an average of 48.8% of the fry diet of the seven species studied and found in the water during this study with annual percentage 7% of the total standing crop of zooplankton, Nauplii larvae 29% in the diet against 57% in the water. *Gammarus aequicauda* 24.32% in the diet against 0.2% in the water. *Euterpina acutifrons* 17.86% in the diet against 0.3% in the water, this means that these fry have great food selectivity.

A total of 28 zooplankton items were recorded only in the guts of the seven fish species fry; this indicates also that the fry of these species were specialized in their food. The fry of these fish species have different feeding strategies. *Liza ramada* and *Sparus auratus* fry appeared in the catch during the period November to April, with a peak during February, during this period about 100 zooplankton items were recorded in the water, 19 and 13 of them were recorded in their guts, respectively.

*Paracalanus parvus* and copepodite stages were the main prey items constituting together 46.1% for *Liza ramada* diet and 62% of the *Sparus auratus* diet. During this period *Paracalanus parvus* and copepodite stages constituting 4.8% of the total zooplankton count. Pihl *et al.* [29] observed a tendency for a spatial segregation between the abundance of zooplankton and larval fish. *Liza ramada* larvae were the most vigorous and it catches (35%) more than the other studied species.

Also. The peak of *Liza aurata* was recorded during January, and the preferable food item was copepodite stages with percent composition 30%. The peak of *Mugil cephalus* was recorded in September, the main food item also copepodite stages (42.5%) of the fry diet.

The peaks of *Dicentracus labrax* fry and *Argirosomus regius* fry were recorded during May and June respectively; these fry ate the amphipode, *Gammarus aquicauda* which nearly removed from the water, although it was found during the last month with high numbers (1635 organisms/$m^3$).

As for the fry of *Solea solea*, which found in the fry collection station during February to May, its diet consisted of 9 species. The amphipode, *Elasmopus*

*pectinicrus* was the main prey item, constituting more than 70% of their diet, and the other 8 species were represented by 30%. The synchrony between the fish fry of this species and its preferable food is very clear where this amphipod species appeared in water during February to May only. This synchrony between ichthyoplankton and zooplankton has already been observed [30]. In spring, most larvae fed on eggs of calanoid copepods and on copepodite stages of cyclopoid copepods [31].

Studied fish fry feed only on zooplankton species with different specialized patterns.zooplanktonic organisms represent the main source of food for fry and juvenile marine pelagic fish[32]. Tsikliras *et al.* [33] indicated that in the northern Mediterranean the species feed mainly on zooplankton and crustaceans. Similar feeding habits have been reported for the studied fry in other areas, with varied percentage composition [34].

Unlike adults, all the Mugilidae larvae and post-larvae feed mostly on zooplankton; during the recruitment phase both larval (planktivorous) and adult (grazing / detrivitorous) feeding strategies coexist in relative proportions, changing according to the food type available. Grey mullets have complex life cycles involving a zooplanktophagous fry stage and several detritivorous / herbivorous post-fry stages [35 – 38]. On the basis of stomach content analysis, Gisbert *et al.* [39, 40] concluded that the larvae of five native grey mullet species (*Chelon labrosus, Liza aurata, Liza ramada, Liza saliens* and *Mugil cephalus* and those of an exotic cyprinid (*Cyprinus carpio*) were the sole members in Western Mediterranean estuaries of a trophic guild that preyed mainly on copepods and cladocerans. During this study a good correlations were noticed between *Liza ramada* fry and the copepod *Acanthocyclops americanus* at $P<0.05$, also between *Mugil cephalus* fry and the cladocerans *Moina micrura* at $P < 0.01$.

In conclusion, studied fish fry feed only on zooplankton species and each one prefer certain items selected from the total zooplankton found in the surrounding water. These results are very important for the attention of fish diet in the early stages of their life, both after being transferred to farms or in the case of artificial hatcheries.

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