

Parasitic specificity in the Sparidae family fish “*Pagellus erythrinus*” of the El Kala coast, Algeria

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Abstract. The present study is the first to address the full set of parasites of the sea bream fish *Pagellus erythrinus* of the shores of El Kala (Algeria). Examination of 180 sea bream (*Pagellus erythrinus*), revealed a high level of diversity of the parasites of this fish. A total de 1,313 parasites were collected. The parasites collected belong to various systematic groups, comprising monogenetics (*Lamellocotyle* sp., *Choricotyle* sp., *Microcotyle* sp., and *Microcotyle erythrini*); digenetics (*Sterigotrema* sp. and *Holorchis* sp.); nematodes (*Hysterothylacium* sp.); and crustaceans (*Caligus* sp., *Hatschekia* sp., *Clavella strumosa*, *Clavellotis* sp., and *Neobrachiella exigua*). A study of the distribution of the parasites in terms of the size of the fish indicates that the smaller sized ones are the most infested and that the infestation of *P. erythrinus* by different parasitic communities (ectoparasites and endoparasites) varies with the season; being more pronounced during the warm season (summer) and low during the cold season (spring).

Key Words: *Lamellocotyle* sp., *Choricotyle* sp., *Microcotyle* sp., *Microcotyle erythrini*, infestation.

Introduction. Parasitism is a lasting interaction involving a species referred to a ‘parasite’, the existence of which existence depends closely on its association with another species. The latter is referred to as the ‘host’, and the parasite reduces the host’s viability (Cassier et al 1998; Combes 2001). Parasitism is a fundamental type of interaction in the living world. Indeed, the life cycle of a large number of organisms depends, at least in part and sometimes fully, on a host organism (Rohde 1989; Combes 1995). Numerous studies have been performed in regard to parasitic specificity (Chabaud 1954; Rohde 1982; Desdevives 2001). Such parasitic specificity is subject to numerous ecological and evolutionary constraints, and host-parasite associations are good models for studying evolutionary phenomena (Price 1980; Paterson et al 1993; De Meeus et al 1998).

The majority of parasites are influenced primarily by their hosts (Brooks & McLennan 1993). According to Rohde (1982, 1994), specificity is measured by the parasitic indices (prevalence, intensity and abundance). Parasitic specificity varies in space and over time, in keeping with the areas and periods under consideration. The same host species are not always infested by the same parasitic communities (Norton & Carpenter 1998). *Pagellus erythrinus* (Linneaus, 1758) belongs to the Sparidae (or sea bream) family of fish, which are of considerable commercial importance for the ichthyophagic populations along the Mediterranean coast, while also representing a significant biological resource in trophic marine networks (Saad Fares & Combes 1992).

The aim of this work was to determine the parasitic richness (parasitofauna) for *P. erythrinus*, and the features of the parasitic indices.

Material and Method

Site of the study. Our study was situated at the extreme eastern end of the Algerian coast. It is part of the El Kala coastline, which runs for about 50 km from Cape Rosa in the west ($8^{\circ}15' E$ and $36^{\circ} 58' N$), to Cape Segleb (or Cape Roux, on the Tunisian border) in the east (Figure 1).

According to recent data from the wilaya d'El Tarf Fisheries Department (DPRH):

- El Kala has two fishing harbors: the old one and the new harbor.
- The fishing fleet comprises a total of 543 vessels (49 sardine fishing boats, 15 trawlers, and 475 smaller-sized boats).

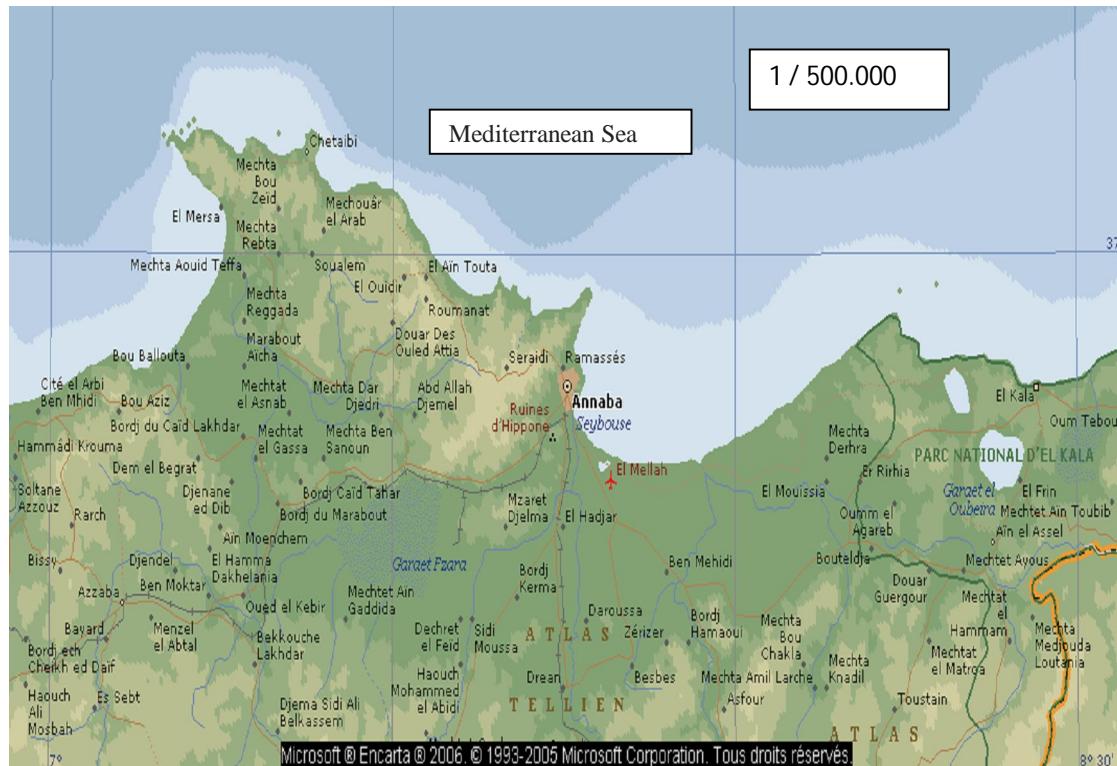


Figure 1. The area of the study (map from the school of EFTP El Kala).

Our study took place from June to November (6 months) of 2016, and a total of 180 *P. erythrinus* specimens from the shores of El Kala, Algeria, were examined. The sample specimens were weighed and their overall lengths were measured. The examination involved a meticulous visual inspection of the various parts of the fish using a stereomicroscope (Olympus SZX10), so as to search for, locate, and collect parasites (ectoparasites and endoparasites).

The retrieved parasites were placed between a microscope slide and a coverslip for live examination, and the monogenetics were transferred to a droplet of a mix of glycerin and ammonium picrate according to the method of Malmberg (1957). Once the specimens had been identified, the parasitic indices (the prevalence, the average abundance, and the average intensity) were calculated according to the method of Margolis et al (1982) and Bush et al (1997), and the statistical analysis of the variance was performed using Fisher's ANOVA test.

Results

Identification of the parasites. Examination of 180 *P. erythrinus* fish from the shores of El Kala allowed us to identify the various classes of parasites. These comprised monogenetics (four species of monogenetics: *Lamellocotyle erythrinii*; *Choricotyle sp.*, *Microcotyle sp.*, and *Microcotyle erythrinii*), trematodes (two species: *Sterigotrema sp.* and *Holorchis sp.*), copepods (five species: *Caligus sp.*, *Hatschekia sp.*, *Clavella strumosa*, *Clavellotis sp.*, and *Neobrachiella exigua*), and nematodes (one nematode species: *Hysterothylacium sp.*). A feature of *P. erythrinus* is that it has a very rich parasitofauna:

➤ Monogeneans

a) *Microcotyle erythrini* : Van Beneden and Hesse, 1863 (Figure 2)

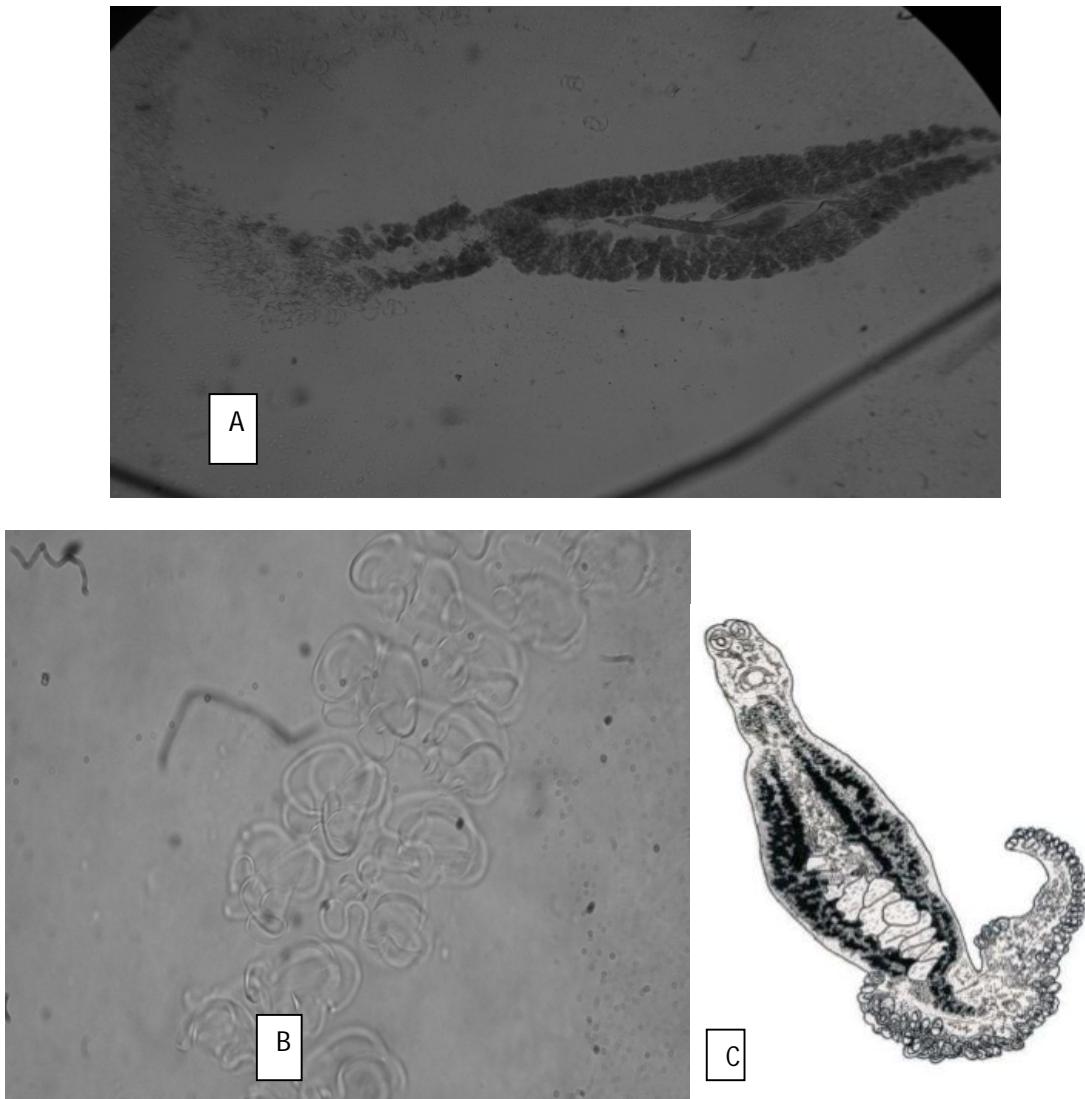


Figure 2. Species *Microcotyle erythrini* Van Beneden and Hesse, 1863.
Photography (photonic microscopy) of general morphology (A)X10 of the haptor (B) X40
(C) anatomy (original).

b) *Microcotyle* sp Van Beneden and Hesse, 1863 (Figure 3)

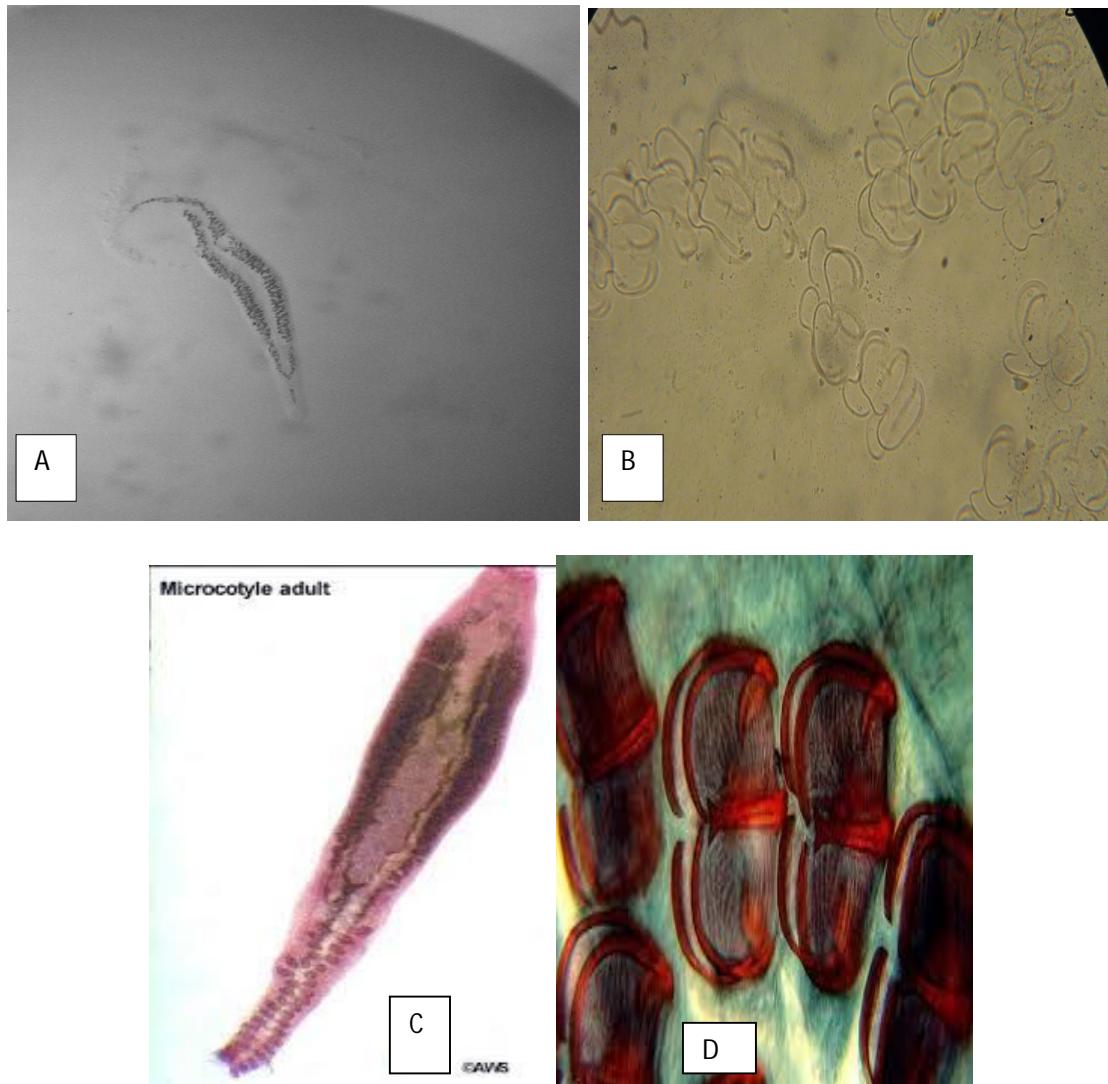
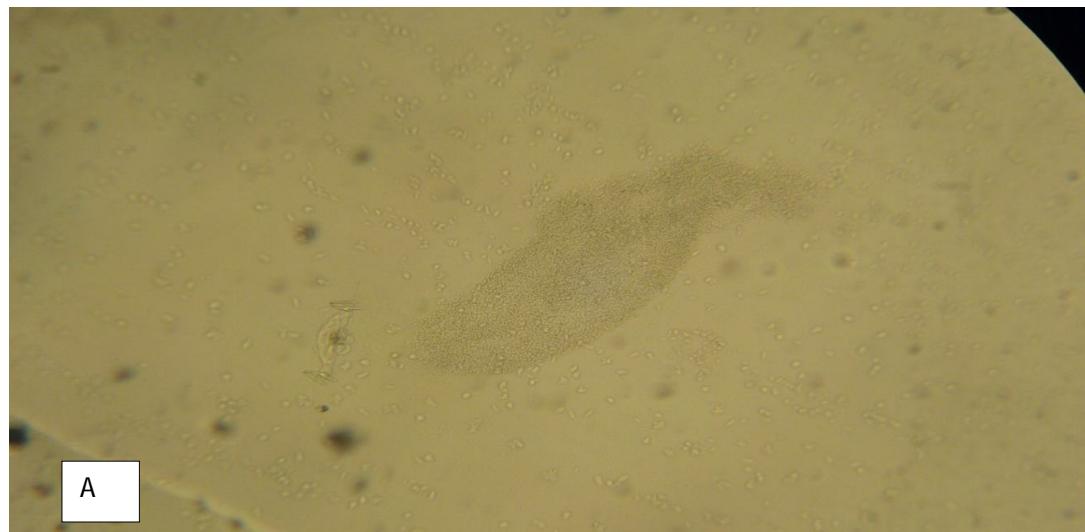
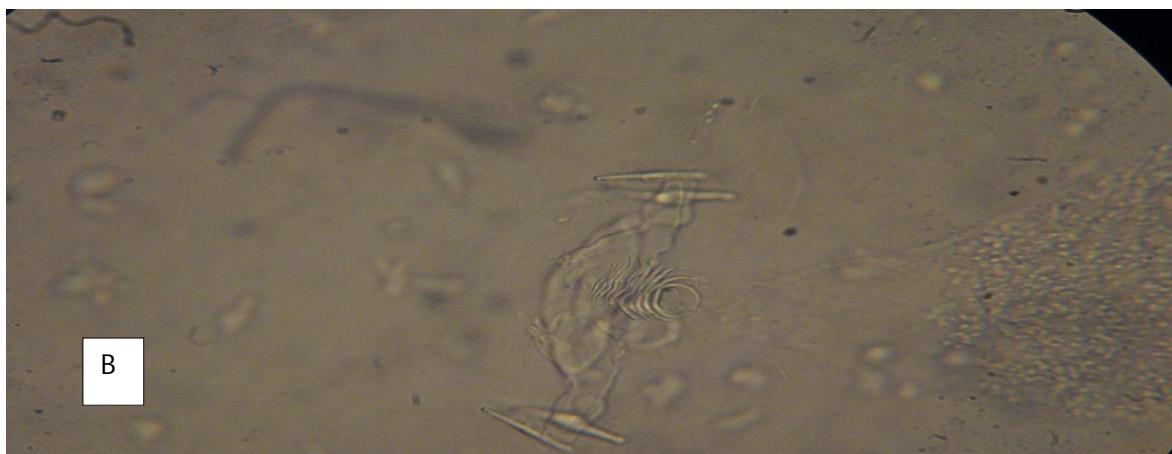


Figure 3. Species *Microcotyle* sp Van Beneden and Hesse, 1863. Photography (photonic microscopy) of general morphology(A)X0,5 of the haptor (B)X40. (C) adult (D) haptor (original).

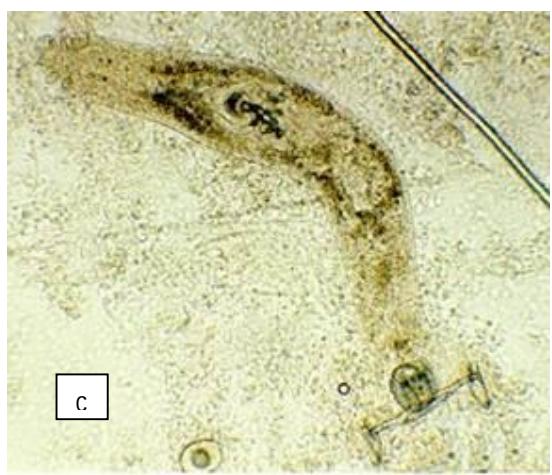
c) *Lamellodiscus* sp Euzet and Oliver, 1966 (Figure 4)



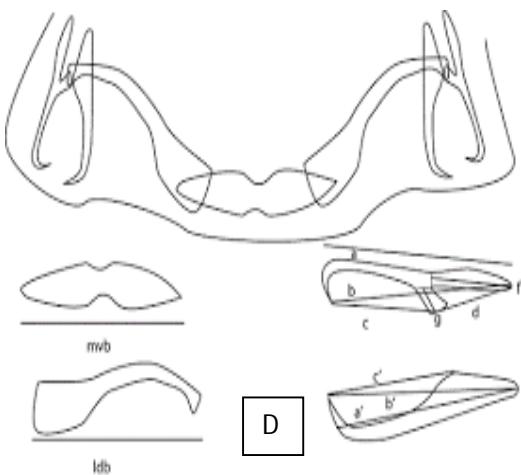
A



B



C



D

Figure 4. Species *Lamellodiscus* sp. Euzet and Oliver, 1966. Photography (photonic microscopy) of general morphology (A)X10 of the haptor (B)X40, (C) adult, (D) overview (upper part) and measurements (lower part) of the haptor of *Lamellodiscus* (original).

d) *Choricotyle* sp Van Beneden and Hesse, 1863 (Figure 5)



Figure 5. Species *Choricotyle* sp Van Beneden and Hesse, 1863. Photography (photonic microscopy) of general morphology (A) X0,5, (B) adult *Choricotyle* sp (original).

➤ **Copépods :**

a) *Caligus* sp Müller, 1785 (Figure 6)

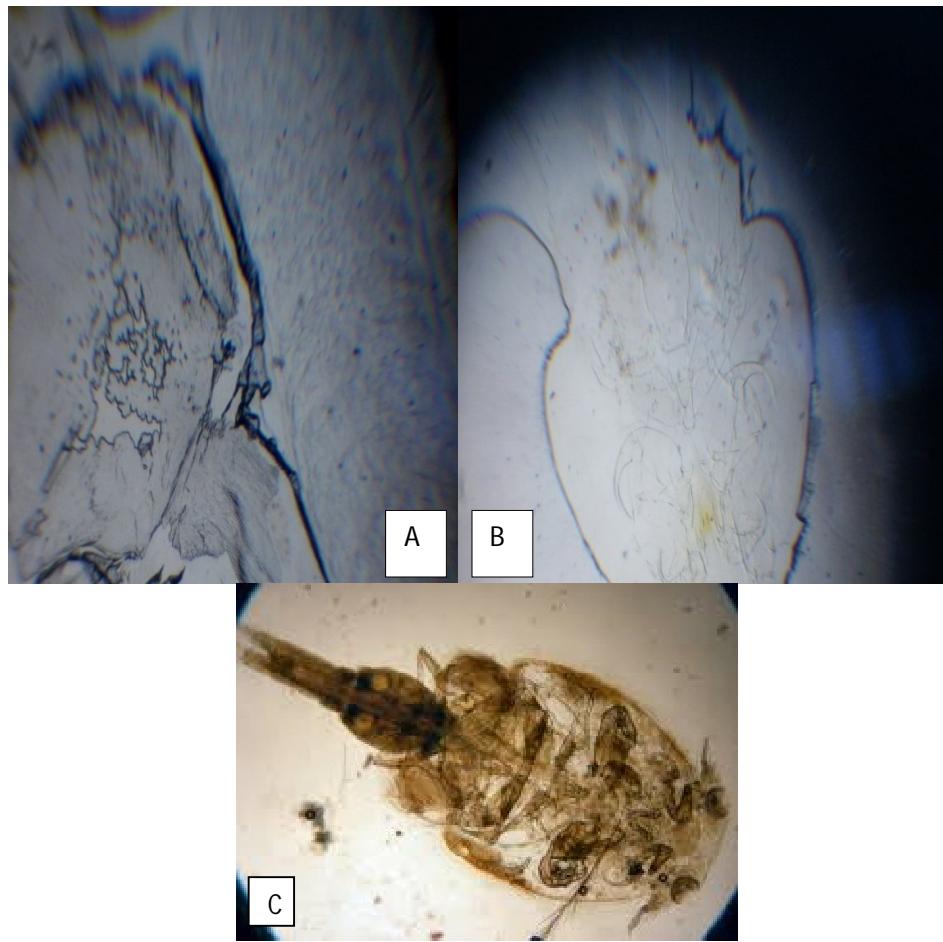


Figure 6. Species *Caligus* sp Müller, 1785. Photography (photonic microscopy) anterior part of species *Caligus* sp (A) and (B)X10, (C) adult (original).

b) *Hatschekia sp* (Hesse, 1879) (Figure 7)



Figure 7. Species *Hatschekia sp* (Hesse, 1879). Photography (photonic microscopy) of general morphology (A)X0.5; (B) adult (original).

c) *Clavella strumosa* (Brian, 1906) (Figure 8)

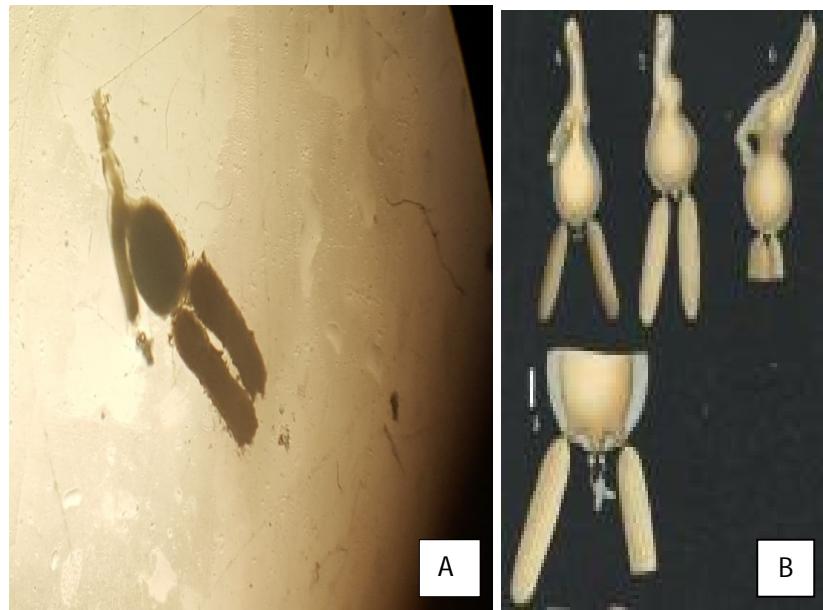


Figure 8. Species *Clavella strumosa* (Brian, 1906). Photography (photonic microscopy) of general morphology (A) x0.5. (B) adult *Clavella strumosa* (original).

d) *Clavellotis* sp (Kroyer, 1863) (Figure 9)

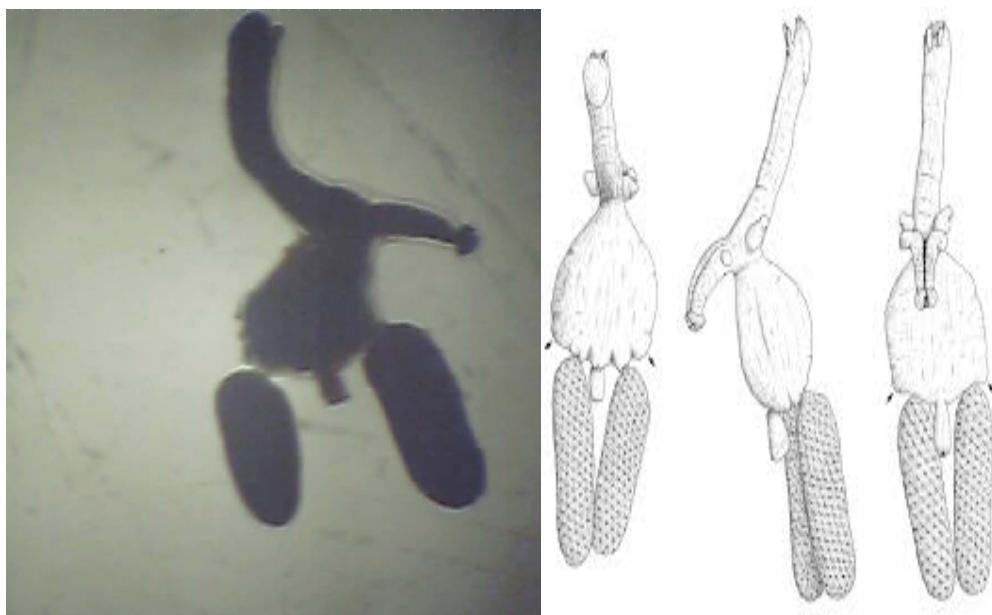


Figure 9. Species *Clavellotis* sp (Kroyer, 1863). Photography (photonic microscopy) of general morphology (A) x0.5. (B) adult (original).

e) *Neobrachiella exigua* (Brian, 1906) (Figure 10)

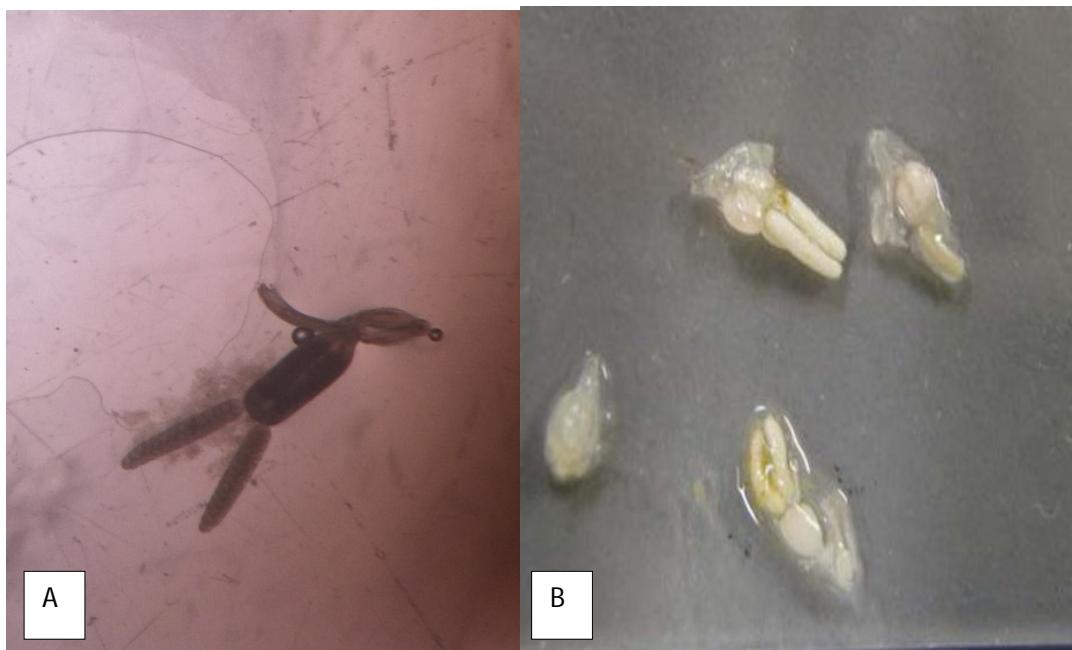


Figure 10. Species *Neobrachiella exigua* (Brian, 1906). Photography (photonic microscopy) of general morphology (A) x0.5; (B) adult forms (original).

Degeneans

a) *Sterigotrema sp* Odhner, 1911 (Figure 11)

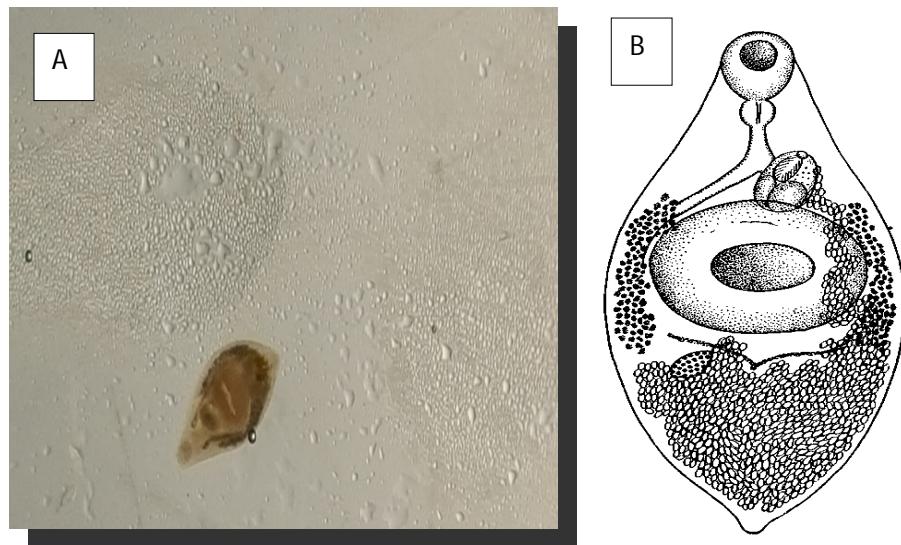


Figure 11. Species *Sterigotrema sp* Odhner, 1911. Photography (photonic microscopy) of general morphology (A) x0.5; (B) anatomy (original).

b) *Holorchis sp* Stossich, 1901 (Figure 12)



Figure 12. Species *Holorchis sp* Stossich, 1901. Photography (photonic microscopy) of general morphology (A) x0.5; (B) anatomy (original).

➤ **Nematoda**
a) *Hysterothylacium* sp Ward and Magath, 1917 (Figure 13)

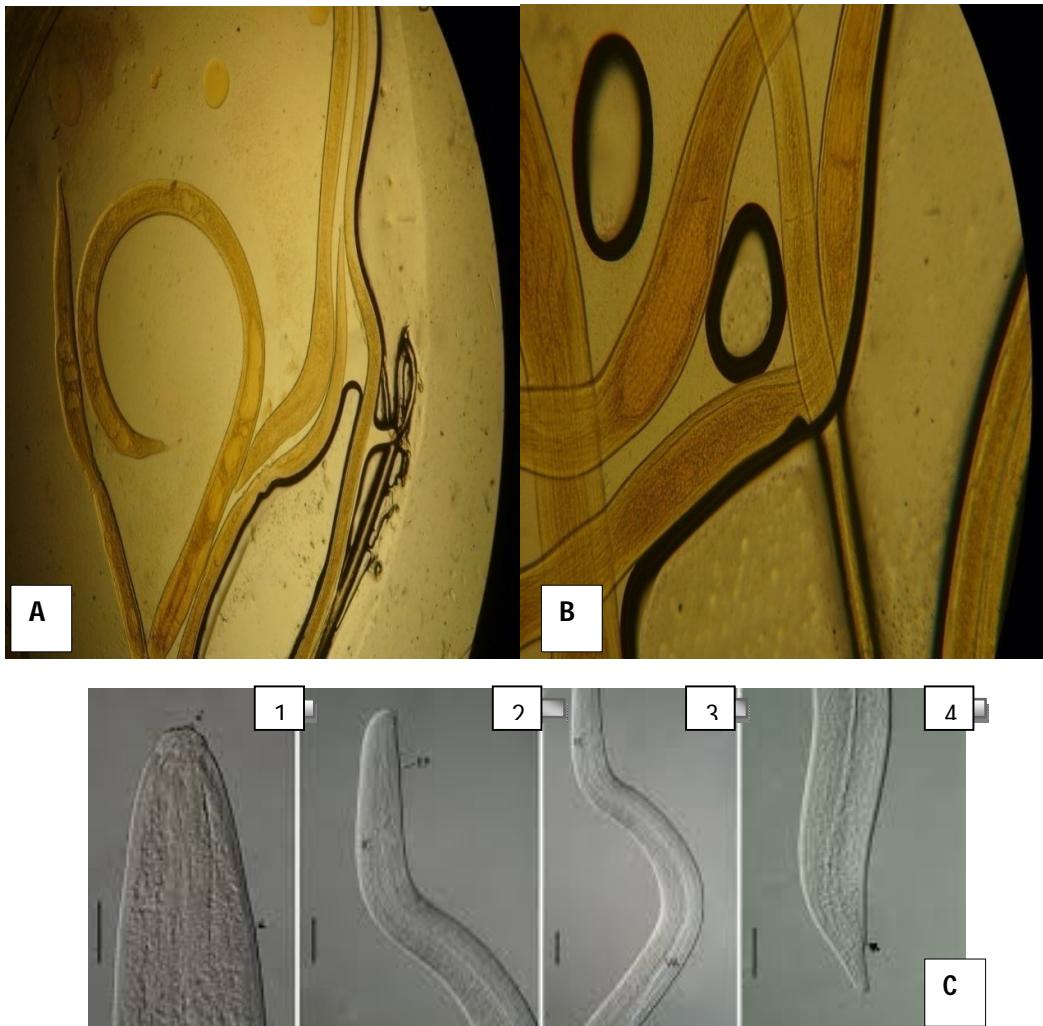


Figure 13. Species *Hysterothylacium* sp Ward and Magath, 1917. Photography (photonic microscopy) of general morphology (A) x0.5; (B) x10; (C) *Hysterothylacium* sp. third stage larva observed by differential interference contrast (DIC) (original).

The parasitic indices. The parasitic fauna of *P. erythrinus* from the shores of El Kala is very rich and very variable (Figure 14).

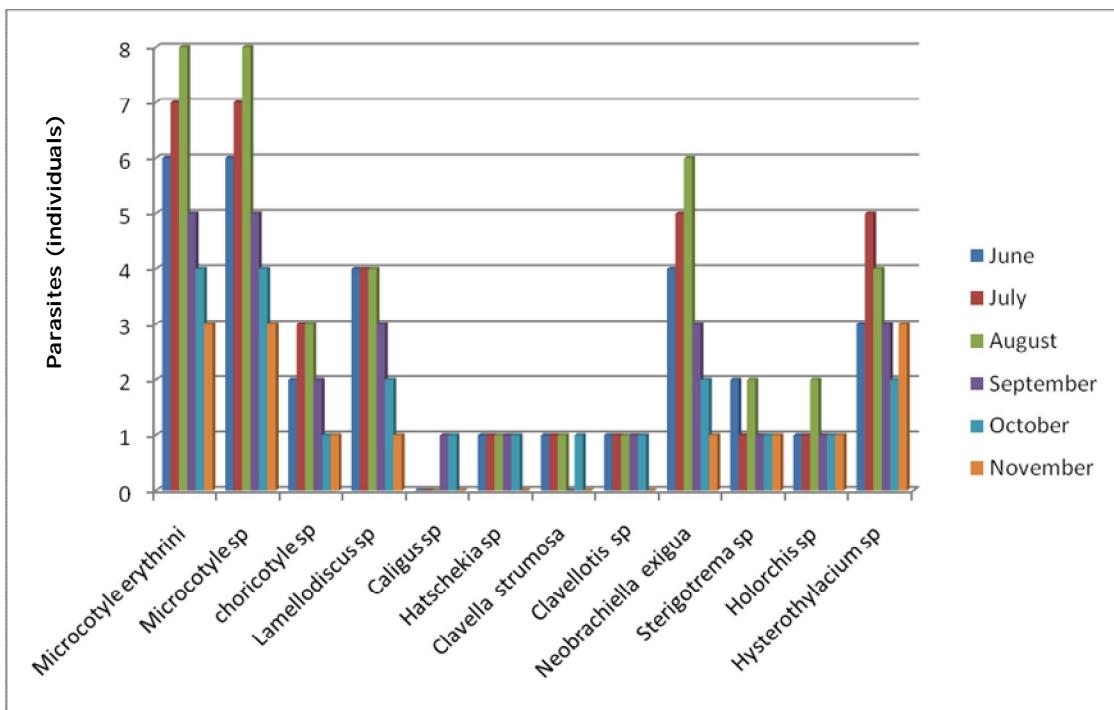


Figure 14. The number of infesting parasites by month.

The predominance of monogenetics (*M. erythrini*, *Microcotyle sp.*, *Choricotyle sp.*, and *L. erythrini*) and copepods (*Caligus sp.*, *Hatschekia sp.*, *C. strumosa*, *Clavellotis sp.*, and *N. exigua*), followed by digenetics (*Sterigotrema sp.*, and *Holorchis sp.*), and nematodes (*Hysterothylacium sp.*), as shown in Figures 15, 16 and 17.

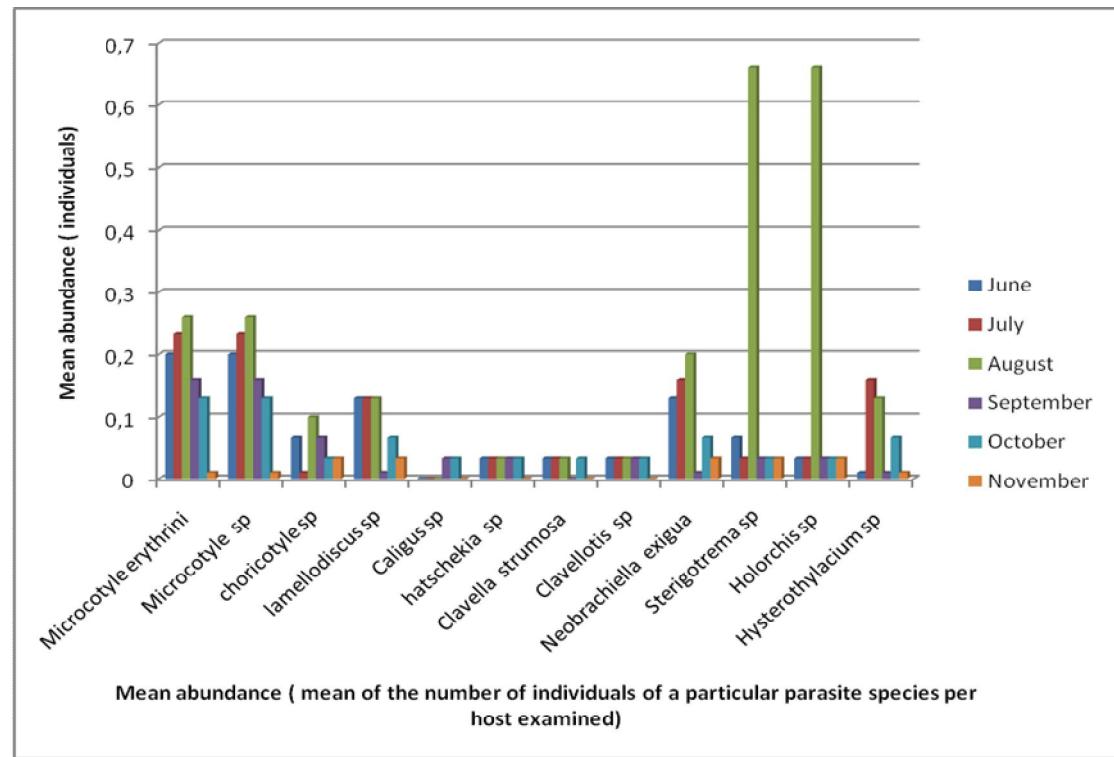


Figure 15. The level of parasite species for the indicated months.

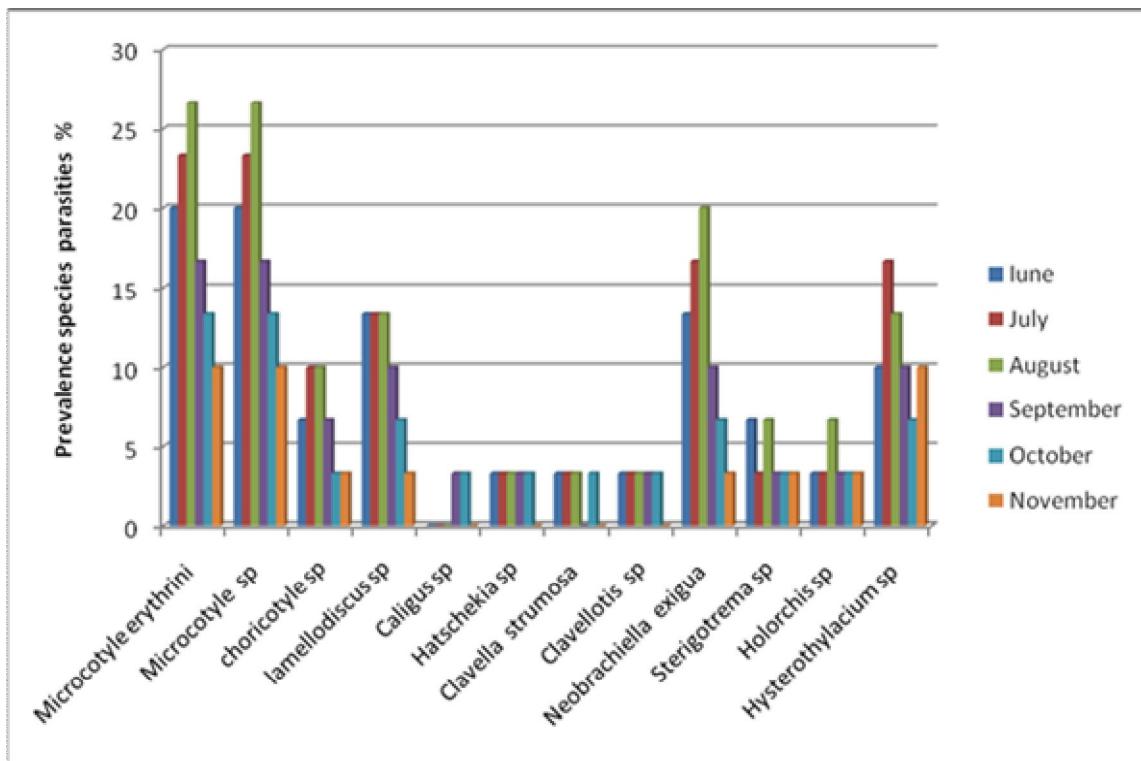


Figure 16. The prevalence of parasite species for the indicated months.

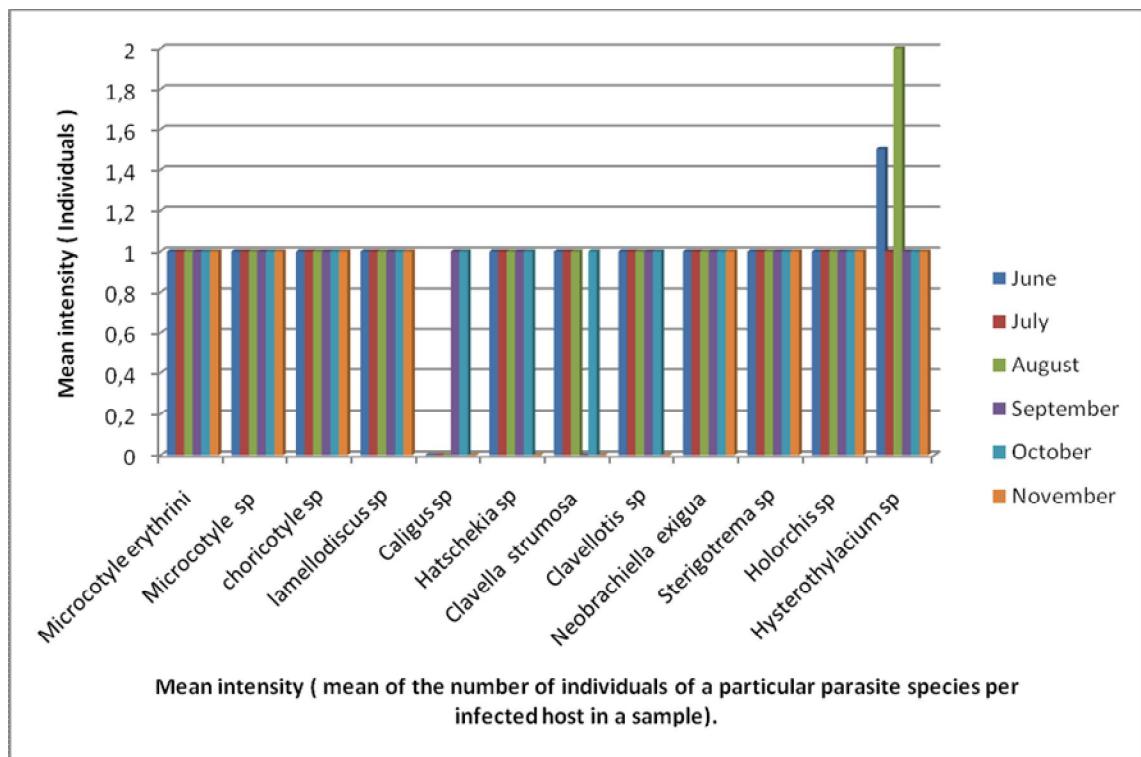


Figure 17. Intensities of parasite species for the indicated months.

The infestation of *P. erythrinus* by different parasitic communities varies according to the seasons, and is more pronounced in the warm season (summer) and low in the cold

season (spring) (Figure 18).

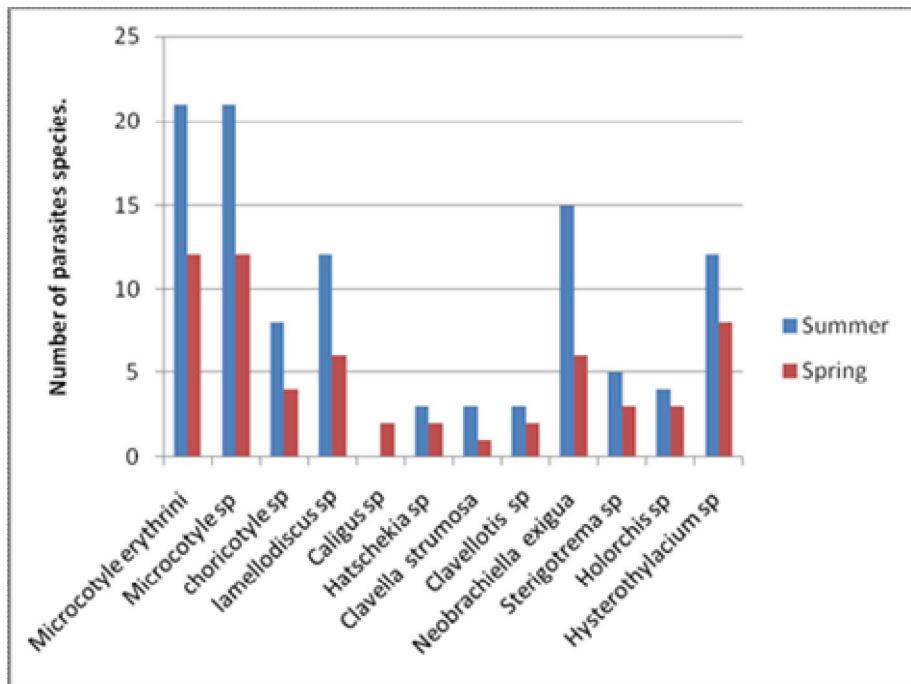


Figure 18. Breakdown of the parasites according to season.

Our study of the distribution of the parasites as a function of the fish size indicates that the smaller-sized classes are the most infested (Figure 19).

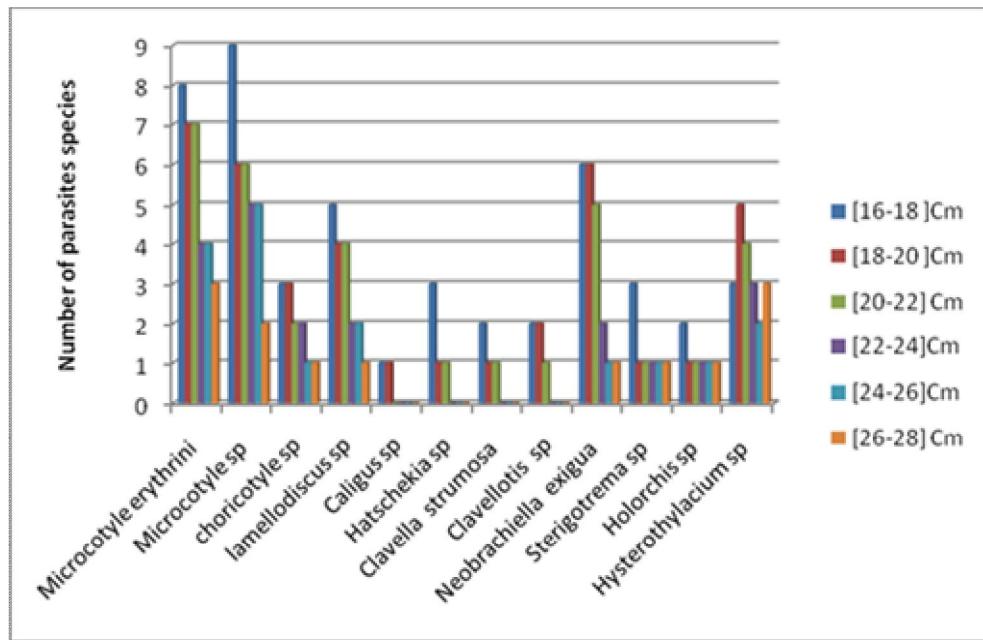


Figure 19. Distribution of the parasites as a function of the fish size.

Analysis of variance showed that there was a highly significant difference for the monogenetics (*M. erythrini*, *Microcotyle sp.*, *Choricotyle sp.*, and *L. erythrini*) and the copepods (*Caligus sp.*, *Hatschekia sp.*, *C. strumosa*, *Clavelotis sp.*, and *N. exigua*), while there was no difference for the digenetics (*Sterigotrema sp.* and *Holorchis sp.*) and the nematodes (*Hysterothylacium sp.*).

Discussion. The present study contributes to knowledge regarding the diversity of the parasitofauna of *P. erythrinus* of the El Kala coastline. Several taxons were identified, comprising monogenetics, digenetics, nematodes, and copepods. Of the 1,313 parasites collected, 180 of which were from *P. erythrinus*, only 168 specimens were identified. These belonged to 9 families and 11 genera of parasite. Numerous studies have been performed regarding the parasitofauna of fish in the Mediterranean Sea, and particularly of Sparidae fish, as reported by Palombi (1949), Euzet (1958, 1989), Euzet & Oliver (1965, 1966, 1967), Oliver (1969, 1984, 1987, 1995), Ktari (1971), Euzet & Maillard (1973), Radujković & Euzet (1989), Neifar (1995), Kouider (1998), Desdevives (2001), Ternengo (2004), Boualleg et al (2010) et Kouachi et al (2010).

The above mentioned researchers have provided a repertory of the different parasite species. In the course of our work, we clearly encountered most of the parasite species known to occur with *P. erythrinus* in the Mediterranean Sea.

The parasitic fauna of *Pagellus erythrinus* from the shores of El Kala was determined to be very rich and very variable (e.g. *M. erythrini*, *Microcotyle* sp., *Choricotyle* sp., *L. erythrini*, *Caligus* sp., *Hatschekia* sp., *Clavella strumosa*, *Clavellotis* sp., *Neobrachiella exigua*, *Sterigotrema* sp., *Holorchis* sp., and *Hysterothylacium* sp.). According to the work of Desdevives (2001) in regard to *P. erythrinus* from the Banyuls-sur-Mer region, the latter is known for its very rich and very variable parasitofauna.

Combes (1995) reported that high parasite loads may indicate that the host offers a good habitat, that parasite-host encounters occur readily, and that compatibility between them is possible. This can give rise to the impression that a host population is essentially homogenous. Yet ethological and immune subtleties create differences in the suitability of the habitat that underlie the association of parasite populations with specific individuals and hosts. According to Zander (1998), variables regarding the external environment, such the temperature and the salinity, can alter the specificity of the parasite. According to Desdevives (2001), this can be due to modification of the physiology of the parasites, or to changes in competitive interactions with the other parasite species which may be less tolerant of these environmental variations.

According to Ternengo (2004), parasitic richness is the most commonly used and the most straightforward measure of the diversity, since it corresponds with the number of parasite species identified. In the present study, the parasitic richness does not appear to be high since there were 1 to 2 parasites per *P. erythrinus* host. According to Ternengo et al (2005), each fish species presents a characteristic parasitofauna and a specific level of infestation. The dominance of monogenetics (*M. erythrini*, *Microcotyle* sp., *Choricotyle* sp., and *L. erythrini*) and copepods (*Caligus* sp., *Hatschekia* sp., *C. strumosa*, *Clavellotis* sp., and *N. exigua*) was followed by digenetics (*Sterigotrema* sp., *Holorchis* sp.) and nematodes (*Hysterothylacium* sp.). Our results of identification are in agreement with those of Lablack (2014) and Hermida (2012). Lo et al (1998) have reported that ectoparasitic communities appear to be influenced more by biological factors, such as the immunity of the host.

We found that the infestation of *P. erythrinus* by different parasitic communities (both ectoparasites and endoparasites) varied as a function of the season; being more pronounced in the warm season (summer) and low in the cold season (spring). Also the work of Flippi (2013) indicates that the level of infestation is higher in summer than in winter. According to Peres et al (1999), a higher water temperature influences the development of numerous fish parasites (monogenetics, copepods, nematodes, etc.). Boualleg et al (2012) have stated that parasites (particularly in case of copepods) infest their hosts in large numbers during autumn and summer. Boualleg et al (2010) also showed that in the Gulf of Annaba the majority of parasites infest their hosts in large numbers during summer, while Kouachi et al (2010) have claimed that parasite numbers are highest in winter.

The results of the study of the distribution of the parasites as a function of size of the fish indicate that the smaller sized classes are the most infested. Hayward et al (1998) noted a variability in the infestation by crustaceans and monogenetics as a function of the size. Winemiller & Rose (1992) have shown that numerous life traits correlate with the size of the fish. Presumably, the resource is more limited for specialized

parasites. According to some authors, parasites can develop adaptive strategies in reaction to the size of the host (Morand et al 1996; Sorci et al 1997; Morand & Sorci 1998). Furthermore, Sasal et al (1999) have shown that monogenetics become specialized on larger-sized hosts. The larger-sized specimens hence exhibit the highest levels of infestation and they harbor the most parasites.

Lo et al (1998) have reported that the richness in parasite species depends on the age and the size of the host, and that the abundance of ectoparasites depends on the body size of the host.

Conclusions. This work is part of a general problem of studying the parasitic specificity of fishes on the coast of El Kala. The data obtained allowed us to characterize the interactions between the parasites and their hosts. The examination of 180 fish allowed us to harvest 1,313 parasites belonging to various systematic groups, thus it emerges from this:

- All the *P. erythrinus* were infested.
- The number of parasites is higher in the warm season.
- Size class (16-18 cm) is more infested by parasite communities.
- High variability of parasitic species (monogenetics, digenetics, nematodes, and copepods) infesting the host species *P. erythrinus*.

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