



Gill ectoparasites of the mugilidae from the Ebrié lagoon, Abidjan (Côte d'Ivoire)

Eby Yoboué Gnamma Honorine Alla^{*1}, Carel Wilfried Bermian Dibi-Ahui²,

Fidèle Kouassi Kouakou³, Abouo Béatrice Adepo-Gourene⁴

¹Nangui Abrogoua University, Animal Biology and Cytology Laboratory, UFR-SN, Abidjan 02, Côte d'Ivoire

²Nangui Abrogoua University, Animal Genetics Laboratory, UFR-SN, Abidjan 02, Côte d'Ivoire

³Félix Houphouët-Boigny National Polytechnic Institute, Animal Production Laboratory, Yamoussoukro, Côte d'Ivoire

⁴Nangui Abrogoua University, Fisheries and Aquaculture Pole, UFR-SN, Abidjan 02, Côte d'Ivoire

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ABSTRACT

Examination of 221 gills from six host species of the Mugilidae family (*Mugil cephalus*, *M. curema*, *M. bananensis*, *Chelon dumerili*, *Neochelon falcipinnis* and *Parachelon grandisquamis*) fished in Ébrié lagoon allowed the collection of 68 ectoparasites belonging to two classes: Crustacea and Monogenea. These crustacean parasites belong to the Ergasilidae family. While the Monogenes represent the Ancyrocephalidae family and are specific to the genus *Ligophorus*. In this study, Ergasilidae were found on the gills of *N. falcipinnis*, *P. grandisquamis*, *C. dumerili*, *M. cephalus* and *M. curema*. On the other hand, the *Ligophorus* were present only on the *Neochelon falcipinnis* and *Chelon dumerili*. It should be noted that no parasite has been observed on the gills of *Mugil bananensis*. The average parasite intensity is very low as well as the total abundance which gives less than two parasites per Mugilidae living in the Ébrié lagoon whether for the Ergasilidae or the *Ligophorus*.

*Corresponding author: Eby Yoboué Gnamma Honorine Alla ✉ honoebby@yahoo.fr

INTRODUCTION

Fish from the Mugilidae family are very popular around the world. They constitute an important economic interest and are the subject of specialized fisheries (Hera *et al.*, 2006). In Côte d'Ivoire, the Mugilidae, together with the Cichlidae and the Clupeidae, constitute one of the fish families most represented in the three lagoon systems (Aby, Ebrié and Grand-Lahou) after the Carangidae (Albaret and Legendre, 1985). However, uncontrolled fishing activities have led to a reduction in the stock of fish available in Ivorian waters and a deficit on the market. According to the FAO (2001), uncontrolled fishing constitutes a source of deterioration of fisheries resources which occurs virtually and can affect 30 % of catches.

Aquaculture appears as an alternative to overcome this problem. Generally, the species farmed in Côte d'Ivoire are Nile tilapia (*Oreochromis niloticus*), clamfish (*Chrysichthys nigrodigitatus*) and catfish (*Heterobranchus longifilis* and *Clarias gariepinus*) (Blé *et al.*, 2008; Bamba, 2017). However, the availability of Mugilidae in lagoon systems and their very high growth potential (Konan, 2014) make most of these fish good candidates for aquaculture. The introduction of Mugilidae into aquaculture requires a good knowledge of these fish. Several studies have focused on the systematics, biology and ecology of Mugilidae (Albaret nad Legendre, 1985; Djadji, 2015; Konan, 2014; Alla and Adepo-Gourène, 2020).

However, those relating to the study of the parasites of these fish remain fragmentary or even non-existent. In 2009, the FAO requested that studies on parasites be taken into account in order to increase the level of production to meet a growing demand for fish. In this respect, the study of Mugilidae ectoparasites in a natural environment is important to carry out their cultures. In Côte d'Ivoire, data on parasitic biodiversity mainly concern Cichlidae (Pariselle, 1991 and 1995), *Tilapia guineensis* (Pariselle, 1995; N'douba *et al.*, 1997; Pariselle, 1997b), *Tylochromis jentinki* (Pariselle, 1995; Gnayoro, 2008), *Oreochromis niloticus* (Coulibaly, 2005; Kone, 2014), *Malapterurus electricus* (N'douba, 1997), *Sarotherodon Melanotheron* (Blahoua *et al.*,

2009). In the Mugilidae these data remain fragmentary or even non-existent.

However, knowledge on the parasites infecting Mugilidae in Ivorian lagoons is essential for the establishment and flourishing of aquaculture of species of this family. Therefore, the general objective of this work is to study the biodiversity of ectoparasites present in Mugilidae. Specifically, this involves: (i) inventorying and describing the biodiversity of Mugilidae ectoparasites; (ii) examine the distribution of parasites in the Mugilidae; (iii) determine the parasitic indices.

MATERIALS AND METHODS

Study environment

The Ebrié lagoon has a total area of 566 km². It is located between 3°47' and 5°29' west longitude and between 5°02' and 5°42' north latitude and stretches over 130 km from the Azagny canal to the west, which makes it communicate with the Bandama river and the Grand-Lahou lagoon. To the east, it merges with the sea outlet of the Comoé (Varlet, 1978) and is connected to the Aby lagoon by the Assinie canal. The Ebrié lagoon communicates with the Atlantic Ocean through the Vridi canal. It was subdivided into six sectors (Durand *et al.*, 1978; Durand and Skubich, 1982) including sector III, the area of this study. The choice of sampling sites (Fig. 1) was based on accessibility, different salinity ranges and the importance of fishing activities.

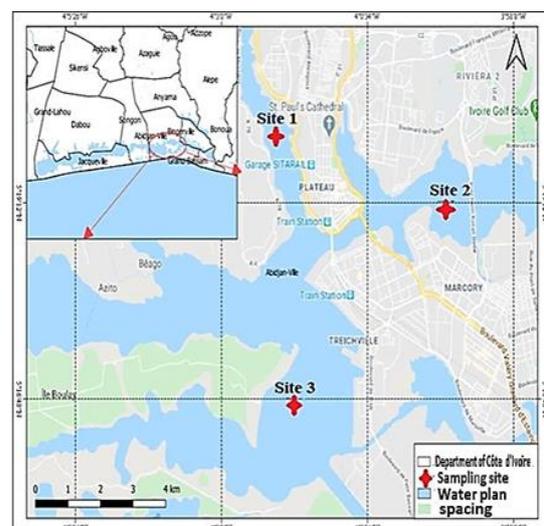


Fig 1. Location of sampling sites for Mugilidae specimens

Ichthyological sampling

Sampling took place between February 2019 and January 2020, precisely in sector III of the Ébrié lagoon. Fishing was carried out with a 70 m long gill net with a 2 m drop and 20 mm side mesh. Once captured, the fish were identified using identification keys (Durand and Whitfield, 2016). In the laboratory, the fish were dissected to remove the gills. Subsequently, the gill filaments were separated and then rinsed using a wash bottle containing a 0.7% saline solution. The gill rinsing water collected in a Petri dish as well as the gill filaments were examined under a binocular magnifying glass (Olympus Z 40 at 10 x 40 magnification). Observation of the morpho-anatomical characteristics of the ectoparasites under a microscope (Carl Zeiss at 10 x 40 magnification) allowed their identifications. Identification was carried out down to the lowest possible taxonomic level using the keys of Geoffrey (1982), Faller *et al.* (2000). Parasites from each host were grouped by type and isolated in a pill box bearing the name of the host species, host number, place of origin, date of capture and date of examination. Parasites were fixed in 0.7% saline solution buffered with 10% formaldehyde between 1 and 7 days, then transferred to 70% ethanol solution for permanent preservation.

Expression of epidemiological indices

Average parasite intensity

The average parasite intensity (AI) is the ratio between the total number of individuals of a parasite species recorded in a sample of a host species (n) and the number of hosts infested by the parasite (N_p). Its formula is as follows:

$$AI = \Sigma n / N_p$$

For average intensities (AI), Bilong-Bilong and Njiné (1998) adopted the following classification:

AI < 10 very low average intensity

AI ≤ 50 low average intensity

50 < AI ≤ 100 average intensity

100 < AI high average intensity

Abundance

Abundance (AB) is the ratio of the total number of individuals of a parasitic species in a sample of hosts (n) to the total number of hosts (parasitized and unparasitized) in the sample examined (N). It is the average number of individuals of a parasitic species per host examined. This index is expressed according to the following formula:

$$AB = \Sigma n / N$$

Statistical analysis

The collected data were stored in a database designed on Excel software. The various statistical tests were carried out using R 4.0.2 software through the R Studio interface. The Shapiro normality test and the Mann Whitney non-parametric test were used to compare the average intensities with each other.

RESULTS

A total of 221 fish specimens, representing the six species of Mugilidae, were the subject of gill observation (Fig. 2).

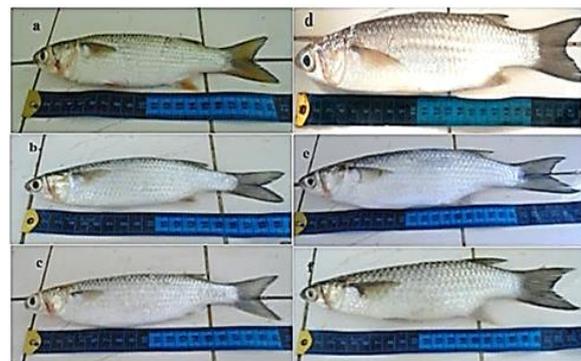


Fig. 2. Photograph of the six species of Mugilidae (a: *M. cephalus*; b: *M. curema*; c: *M. bananensis*; d: *Chelon dumerili*; e: *Neochelon falcipinnis*; f: *Parachelon grandisquamis*)

Among these specimens, 48 belong to the species *Neochelon falcipinnis*, 35 to *Chelon dumerili*, 35 to *Parachelon grandisquamis*, 35 to *Mugil cephalus*, 36 to *M. curema* and 32 to the species *bananensis*. Examination of the gills made it possible to collect a total of 136 parasites belonging to the groups Copepods and Monogeneans (Table 1).

Table 1. Distribution of parasites by host fish species (nb: number of fish specimens per Mugilidae species)

	Host species						Total
	<i>Neochelon falcipinnis</i> nb = 48	<i>Chelon dumerili</i> nb = 35	<i>Parachelon grandisquamis</i> nb = 35	<i>Mugil cephalus</i> nb = 35	<i>Mugil curema</i> nb = 36	<i>Mugil bananensis</i> nb = 32	
Ergasilidae	38	18	6	11	3	-	76
Ligophorus	52	8	-	-	-	-	60

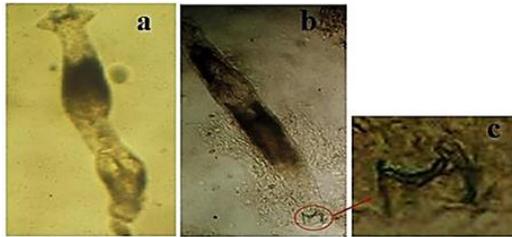


Fig 3. Photographs of specimens of the genus *Ligophorus* under an optical microscope (G x 400)

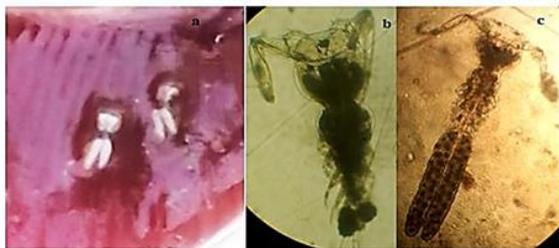


Fig 4. Photographs of specimens of the family Ergasilidae (a: with the naked eye on gill of *Chelon dumerili*; b and c: microscopic preparations) (Gx400)

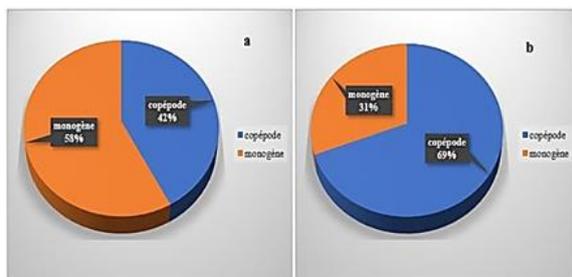


Fig 5. Distribution of ectoparasites identified in *Neochelon falcipinnis* (a) and *Chelon dumerili* (b)

These Monogeneans belong to the order Dactylogyridea, the family Ancyrocephalidae and the genus *Ligophorus* (Fig. 3), while the Copepods belong to the order Cyclopoida and the family Ergasilidae (Fig. 4). For this last family, the gender could not be specified. The parasitic community recorded consists of 60 specimens of the *Ligophorus* genus and 76 of the Ergasilidae family, representing respectively 44% and 56% of the parasites. In terms of the distribution of parasitic species by host,

copepods (Ergasilidae) were present on five of the six host species (*Neochelon falcipinnis*, *Chelon dumerili*, *Parachelon grandisquamis*, *Mugil cephalus* and *M. curema*). On the other hand, Monogeneans (*Ligophorus*) were only found on *Neochelon falcipinnis* and *Chelon dumerili*. Monogeneans (*Ligophorus*) represent 58% of the parasites collected compared to 42% for Copepods (Ergasilidae) in *Neochelon falcipinnis* while in *Chelon dumerili*, these parasites represent 31% and 69% respectively (Fig. 5). Of the species *Parachelon grandisquamis*, *Mugil cephalus* and *Mugil curema*, only Ergasilidae have been recorded. No ectoparasites were observed on the specimens of *Mugil bananensis* sampled.

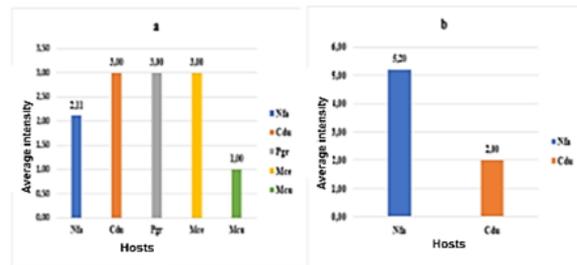


Fig. 6. Distribution of the average intensity of specimens of the family Ergasilidae (a) and that of specimens of the genus *Ligophorus* (b) by host species of Mugilidae Nfa: *Neochelon falcipinnis*; Cdu: *Chelon dumerili*; Pgr: *Parachelon grandisquamis*; Mce: *Mugil cephalus*; Mcu: *Mugil curema*

The parasitic intensities of Copepods (Ergasilidae) are very low in the hosts examined and are between 1 and 3. Those of Monogeneans (*Ligophorus*) are also very low in Mugilidae with values of 2 and 5.2. The Mann Whitney (U) test showed that there is no significant difference between the average intensities of Ergasilidae and those of *Ligophorus* (Fig. 6).

During this study, the abundance varied between 0.17 (*Mugil curema*) and 1.8 (*Chelon dumerili*) parasites

per host species examined for Ergasilidae. While, that of Monogenea (*Ligophorus*) is between 0.8 (*Chelon dumerili*) and 1.44 (*Neochelon falcipinnus*) (Fig. 7).

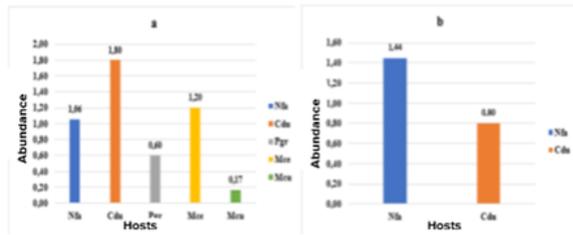


Fig. 7. Distribution of the abundance of Ergasilidae (a) and *Ligophorus* (b) by species of Mugilidae Nfa: *Neochelon falcipinnus*; Cdu: *Chelon dumerili*; Pgr: *Parachelon grandisquamis*; Mce: *Mugil cephalus*; Mcu: *M. curema*

DISCUSSION

Ectoparasites were searched for in *Neochelon falcipinnus*, *Chelon dumerili*, *Parachelon grandisquamis*, *Mugil cephalus*, *Mugil curema* and *Mugil bananensis*, six species of the Mugilidae family. The parasites collected from these fish belong to the class Monogenea and Crustacea (Copepode). These parasites are most common in marine fish (Del Rio-Zaragoza *et al.*, 2010; Costello, 2006). The observation of their morpho-anatomical characters made it possible to link the Monogeneans to the genus *Ligophorus*. This result agrees with that of Boumendjel (2005) who also found *Ligophorus* on four species of Mugilidae (*Mugil cephalus*, *Chelon labrosus*, *Liza aurata* and *Liza saliens*) in the Gulf of Annaba. These observations corroborate those of Euzet and Suriano (1977) who mention that ectoparasites of the *Ligophorus* genus are found only in species of the Mugilidae family. The Copepods observed belong to the family Ergasilidae. Ergasilidae affect both freshwater and euryhaline fish and are present in all major African river systems (Fryer, 1968). The species *Ergasilus lizae* is very widespread on the Atlantic and Mediterranean coasts (Robert, 1970). Moreover, *Ergasilus lizae* and *E. bora* were reported on *Mugil cephalus* in Algeria in the Gulf of Annaba by Boumendjel (2005).

Parasites of the family Ergasilidae and those of the genus *Ligophorus* presented unequal numbers on each host. This suggests that there could be interspecific competition between them at the gill level. This competition seems to be slightly in favor of the Ergasilidae given that their number is greater than the *Ligophorus* on four of the Mugilidae namely *Chelon dumerili*, *Parachelon grandisquamis*, *Mugil cephalus* and *M. curema*. This observation is in the same direction as that made by Baker *et al.* (2005) on the gills of *Mugil cephalus* between the Monogenean *Metamicrocotyla macracantha* and the Copepod *Naobranchia lizae*. On the other hand, this competition would be slightly in favor of *Ligophorus* among *Neochelon falcipinnus*. This change could be due to the feeding method because according to Albaret and Legendre (1985), *Neochelon falcipinnus* has a slightly different feeding mode from that of other West African Mugilidae. On the other hand, no parasites were observed on the specimens of *Mugil bananensis* captured during this study. This result could be due to the low number of specimens captured. The *Mugil bananensis* species seems to be poorly represented in the Ebrié lagoon. This observation was made by Konan *et al.* (2014) who only sampled a few specimens of this species in the same lagoon. In addition, Albaret and Legendre (1995) had not reported the presence of this species in the Ebrié lagoon. This absence of parasites could imply that this species has an immune system capable of eliminating gill parasites, but this remains to be verified.

The average parasite intensity was very low overall for all hosts studied and for each type of parasite. This low parasite load could be explained by the fact that these Mugilidae are in a natural environment. Indeed, according to Obiekezie (1991) parasites have a low intensity in the natural environment. Also, Euzet and Pariselle (1996) and Broglia and Kapel (2011) mention that in general and in fish in particular the pathogenic effect of parasites, in natural conditions, is reduced, a consequence of the balance established during evolution in the host/parasite system. Parasitic

diseases occur when this natural balance of the environment is disturbed by environmental and/or anthropogenic factors. During this study no pathological signs were observed on the gills of the Mugilidae species studied. This observation was made by Mentz *et al.* (2016) and Ranzani-Paiva and Silva-Souza (2004) on *Mugil liza* in the Tramandai-Armazém lagoon system in southern Brazil and *M. platanus* in the eastern region of Cananéia, in the state of São Paulo, Brazil, respectively.

CONCLUSION

The study on Mugilidae ectoparasites in sector III of the Ebrié lagoon showed the presence of representatives of the Ergasilidae family on the three *Neochelon falcipinnis* species; *Parachelon grandisquamis* and *Chelon dumerili* and on two species of the *Mugil* genus (*M. cephalus* and *M. curema*). Parasites of the genus *Ligophorus* have only been found on the species *Neochelon falcipinnis* and *Chelon dumerili*. No parasites have been observed on the species *Mugil bananensis*. The average parasite intensity is very low with an abundance of less than two parasites per Mugilidae for both Ergasilidae and *Ligophorus*.

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