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Host-Ectoparasite Interactions and Condition Factor Variation in the Catfish *Chrysichthys nigrodigitatus* (Claroteidae) from Aby Lagoon, Côte d'Ivoire

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Abstract

The machoiron, *Chrysichthys nigrodigitatus*, is a catfish of major economic and nutritional importance widely exploited in lagoon and estuarine ecosystems of West Africa, particularly in the Aby Lagoon. In a context of increasing anthropogenic pressures, assessing its health status through the study of gill ectoparasites and the condition factor (K) has proven essential. Four hundred and eighty (480) specimens of *Chrysichthys nigrodigitatus* were sampled monthly between March 2024 and February 2025 using gill nets. The gills were examined to identify parasites, determine their prevalence and mean intensity, and analyze seasonal variations. The condition factor was calculated and compared between parasitized and non-parasitized individuals according to season, sex, and size classes using chi-square (X^2), Kruskal-Wallis (K) and Mann–Whitney tests. Nine species were identified : the Copepods *Ergasilus latus, Lernaea cyprinacea* copepodite

stage and *Ergasilus sarsi*, and the monogeneans *Protoancylodiscoides valentini*, *P. combesi*, *P. chrysichtes*, *P. spirovagina*, *P. mansourensis* and *P. yombai*. The dominant species were *E. latus* (69.56%), *Lernaea cyprinacea* (61,57%), *P. valentini* (80.60%), *P. combesi* (79.97%) and *P. mansourensis* (73.91%). Infestations were generally higher during the rainy season, with significant seasonal differences ($p < 0.05$). Mean intensities reached 25.92 ± 1.3 for *P. valentini* and 32.80 ± 1.5 for *P. yombai*. Parasitized fish exhibited lower K values (0.57 ± 0.03 in the rainy season ; 0.48 ± 0.01 in the dry season) than non-parasitized individuals (0.84 ± 0.02 ; 0.78 ± 0.01), with a significant difference ($p < 0.05$). These results demonstrated that ectoparasitic infestations negatively affected the body condition of the species and highlighted the importance of parasitological monitoring for assessing the health of natural populations.

Keywords: *Chrysichthys nigrodigitatus*, Gill ectoparasites, Condition factor (K), Seasonal variation, Aby Lagoon

Introduction

Fish, regardless of their species, are exposed to a wide diversity of parasitic infections, the composition and intensity of which depend both on the biological characteristics of the host (age, size, sex, diet) and on the environmental conditions of the aquatic habitat they occupy (Edema, 2008). Parasitism is defined as a mode of life in which an organism, the parasite, lives in a close and long-term association with another organism, the host, from which it derives benefits at the host's expense, without immediately causing its death (Lafferty *et al.*, 2008). This complex relationship influences not only the individual health of fish but also plays a major role in population regulation and the structuring of aquatic communities.

However, this fragile balance can be disrupted by environmental changes, whether natural or induced by human activities, such as pollution, eutrophication, or habitat modification. These disturbances may alter host–parasite interactions, promoting the emergence of diseases and compromising the health of fish populations (Lafferty, 2008). In this context, certain categories of parasites, particularly ectoparasites with direct life cycles such as copepods and monogeneans, represent a particularly relevant group to investigate. These parasites preferentially colonize external organs, especially the gills and skin, frequently causing tissue damage, physiological disturbances, and behavioral changes that can affect respiration, feeding, and fish survival (Blahoua *et al.*, 2009).

The consequences of ectoparasitic infestations extend beyond the individual and operate at the population and ecosystem levels. They can influence host population dynamics, modify community structure, and

disrupt the overall functioning of aquatic ecosystems (Lafferty *et al.*, 2008). In both natural environments and aquaculture systems, high parasite burdens have been associated with reduced growth, poorer body condition, and decreased fish productivity, resulting in significant economic and ecological losses (Buchmann & Lindenstrøm, 2002). Parasitological investigations therefore provide a valuable tool for assessing fish health and detecting potential infestations. The condition factor, which measures the degree of plumpness of individuals, is widely used as an indicator of fish health, well-being, and reproductive potential (Schmitt & Dethloff, 2000). Parasitic infestations may alter this condition factor through several mechanisms: by diverting host nutrients for their own growth and reproduction, by impairing nutrient absorption at the digestive or respiratory level, or by increasing host metabolic demands in response to physiological stress induced by infestation (Buchmann & Lindenstrøm, 2002 ; Lafferty *et al.*, 2008). Consequently, heavily parasitized fish may exhibit a reduced condition factor, reflecting a relative loss of body mass in relation to length, lower energy reserves, and compromised physiological status. The combined analysis of ectoparasite diversity and condition factor thus provides a quantitative approach to evaluating the impact of parasitism on fish health and performance in their natural environment.

Within this ecological context, the machoiron, *Chrysichthys nigrodigitatus*, an African catfish species, is of considerable economic, nutritional, and aquacultural importance. It is widely distributed in aquatic ecosystems of West Africa, including lagoons, rivers, and estuaries (Bédia *et al.*, 2017). In heavily anthropized areas such as the Aby Lagoon, this species may be exposed to a wide range of pathogens and may experience increased impacts related to pollution and habitat degradation. Understanding parasitic infestations in this species under such conditions is therefore crucial for assessing its health status, physiological robustness, and economic value.

Studies have been conducted on copepods and monogeneans parasitic affecting the gills of the silver catfish *Chrysichthys nigrodigitatus*, notably those carried out in Cameroon on the description of new species of parasitic monogeneans, in Burkina Faso on the dynamics of certain monogeneans of the genus *Protoancylodiscoide*s, and in Nigeria, where research has focused on the inventory and impact of copepods on fish condition factors, in general and specifically in *C. nigrodigitatus* (Arinze *et al.*, 2014 ; Bassock, 2016 ; Emmanuel & Aromodiu, 2017; Omeji *et al.*, 2022 ; Bassock *et al.*, 2024; Zougouri *et al.*, 2025). In Côte d'Ivoire, however, research remains limited. Apart from the work of (Affourmou *et al.*, 2016) on the prevalence and effectiveness of three treatments of *C. nigrodigitatus* in the Jacqueville and Adou ponds and Adou *et al.*, (2025) documenting the prevalence of the

copepod parasitic *Ergasilus latus* and *Lernaea cyprinacea* on *Chrysichthys nigrodigitatus* of the Aby lagoon in relation to water quality,)

To date, no study has specifically focused on parasitic infestations and their impact on *Chrysichthys nigrodigitatus* in Côte d'Ivoire, particularly in the Aby Lagoon. This lagoon, especially in the Adiaké region, is subject to intense anthropogenic pressure from untreated domestic discharges, nutrient-rich agricultural effluents, intensive fishing, and urban and tourist development. These activities have led to a deterioration of water quality, marked by the accumulation of nutrients (nitrates, ammonium, orthophosphates) and chemical pollutants, which promote eutrophication and hypoxic conditions. Such disturbances weaken fish, including *Chrysichthys nigrodigitatus*, making them more vulnerable to parasitic infestations. Fish stocks, including catfish populations, are experiencing a marked decline, especially in the Adiake region. Chemical contaminants further compromise immune defenses, while habitat alterations (mangrove destruction, increased sedimentation, high turbidity) disrupt parasite life cycles and those of their intermediate hosts, thereby enhancing transmission particularly of direct-cycle parasites such as monogeneans and certain copepods. In this context, the study of parasite communities and their relationship with fish physiology emerges as a relevant indicator of environmental quality and a strategic tool for the sustainable management of fisheries resources in the Aby Lagoon.

Material snd Methods

1. Study Area

Located in the southeastern part of Côte d'Ivoire, specifically within the Adiake Department, between longitudes 3°00' and 3°30' W and latitudes 5°10' and 5°30' N, Aby Lagoon serves as a natural border between Côte d'Ivoire and Ghana. The lagoon covers an area of approximately 424 km². Aby Lagoon experiences a climate characterized by four seasons, including two rainy seasons and two dry seasons (Brou *et al.,* 2005). The main rainy season extends from April to July, while the short rainy season occurs from October to November. Regarding dry seasons, the main dry period occurs between December and March, and the short dry season falls between August and September. The lagoon is fed by the Bia and Tanoé rivers (N'Guessan *et al.,* 2013). The connection between Aby Lagoon and the Atlantic Ocean is narrow and shallow. The study area is strongly influenced by human activities, including fishing, livestock farming, and various domestic practices. In addition, plantations of oil palm, rubber trees, coffee, cocoa, cassava, and plantains are developed around the lagoon. Artisanal gold mining, particularly active near Noé (Ghanaian border locality), also represents a significant potential source of pollution for the lagoon ecosystem, especially due to the use of mercury (Mensah *et al.,* 2021). For

this study, the Adiaké town station was selected as a sampling site. At this station, the substrate is dominated by sand and gravel.

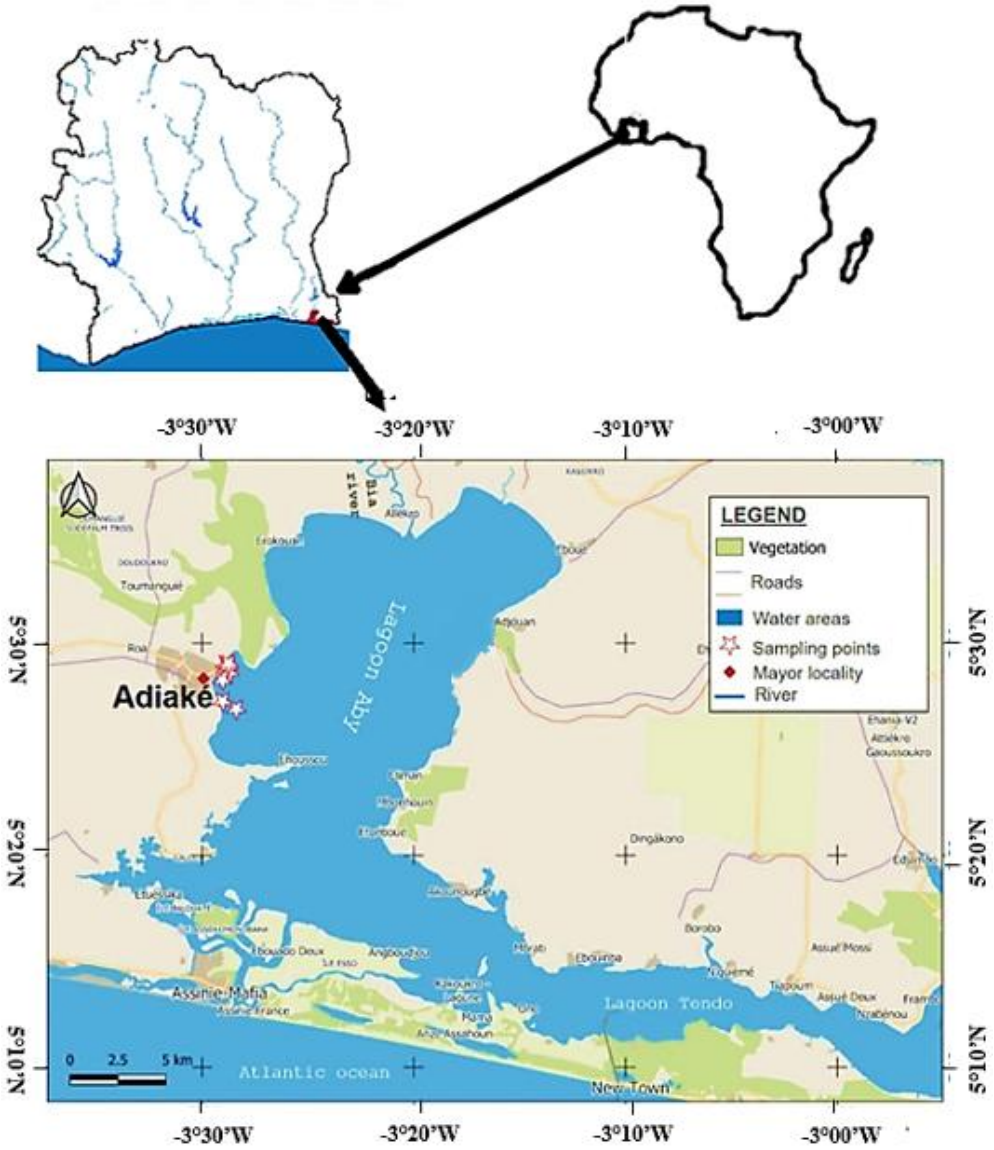


Figure 1: Map of the sampling sites in the Aby Lagoon

2. Host fish sampling and parasitological examination

A total of 480 specimens of *Chrysichthys nigrodigitatus* were collected monthly between March 2024 and February 2025 using gill nets and fish traps. For each individual, standard length (measured from the anterior tip of the snout to the base of the caudal fin) and total length (measured from the anterior tip of the snout to the posterior end of the caudal

fin) were recorded in millimeters (cm), and body weight was measured in grams (g) using an electronic balance. The sex of the fish was determined by making a mid-ventral abdominal incision to directly observe the gonads. Individuals were then grouped into five size classes according to Bilong Bilong (1995) : class A (70-20), class B (20-33), class C (33-46), class D (46-59), and class E (59-72). This classification allowed for the assessment of the influence of host size on parasitic infestations and on the condition factor.

The condition factor of the examined fish was calculated to assess their physiological status. Fulton's Condition Factor (K) is based on the assumption that a fish's weight is proportional to the cube of its length and is widely used as an indicator of the overall health of individuals and populations. For each fish, total length, standard length, and body mass were measured. The calculation of the condition factor relies on an allometric model in which the exponent *b* is considered constant, allowing for comparisons of condition factor across different size classes or categories of fish. The condition factor (K) was determined from these measurements using the following formula by Le Cren, (1951) :

$$K = W*100/ L^b$$

Where W = weight of fish (g), L = standard length of the fish (cm), b = coefficient of allometry considered equal to 3. The Fulton's condition factor was multiplied with 100 to get it close to 1, and the number 1 indicated a normal condition of the fish, greater 1 indicated fat fish and less than 1 indicated skinny fish. This morphometric index assumes that the heavier fish for a given length the better condition.

After capture, the gills of each fish were carefully excised and individually preserved in aluminum foil, kept cold in the field until examination. In the laboratory, following air thawing, gill filaments were rinsed using a wash bottle, and the rinse water was collected in a Petri dish. The gill filaments were then examined under a binocular microscope at 60× magnification. Monogeneans and Copepods observed were detached using size 00 entomological needles and mounted on a slide with a cover slip in a microdrop of ammonium picrate-glycerine mixture for monogeneans (Malmberg, 1957) or in Canada balsam for copepods. Parasite identification was performed under a microscope at 100× magnification using the identification keys of Pariselle & Euzet, (2009) for Monogeneans and Yamaguti (1963) & Kabata, (1979) for Copepods.

3. Terminology

Parasitism was assessed by calculating the prevalence (P%) and mean intensity (MI) of parasites following the methods described by Bush *et al.*, (1997). Prevalence (P%) is the percentage ratio between the number of hosts

infested (N) by a given parasite species and the number of fish examined (H).

$$P = N/H \times 100$$

The adopted classification of parasite species based on prevalence is that of Valtonen et al. (1997). Dominant species: (prevalence > 50%) Satellite species: (10 ≤ prevalence ≤ 50%) Rare species: (prevalence < 10%)

Mean parasite intensity (IM) is the ratio of the total number of individuals of a parasite species (n) in a sample of hosts to the number of infested hosts (N) in the sample.

$$IM = n/N$$

4. Data analysis

To evaluate differences among groups, several statistical tests were applied. The chi-square (X^2) test was used to compare two or more proportions, particularly the prevalence of parasitic infestations across different fish categories. Infestation intensities were compared among multiple groups using the non-parametric Kruskal-Wallis (K) test, while the Mann-Whitney (U) test was applied for comparisons between two groups. Differences were considered statistically significant at $p < 0.05$. All statistical analyses were performed using Microsoft Excel for data organization and STATISTICA 7.1 for detailed statistical testing. This approach allowed a rigorous assessment of the influence of factors such as fish sex, size, and morphometric classes on parasite prevalence and intensity.

Results

1. Composition of gill parasite fauna in *Chrysichthys nigrodigitatus*

Nine gill parasitic species, including three Copepods and six Monogeneans, were identified on the gills of *Chrysichthys nigrodigitatus* (Figure 2). These species were *Ergasilus latus*, *Lerrnea cyprinacea* at copepodite stage, *E. sarsi*, *Protoancylodiscoides valentini*, *P. combesi*, *P. spirovagina*, *P. chrysichtes*, *P. mansourensis*, and *P. yombai*. Among these, *E. latus* (69.56%), *L. cyprinacea* (61.57%), *P. valentini* (80.60%), *P. combesi* (79.97%), and *P. mansourensis* (73.91%) were the dominant species on the gills, with prevalence rates exceeding 50%. The species *E. sarsi*, *P. chrysichthes*, *P. spirovagina*, and *P. yombai*, which had prevalence values between 10% and 50%, were classified as secondary species.

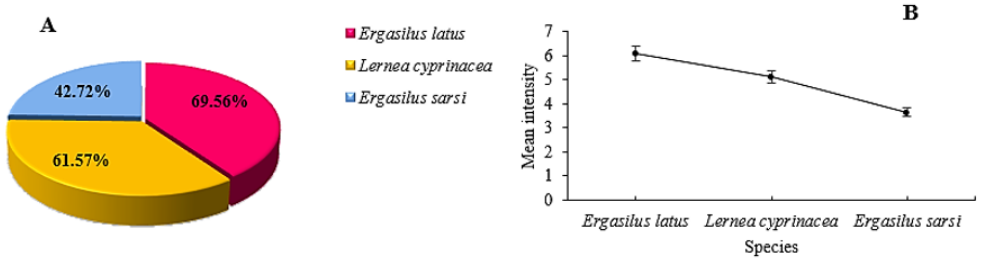


Figure 2: Variation of prevalence (A) and mean intensity (B) of gill Copepod of *Chrysichthys nigrodigitatus* in Aby Lagoon

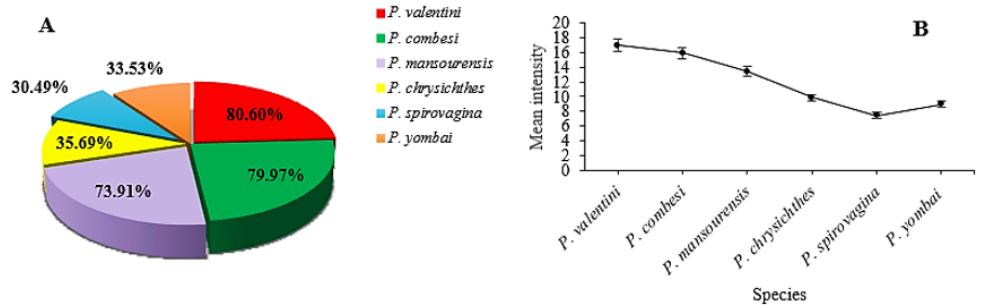


Figure 3: Variation of prevalence (A) and mean intensity (B) of gill Monogean of *Chrysichthys nigrodigitatus* in Aby Lagoon

2. Seasonal variations of *Chrysichthys nigrodigitatus* infestation

Regarding seasonal fluctuations in parasitic infestations, the highest prevalence values were observed during the rainy season for the Copepods *Ergasilus latus* (77.86%), *Lernaea cyprinacea* (68.62%) and *E. sarsi* (41.59%), as well as for the Monogeneans *Protoancylodiscoides valentini* (95.90%), *P. combesi* (89.51%), *P. mansourensis* (88.71%), and *P. spirovagina* (49.54%). Only the Monogenean *P. chrysichthes* (46.89%) and *P. yombai* (43.76%) reached its highest prevalence during the dry season (Table 1). A chi-square (X^2) test applied to seasonal prevalence data revealed significant differences between seasons (X^2 ; $p < 0.05$). Seasonal patterns in mean intensity mirrored those of prevalence. The highest mean intensity values occurred during the rainy season for all species except *P. yombai (*32.80 ±1.3). Observed mean intensities (± SD) were 5.12 ± 0.6 for *E. latus*, 5.53 ± 0.3 for *E. sarsi*, 25.92 ± 1.8 for *P. valentini*, 25.85 ± 1.6 for *P. combesi*, 23.54 ± 1.7 for *P. mansourensis*, 28.09 ± 1.5 for *P. spirovagina* and 31.47± 1.8 for *P. chrysichthes*. The Mann-Whitney test applied to infestation intensities confirmed a significant seasonal effect on parasitic infections in the host fish ($p < 0.05$).

Table 1: Prevalence and mean intensity of gill parasitic Copepod and Monogean at *Chrysichthys nigrodigitatus* according to the seasons

Parasite group	Parasitic species	Seasons	%P	MI ± SD
COPEPODS	*Ergasilus latus*	Rainy	77.86	5.12 ± 0.6
		Dry	61.25	4.12 ± 0.2
	Lernaea cyprinacea	Rainy	68.62	6.9 ± 0.5
		Dry	54.51	3.3 ± 0.1
	Ergasilus sarsi	Rainy	41.59	5.53 ± 0.3
		Dry	37.37	2.06 ± 0.2
MONOGENEANS	*Protoancylodiscoides valentini*	Rainy	95.9	25.92 ± 1.6
		Dry	65.5	13.91 ± 1.3
	Protoancylodiscoides combesi	Rainy	89.51	25.85 ± 1.7
		Dry	70.43	12.26 ± 1.1
	Protoancylodiscoides mansourensis	Rainy	88.71	28.09 ± 1.5
		Dry	59.11	10.22 ± 0.7
	Protoancylodiscoides chrysichthines	Rainy	27.98	13.47 ± 1.6
		Dry	46.89	31.47 ± 1.4
	Protoancylodiscoides spirovagina	Rainy	49.54	28.09 ± 1.8
		Dry	17.66	15.73 ± 0.9
	Protoancylodiscoides yombai	Rainy	23.31	15.38 ± 0.4
		Dry	43.76	32.80 ± 1.3

%P: prevalence; MI: Mean Intensity; SD: Standard Deviation

3. Seasonal variations of the condition factor (K) in *Clarias anguillaris* infested and uninfested by parasites

Concerning the variation of the condition factor (K) in infested and uninfested fish across seasons, Table 2 presents the mean values observed. uninfested fish exhibited higher condition factors, with mean values of 0.84 ± 0.02 during the rainy season and 0.78 ± 0.01 in the dry season. In contrast, parasitized fish showed lower values, with means of 0.57 ± 0.03 and 0.48 ± 0.01 for the rainy and dry seasons, respectively. Statistical analysis using the Mann-Whitney U test revealed a significant difference in condition factor between parasitized and uninfested fish for both seasons ($p < 0.05$), indicating that parasitized fish were generally leaner than uninfested individuals. However, within the parasitized group, seasonal variation in condition factor was not significant ($p > 0.05$).

Table 2: Mean condition factor (K)($g/cm^{3)}$ of fish infested and uninfested by gill parasitic Monogeneans Copepods, according to seasons

Seasons	Hosts	Number	Condition factor (g/cm^3)	p-value
Rainy	Examined	258	0.57 ± 0.03	0.02
	Infested	247		
	Uninfested	11	0.84 ± 0.02	0.03
Dry	Examined	222		
	Infested	145	0.48 ± 0.01	
	Uninfested	77	0.78 ± 0.01	

4. Condition factor (K) of *Chrysichthys nigrodigitatus* in relation to host sex and parasitic infestation

Table 3 presents the mean condition factor (K) values for male and female *C. nigrodigitus* infested and uninfested in the Aby lagoon. Among infested individuals, males exhibited lower K values (0.47 ± 0.03) compared to females (0.55 ± 0.02). In contrast, among uninfested, males had slightly higher K values (0.86 ± 0.01) than females (0.83 ± 0.01). Statistical analysis using the Mann-Whitney U test revealed a significant difference in condition factor between infested and uninfested fish ($p < 0.05$).

Table 3: Mean condition factor (K)($g/cm^{3)}$ of fish infested and uninfested by gill parasitic Monogeneans Copepods, according to seasons

Sizes (cm)	Hosts	Number	Condition factor (g/cm^3)	p-value
[7–20[	Examined	97		
	Infested	59	0.38 ± 0.01	0.02
	Uninfested	38	0.72 ± 0.01	
[20–33[	Examined	95		
	Infested	73	0.41 ± 0.02	0.03
	Uninfested	22	0.74 ± 0.02	
[33–46[	Examined	97		
	Infested	82	0.47 ± 0.02	0.01
	Uninfested	15	0.77 ± 0.04	
[46–59[	Examined	96		
	Infested	91	0.52 ± 0.02	0.02
	Uninfested	5	0.83 ± 0.01	
[59–72]	Examined	95		
	Infested	94	0.57 ± 0.02	0.03
	Uninfested	1	0.88 ± 0.02	

5. Condition factor (K) of infested and uninfested fish according to host size

Analysis of the variation in condition factor (K) among uninfested fish showed that all size classes had mean K values below 1 (Table 3). In contrast, for parasitized fish, the condition factor increased progressively with host size, from the smallest class (7-20 cm) to a maximum in the largest class (59-72 cm), with corresponding values of 0.38 ± 0.01 and 0.57 ± 0.02, respectively. Mann-Whitney U tests revealed a significant difference in condition factor between infested and uninfested fish across all size classes considered ($p < 0.05$).

Discussion

The analysis of the gill parasites fauna of *Chrysichthys nigrodigitatus* revealed the presence of nine parasitic species, including three copepods and six monogeneans. This diversity and variability in parasitic intensity may be attributed to the feeding habits of the fish, which directly influence their

exposure to infectious stages of parasites. Furthermore, the observed species composition reflects a typical parasite community in tropical aquatic environments, where the coexistence of multiple copepod and monogenean species on a single host is common. The dominance of *P. valentini*, *P. combesi*, *P. mansourensis*, *E. latus* and *L. cyprinacea* can be explained by their ability to adapt to different hosts as well as their broad geographic distribution. In addition, the coexistence of multiple monogenean species on a single host may result from fine-scale specialization within gill microhabitats. Each species tends to occupy specific gill arches or filaments preferentially, thereby reducing interspecific competition, as reported by Bassock *et al.,* (2016). Monogeneans, being direct-life-cycle parasites, have their abundance and diversity closely linked to host density and local environmental conditions, particularly temperature and salinity, which affect their survival and reproduction. This dynamic partially explains the structuring of the parasite community observed in Aby Lagoon.

The increase in parasitic infestation observed during the rainy season can be explained by particularly favorable environmental conditions for both fish and parasites. During this period, water oxygenation is generally optimal, turbidity is lower, and the concentration of dissolved nutrients is higher, promoting the growth, reproduction, and activity of host fish. These conditions lead to an increased host density, which raises the likelihood of contact between individuals and facilitates the transmission of parasites with free-living infectious stages (Ali & Al-Hyali, 2018; Marcogliese, 2005). Furthermore, the parasites themselves benefit from a more favorable environment for survival and reproduction, contributing to the observed increase in infestation. In contrast, the dry season is often characterized by a degradation of environmental quality, due to reduced water flow, accumulation of organic matter, and contamination from domestic wastewater and agrochemical runoff. These conditions create significant environmental stress for the fish, resulting in reduced immunocompetence and increased susceptibility to parasitic infections. The combination of factors such as decreased dissolved oxygen, higher pollutant concentrations, and limited food resources weakens the individuals and contributes to more intense parasitic infestations in vulnerable hosts, even if host density may be lower than during the rainy season (Thieltges *et al.,* 2008 ; Poulin, 2007).

Fish well-being, as well as the overall health of the population, can be assessed through the analysis of the condition factor (K). This index is widely used to evaluate the physiological and energetic state of fish, where individuals of the same length but higher body mass are generally considered to be in better condition. In this study, it was observed that parasitized fish consistently exhibited lower condition factor values than non-parasitized fish, suggesting that parasitism has a direct negative impact on host body

condition. This reduction in K among infected individuals can be explained by several physiological mechanisms. Parasitic infestation results in a loss of essential nutrients and metabolic energy, as parasites directly extract resources from their host for growth and reproduction. Additionally, parasitized fish become more vulnerable to other stressors, such as environmental fluctuations, limited food availability, or interactions with other organisms, which can further exacerbate weight loss and impair overall condition (Combes, 1995). Furthermore, the data indicate that the condition factor of fish is generally lower during the dry season compared to the rainy season. This pattern can be attributed to unfavorable environmental conditions characteristic of the dry season, including decreased dissolved oxygen, reduced nutrient availability, and eutrophication in certain habitat areas. These physiological and ecological constraints create significant stress in fish, resulting in reduced immunocompetence and increased susceptibility to parasitic infestations. The combined effect of environmental stress and parasitism thus leads to a marked decline in condition factor, illustrating the strong interaction between biotic factors (parasitism) and abiotic factors (environmental conditions) in determining the physiological state of fish populations.

Parasitism exerts a differential effect on the body condition of fish depending on sex. Several studies have shown that parasitized males consistently exhibit lower condition factor (K) values than parasitized females (Adou *et al.,* 2025 a and b). This difference can be explained by physiological and hormonal mechanisms: male androgens, particularly testosterone, are known to induce partial immunosuppression, reducing the effectiveness of the immune response against parasitic infections and increasing susceptibility to higher parasite loads (Chaves-Pozo, 2018). Consequently, the physiological costs of parasitism including nutrient loss, reduced energy available for growth and reproduction, and increased metabolic stress are generally greater in males, resulting in a more pronounced decrease in condition factor compared to parasitized females. Additionally, behavioral differences between sexes, such as higher activity levels in males or different movement patterns, may further increase contact with infectious parasite stages, amplifying the effects of parasitism.

In uninfested fish, all size classes exhibited a condition factor below 1, suggesting a relatively poor physiological state. This observation may be related to environmental constraints experienced by individuals, such as temperature fluctuations, decreased dissolved oxygen, water quality, or limited food availability, as well as chronic stress associated with intra- and interspecific competition. These environmental factors can reduce metabolic efficiency, limit growth, and weaken the immune system, resulting in low body condition even in non-parasitized fish (Noble *et al.,* 2010; Marcogliese,

2005). In uninfested fish, the condition factor increased with host size, suggesting that the impact of parasitism is strongly modulated by the individual's energy reserves and immune capacity. Small fish were notably more affected, exhibiting very low K values, likely due to their less developed immune system and limited energy stores. These individuals are more vulnerable to parasite accumulation and the associated physiological impacts, such as nutrient loss and increased oxidative stress, leading to a greater reduction in relative body mass (Poulin, 2007). Conversely, large individuals appear better able to tolerate parasitic infestations. Their more developed immunocompetence and higher energy reserves allow them to partially offset the physiological costs of parasitism, resulting in higher condition factor values despite the presence of parasites. This phenomenon can be interpreted within the "resistance versus tolerance" framework in parasitology, where larger individuals do not necessarily reduce parasite load but tolerate its effects more effectively, thereby maintaining a more stable physiological state (Kurtz *et al.,* 2007). Furthermore, the relationship between size and parasitism impact may also be influenced by parasite transmission dynamics. Smaller individuals may accumulate parasites more rapidly due to their relatively larger surface area-to-volume ratio and more frequent contact with vectors or infectious stages, amplifying the negative effects on their condition. This observation aligns with several studies on tropical fish, where juveniles' susceptibility to infestations leads to a notable decrease in condition factor compared to adults (Barber *et al.,* 2000 ; Thieltges *et al.,* 2008).

Conclusion

This study highlighted the diversity and significance of gill ectoparasitic infestations in *Chrysichthys nigrodigitatus* in the Aby Lagoon. Nine species were recorded, including three copepods (*Ergasilus latus*, *Ergasilus sarsi and Lernaea cyprinacea*) and six monogeneans (*Protoancylodiscoides valentini*, *P. combesi*, *P. spirovagina*, *P. mansourensis*, *P. chrysichthes* and *P. yombai*), several of which exhibited high prevalence rates, reflecting a strong parasitic pressure on the host's gills. Seasonal variations were observed, with significantly higher infestation levels during the rainy season, confirming the influence of environmental factors on the dynamics of parasite communities. Analysis of the condition factor (K) showed that parasitized individuals had significantly lower values than non-parasitized fish, regardless of sex or size class. These results highlighted the negative impact of ectoparasites on body condition and likely on the physiological performance of the species.

In a context of increasing anthropogenic pressures in the Aby Lagoon, these findings underscored the importance of parasitological

monitoring as a tool for assessing the health of natural populations of *Chrysichthys nigrodigitatus*. A better understanding of the interactions between environmental conditions, parasite dynamics, and host physiological status is essential for the sustainable management of fisheries resources and the conservation of this socio-economically important species.

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