Biology features and parasites study of Mullet (Mugilidae) caught from Algerian coast

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Abstract
Mugilidae are one of the most farmed fish in Algerian freshwater aquaculture. The objective of the paper was to study the biological and parasitological characteristics of Mugilidae caught in Algerian coast. Six species were identified *Mugil cephalus* (Linnaeus, 1758), *Liza ramada* (Risso, 1827), *Liza aurata* (Risso, 1810), *Liza saliens* (Risso, 1810), *Chelon labrosus* (Risso, 1827) and *Oedalechilus labeo* (Cuvier, 1829), using morphological observation. Mullet fed on a variety of diet items including detritus, polychaetes, and sediments. Parasite groups recovered (from what) were identified as Nematoda, Monogenea, Copepoda, Ectoparasites, Cestoda, Digenea, and Cysts. Overall infection prevalence (%), mean intensity, and abundance values were 60%, 40.63, and 24.38, respectively. A significant correlation was observed (R>0.7) between fish size or weight and prevalence. Therefore, a sanitary treatment for the mullets before ponds introduction is necessary in order to prevent parasite transmission to cultured fish.
Keywords: Abundance, diet items, mean intensity, mullet, prevalence.

Résumé
Les Mugilidae sont parmi les poissons les plus élevés en aquaculture d'eau douce en Algérie. L'objectif de ce travail est d'étudié les caractéristiques biologiques et parasitologiques des Mugilidae pêchés en eau de mer. Six espèces ont été identifiées *Mugil cephalus* (Linnaeus, 1758), *Liza ramada* (Risso, 1827), *Liza aurata* (Risso, 1810), *Liza saliens* (Risso, 1810), *Chelon labrosus* (Risso, 1827), *Oedalechilus labeo* (Cuvier, 1829), grâce à l'observation morphologique. Le mulet se nourrit d'une variété d'aliments, parmi lesquels les détritus, les polychètes et les sédiments dominent. Les groupes de parasites identifiés sont les nématodes, les monogènes, les copépodes, les ectoparasites, les cestodes, les digènes et les cystes. La prévalence, l'intensité moyenne et l'abondance globale sont de 60 %, 40,63 et 24,38, respectivement. Une corrélation significative (R>0.7) entre la taille ou le poids des poissons et la prévalence a été observée. Par conséquent, un traitement sanitaire des mulets avant l'introduction dans les étangs est nécessaire afin d'éviter la transmission des parasites aux poissons d'élevage.
Mots-clés : Abondance, variété d'aliments, intensité moyenne, mulet, prévalence.

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Introduction

Mugilidae have a worldwide distribution and inhabit tropical and temperate areas both in seawater and freshwater (Ragias et al., 2005; Nelson, 2006). Their culture is practiced in Algeria and it is based on freshwater polyculture in earth ponds with carp (*Cyprinus carpio*) as part of the integration of aquaculture with agriculture mainly. However, it can be cultured in seawater or with other fish such as tilapia (*Oreochromis mozambica*) (Lahav, 1974, Paperna, 1964, 1975, Sarig, 1971). With the increasing development of Mugilidae aquaculture, the study of parasites and diseases of mullets continues to grow (Paperna, 1975). The latter can play an important and significant detrimental role in aquaculture and they can present aquaculture industry barriers (Paperna, 1975).

The objective of the present study was therefore to characterize the Mugilidae population and describe the main parasites found in these species caught in the wild.

Materials and Methods

This study was carried out in ENSSMAL laboratories. Fishes samples were purchased from the Algiers fishing port in the Spring of 2006.

According to Farrugio (1977) and Bauchot (1987), five meristic characters are commonly used to describe mullets using a binocular microscope: the number of anal rays, fish upper lip, adipose tissue, color, and pyloric caeca.

Specimens were measured for total length (TL) to the nearest 1 mm and weighed for total weight (TW) to the nearest 0.01g. Age was determined on 50 fish specimens (according to Lagler (1966)) by taking 7 scales from each individual (scales taken from the side of the body, between the end of the pectoral fin and the beginning of the dorsal fin).

The stomach content was analyzed by using occurrence index (OI%) and vacuity index (VI), (Hyslop,1980). Each prey was identified in the alimentary canal using various textbooks (Merritt and Cummins, 1996).

For the parasitological study, the skin, eyes, muscles, brain, heart, gills, body cavity, gonads, digestive system, and swimbladder of each individual, were meticulously dissected and observed under a binocular microscope. The identification of parasites was carried out using various textbooks (Radujkovic, 1982; Radujkovic and Euzet, 1989; Papoutsoglou, 1976). The parasitological indices were estimated according to Margolis et al. (1982) and Tor et al. (2002). The criteria include: prevalence (the percentage of the total number of fish infested out of the total number of fish examined), mean intensity (the number of parasites in the total number of infected fish) and abundance (the total number of parasites in the total number of examined fish).

Results

According to the observed meristic characters, six mullet species were identified: *Mugil cephalus* (Linnaeus, 1758), *Liza ramada* (Risso, 1827), *Liza aurata* (Risso, 1810), *Liza saliens* (Risso, 1810), *Chelon labrosus* (Risso, 1827), *Oedalechilus labeo* (Cuvier, 1829).

Regarding species distribution, *Liza aurata* is the most represented specie in the sample (32%), followed by the two other species: *Liza saliens* (26%) and *Chelon labrosus* (24%). *Mugil cephalus* (8%), *Liza ramada* (6%), and *Oedalechilus labeo* (4%) were found in a low proportion (Figure 1).

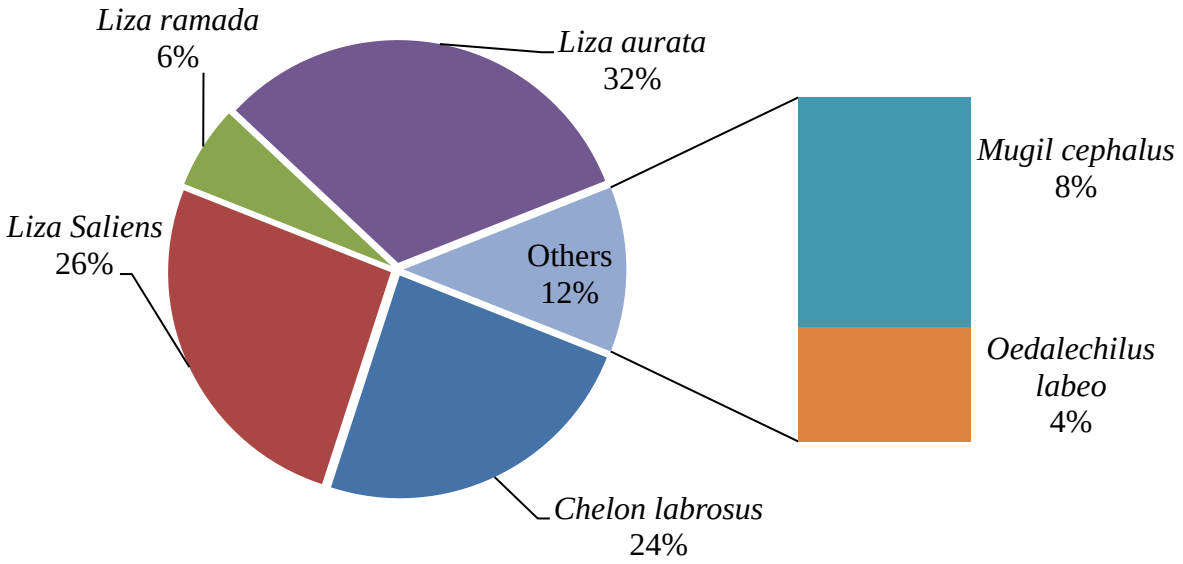

Figure 1 *Distribution of Mugilidae species caught in 2006.*

Length-frequency distribution indicates that [25-27[, [27-29[and [33-35[length groups had the highest number of specimens (species combined) (Figure 2).

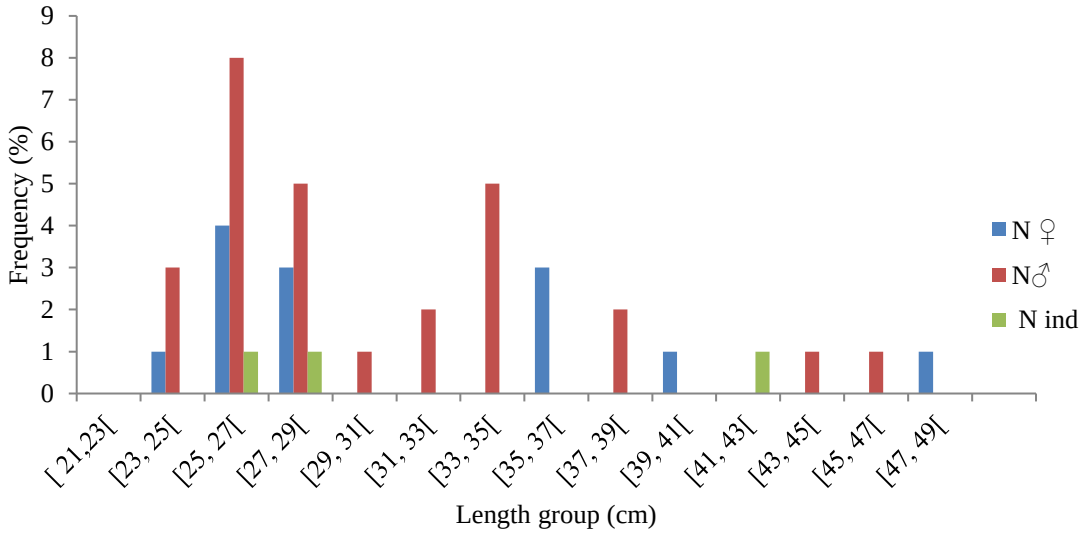

Figure 2 Length-frequency distribution of Mugilidae (n=50, species combined).

Eight age groups (1+, 2+, 3+, 4+, 5+, 6+, 7+, 10+) have been identified in Mugilidae species. The early age groups fish dominated the population, 9+ and 8+ year-old fish are absent and 10+ year-old fish are rare. The overall sex ratio was 1:1.76 males to females (species combined).

Among 50 stomachs examined, 17 were empty, corresponding to a vacuity index (VI%) of 34%. Mugilidae diet was composed of polychaetes (14%), algae (8%), mollusca (6%), lamellibranchs (4%), amphipod (2%), insects (2%), fish parts (4%), detritus (26%), and sediments (40%) (Table 1).

Table 1. Diet composition of Mugilidae (O%: occurrence index).

Group	O%
Polychaetes	14%
Algae	8%
Mollusca	6%
Lamellibranchs	4%
Amphipod	2%
Insects	2%
Fish parts	4%
Detritus	26%
Sediments	40%

A total of 50 Mugilidae were examined for parasites, out of which 30 specimens were infected by Nematoda, Monogenea, Copepoda, Ectoparasites, Cestoda, Digenea, and Cysts. A total of 1219 parasite individuals were isolated. The global prevalence was 60%, global mean intensity was 40.64, and global abundance was 24.38. The prevalence, mean intensity, and abundance varied from parasite group to another. The Nematoda and cysts were the dominant parasites: prevalence of 46% and 22%, mean intensity of 12.13 and 98.54, and abundance of 5.58 and 21.68, respectively (Table 2).

Table 2. Variation prevalence, mean intensity, and abundance of the parasites.

Parasite groups	Number of infected fish	Number of Parasites	Mean intensity	Prevalence (%)	Abundance
All Parasites	30	1219	40.63	60	24.38
Nematoda	23	279	12.13	46	5.58
Monogenea	4	9	2.25	8	0.18
Copepoda	4	66	16.5	8	1.32
Ectoparasites	3	5	1.66	6	0.1
Cestoda	3	3	1	6	0.06
Digenea	2	71	35.5	4	1.42
Cysts	11	1084	98.54	22	21.68

The length of Mugilidae had a significant positive correlation (R=0.8) with the prevalence (Figure 3). Also, mean intensity and abundance had a positive relationship between lengths 21-29 cm (Table 3).

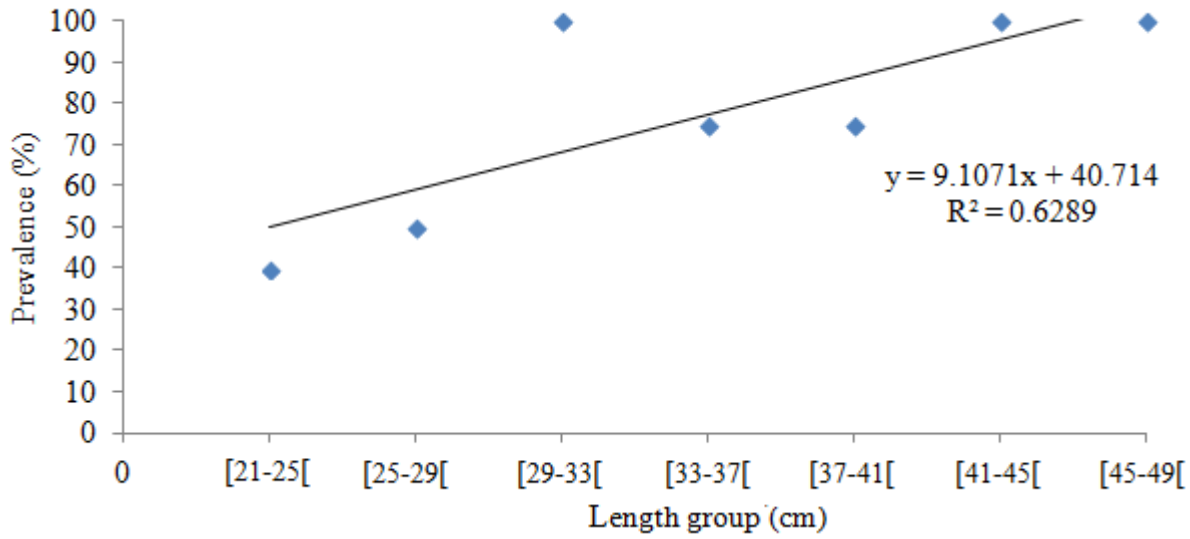

Figure 3. *Variations in prevalence of parasites versus length groups in Mugilidae.*

Table3. Variations in number, prevalence, mean intensity and abundance of parasites according to Mugilidae lengths.

Mugilidae size class (cm)	[21-25[	[25-29[	[29-33[	[33-37[	[37-41[	[41-45[	[45-49[
Prevalence %	40	50	100	75	75	100	100
Mean intensity	36.25	63.63	9.66	40.50	5.66	1	42
Abundance	14.5	31.81	9.66	30.37	4.25	1	42

The mean intensity, prevalence and abundance reached the highest values in Mugilidae specimens weighing less than 328.95 g. A significant positive correlation (R=0.8) was noticed between the weight of Mugilidae and the prevalence (Figure 4; Table 4).

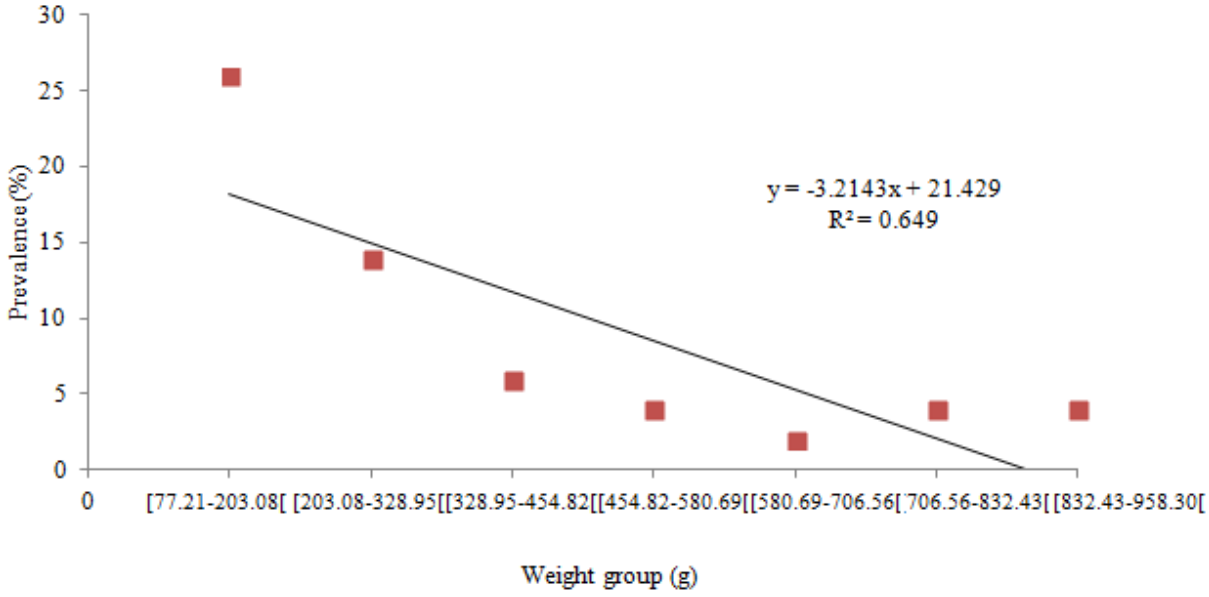

Figure 4. *Variations in prevalence of parasites according to Mugilidae weight groups.*

Table 4. Variations in number, prevalence, mean intensity and abundance of parasites according to Mugilidae weight.

Mugilidae size weight (g)	[77.21-203.08 [	[203.08-328.95 [	[328.95-454.82 [	[454.82-580.69[	[580.69-706.56[	[706.56-832.43[	[832.43-958.30[
Prevalence %	26	14	6	4	2	4	4
Mean intensity	30.38	73.71	9	94	5	2	42
Abundance	21.94	57.33	5.4	62.66	5	2	42

Table 5 shows the relationships between age and parasite parameters (prevalence, mean intensity and abundance). The age of Mugilidae had a significant positive correlation (R=0.77) with the prevalence (Figure 5).

The last length (>37cm), weight (>580.69g) and age groups (>7) were not taken into consideration due to the low number of individuals.

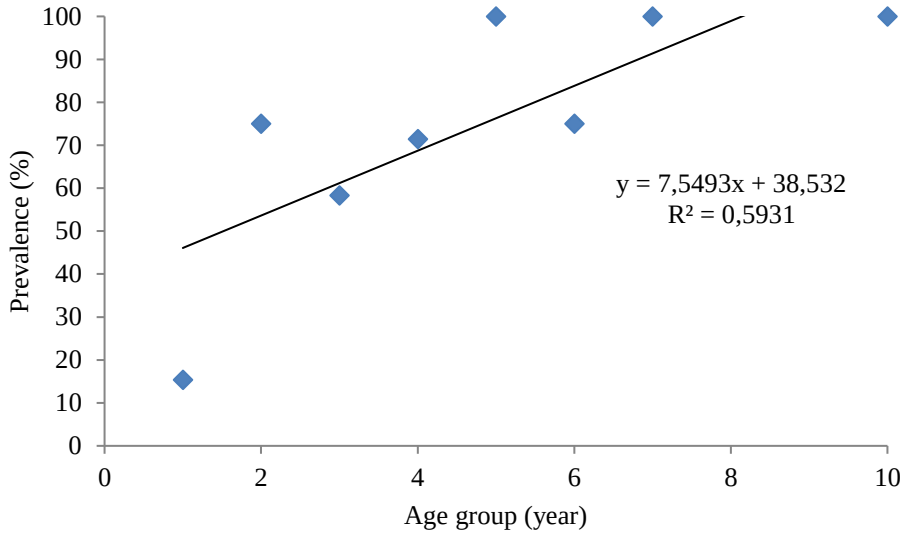

Figure 5. *Variations in prevalence of parasites according to Mugilidae age groups.*

Table 5. Variations in number, prevalence, mean intensity and abundance of parasites according to Mugilidae age.

Mugilidae Age class (Year)	1	2	3	4	5	6	7	10
Prevalence %	15.38	75	58.33	71.42	100	75	100	100
Mean intensity	72	38.66	71.14	8	6.75	64.66	83	1
Abundance	11.07	29	41.5	5.71	6.75	48.5	83	1

Discussion

This study outlined the biology features and parasites in Mugilidae fish caught from Algerian coast. This type of data is very precious since few papers were published from Algerian Mugilidae.

Our results indicated some species richness in Mugilidae, in Algerian coast which includes the following species: *Liza aurata* (Risso, 1810), *Liza saliens* (Risso, 1810), *Chelon labrosus* (Risso, 1827), *Mugil cephalus* (Linnaeus, 1758), *Liza ramada* (Risso, 1836), *Oedalechilus labeo* (Cuvier, 1829). Also, the results revealed a large distribution of *Liza aurata* (Risso, 1810), *Liza saliens* (Risso, 1810) and *Chelon labrosus* (Risso, 1827) compared to other species (*Mugil cephalus*, *Liza ramada*, *Oedalechilus labeo*). This can be explained by the combination of environmental, biotic and stochastic factors that affect the distribution of wild animals (Cardona, 2006).

Cardona (2006) reported that the distribution of Mugilidae species was strongly affected by salinity. Species like *Liza ramada* and *Mugil cephalus* are good osmoregulators: they maintain a stable internal osmolality in a large range of external salinity levels, including freshwater (Lasserre and Gallis, 1975; Nordlie et al., 1982; Kulikova et al., 1989).

The diets of Mugilidae consisted of 9 broad food categories. The present results is in agreement with other studies concerning Mugilidae diets (Laffaille et al., 2002; Almeida, 2003; Gautier and Hussenot, 2005; Isangedighi et. al., 2009; Nicolas, 2010; Sarr et al., 2013; Salvarina et al., 2018). The vacuity index (34%) can be explained by Mugilidae's feeding character affected by food availability and environmental parameters like temperature and salinity that have a negative effect on feeding intensity (Williams and Williams, 1991; Jardas et al., 2004; Hammerschlag et al., 2010). Salvarina et al., (2018) studied the feeding behavior of five Mugilidae species in the North Aegean Sea and reported that *Chelon labrosus*, *Liza saliens* and *Mugil cephalus* have a higher feeding intensity in summer and autumn, when the water temperature is relatively higher. This finding is also showed for other species by Vassilopoulou (2006) and Cardona (2016).

The study of fish parasites is an important and valuable measure that facilitates the interpretation and understanding of fish health. Parasites identification in Mugilidae revealed 7 parasite categories (Nematoda, Monogenea, Copepoda, Ectoparasites, Cestoda, Digenea, and Cysts), with mean intensity, prevalence, and abundance differing in each parasite category. These parasites categories were also reported previously (Orecchia and Paggi, 1978; Paggi et al., 1979; Paperna and Overstreet, 1981; Paggi et al., 1988; Ragias et al., 2005).

Nematoda was determined as the most common parasite group found in Mugilidae. This group has been reported earlier in Mugilidae (Pronkina and Belofastova, 2005; Al-Bassel and Hussein, 2012).

Our results showed that cysts are one of the most affecting parasites of Mugilidae. Witenberg (1929) noted over 1000 cysts in 1 g of the muscle of *Mugil cephalus*. Paperna (1975) reported 6000 cysts/g of muscle tissue of *Mugil capito* and 1136 cysts/g of muscle tissue of *Mugil cephalus*. Paperna and Overstree (1981) also found a great load of cysts in the muscles of mullets from eastern Mediterranean waters.

We also identified Copepoda in the Algerian coast Mugilidae (mean intensity of 16.5). Paperna and Overstreet (1981) reported Copepoda parasites in the young mullets that reach coastal waters. Similarly, Ben-Hassine and Raibaut (1981), Oldewage and Van (1988) and Öztürk (2013) found Copepoda parasites in Mugilidae.

Digenea parasite was recorded on Mugilidae during the present investigation. Ragias et al., (2005) observed that Digenea had the highest prevalence of all parasites; the most important in terms of the pathological potential for Mugilidae.

Many species of Monogenea, Cestoda, and Ectoparasites identified in Mugilidae during the present investigation have been reported in the litterature (Paperna and Overstreet, 1981; Ragias et al., 2005; Öztürk, 2013).

Strong relationship between prevalence and mullet length, weight and age were observed. Shawket et al. (2018) determined and discussed the relation between the fish infection and the length of fish. Mullet are one of the most fish stocked by fish farmers in Algeria, especially in agri-aquaculture integrated systems. They are caught at sea

or in estuaries, and because they are in a close connection with other farmed fish such as Tilapia, sanitary measures must be taken before any mullet introduction to prevent parasites transmission.

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