Copepod Parasites in Gills of Economically Important Fish Mugilidae (*Mugil cephalus* and *Liza falcipinnis*) from Lagos Lagoon, West Africa, Nigeria.

[1,2]Nike F. Aladetohun,[2] Nestor G. Sakiti, [3]Emmanuel E. Babatunde.

[1]Federal college of Fisheries and Marine Technology, Ahmadu Bello way, Victoria Island, Lagos, Nigeria. [2]Laboratory of Parasitological and Ecology of parasites Department of Zoology and Genetics, Faculty of Sciences and Technology, University of Abomey Calavi, Republic of Benin, West Africa.[3]Department of Marine Sciences, University of Lagos, Akoka, Lagos, Nigeria.
adenike63@yahoo.com

Abstract: Ecologists have now recognized the importance of parasitism and diseases as major factors affecting the viability of natural populations and communities, especially nowadays that the world is tending towards mariculture. In this work, copepod parasitic study in gills of 1076 fish mugilidae (*Mugil cephalus* and *Liza falcipinnis*) in three stations (Makoko, Mcquin and University of Lagos) of Lagos lagoon in both dry and wet seasons. Three species of parasitic copepod were identified: *Ergasilus latus*, *Nipergasilus bora* and *Ergasilus lizae*. The percentage number of fish infested was highest in Unilag (95.58%) and least in Mcquin (92.68%), while the total percentage copepod parasite prevalence was highest in Makoko (94.86%), and least in Mcquin (83.41%). *Liza falcipinnis* shows higher number of fish infested and total percentage of copepod parasite prevalence than *Mugil cephalus* in the three stations. There is significant difference P<0.05 in the rate of infestation of *Liza falcipinnis* at Makoko than the other two stations, where as *Mugil cephalus* shows no significant difference in the rate of infestation in the three stations. The research revealed higher number of parasite copepods in fish during the rainy season than dry season. [Aladetohun, N. F., Sakiti, N. G., Babatunde, E. E. **Copepod Parasites in Gills of Economically Important Fish Mugilidae (*Mugil cephalus* and *Liza falcipinnis*) from Lagos Lagoon, West Africa, Nigeria.** *J Am Sci* 2013;9(11):392-401] (ISSN:1097-8135).). http://www.jofamericanscience.org. 50

Key words: Copepod parasites, Mugilidae fish, Copepod parasites, Lagos lagoon.

1. Introduction

Mugil cephalus and *Liza falcippinis in the family* Mugilidae*,* constitute important proportion of the catches by artisanal or subsistence fishermen and are of high economic importance in Nigeria. (Soyinka, 2008). Therefore it is fundamental to know about all the potential pathogens parasites which can perturb their health and reproduction. It is noteworthy that in Nigeria, no single work has been carried out on parasites of these fish. They are economically important species for both aquaculture and commercial fisheries around the world.They inhabit coastal waters, estuaries and fresh waters in tropical and temperate waters of all seas(Render *et al*,1995). They are euryhaline, eurythermal and not competitors for food.(Azien *et al*,2005). The commercial and environmental attributes of mullets makes them an important candidates for domestication (Azien *et al*, 2005). Nigeria has great diversity of fresh, marine and brackish water that can be used for the culture of these economically important fish.

Most of the human impacts on the aquatic environment affect the health of the resident fishes fauna, eventually causing diseases and associated mortalities (Paulin,1992). Among the constrains and problems confronting those daring enough to attempt to produce significant qualities of food from marine aquaculture, none has proved more severe or resistant to resolution than diseases (Paulin,1992). According to Aladetohun and Sogbesan, (2010) in Nigeria, there is still paucity of information on fish disease and control. Fish parasites have been repeatedly reported to be a major threat to the developing industry of fish both in the wild and fish culture. Parasites have recently been highlight as serious pathogenic problems in cultured mullet fish in marine and brackish water Among the parasites, copepode family is commonly found on fishes cultured in brackish water (Noor et al, 2012).

Unfortunately, parasites of animals and humans use fish as intermediate host potential. Diseases and parasites affects fish in general by reducing their productivity and regeneration rate and causes mortality in fish farms and natural environment, that leads to economic loss, (De Kinkelin,*et al*, 1985, Okaeme and Ibiwoye,1989). According to Deveney *et al*. (2001) parasite outbreaks led to high fish mortalities in Australia. It has also been reported that mass production in general,are always accompanied by parasites and pathogens threatening cultured fish, especially parasites with single host life cycles (monoxenous parasites) such as protozoans, monogeneans and crustaceans can spread rapidly under high stocking density conditions (Leong, 1992; Diamant *et al*., 1999; Williams and Bunkley-Williams, 2000,Ruckert *et al*,2008).

Lagos Lagoon is the largest of the four lagoon systems of the Gulf of Guinea (FAO, 1969, Emmanuel, 2008; Soyinka, 2008). The lagoon supports tremendous artisanal fishing of the capture fisheries sector. Owing to the dynamics of river inflow and seawater incursion, the Lagos lagoon experiences brackish condition that is more discernable in the dry season. In the wet season, the increased river inflow creates freshwater and low brackish conditions in various parts of the lagoon. Conversely in the dry season, freshwater inflow is greatly reduced and seawater enters the lagoon through the harbour giving rise to marine conditions near the harbour and brackish water extending far inland (Hill & Webb, 1958; Nwankwo, 1996; Onyema *et al.,* 2003). The harmattan is a short season of dry, dusty North-East Trade winds are experienced sometimes between November and January in the region reducing visibility and lowering temperatures (Onyema *et al.*, 2003; Yakub et.al,2011). In the Lagos lagoon, there is a direct relation between the seasonal bimodal rainfall pattern, the environmental gradient and the biotal gradient. Previous studies of anthropogenic wastes and environmental modifications in the Lagos lagoon have revealed increased levels of pollution stress in the water body (Ajao, 1996; Edokpayi and Nkwoji, 2007; Onyema and Nkwoji, 2009; Emmanuel *et al*., 2010). The enrichment of the water body with high level of biodegradable matter, nutrients, toxic and other land-based substances could upset the natural ecological equilibrium, therefore distorting biodiversity (Nwankwo and Akinsoji, 1992; Emmanuel *et al.*, 2010).

The objective of this study is to determine copepod parasites in economically important fish *Mugil cephalus* and *Liza falcipinnis* in some major fishing areas of the largest fishing lagoon in Nigeria. Determining the copepods parasites species of this world economically important fish with high commercial and environmental attributes will provide better culture condition for them, especially in mariculture and help to solve some of the problems of fish diseases that can perturb their health and productivity, both in the wild and fish culture.

2. Materials and Methods

Study area and sampling sites:

Lagos lagoon, the largest in the southern part of Nigeria is the largest of the lagoon systems of the West Africa sub-region. The lagoon lies between longititude 3°20' and 3°40E and latitudes 6°154 and 6°40' has an area of 208km² (Soyinka, 2008).The Lagos lagoon extends eastwards for about 200km from the Nigerian-Benin Republic border to the western limit of the transgressive mud coast. The morphology has been described in terms of coastal dynamics and drainage and largely affected by the long shore current actions (Ibe, 1988). Lagos Lagoon (Fig.1), has tropical climatic conditions with rainy season from April through November and dry season from December through March. Owing to the dynamics of river inflow and seawater incursion, the lagoon experiences brackish condition that is more discernable in the dry season. In the rainy season, the increased river inflow creates freshwater and low brackish conditions in various parts of the lagoon (Yakub *et al,* 2011). Three stations were selected within the Lagos Lagoon for the study. The stations are Makoko (station 1) University of Lagos (station 2) and Mcquin (station 3) (Fig. 1). The entire study area lies within latitude and longitude (Fig. 1). Sampling was carried out at each station both in the dry (December-March, 2011) and the rainy (April-July, 2012) seasons.

Collection and analysis of water samples

Water samples were collected with 1dm 3 water samplers and stored in 1litre water bottles and analysed in the laboratory for pH, conductivity, salinity and turbidity using a multi-meter water checker (Horiba U- 12). Water sample was collected in 250 ml dissolved oxygen bottle and fixed with Winkler solution at each station. This was followed by dissolved oxygen estimation using Iodometric Winkler's method. Water temperature was measured *in situ* using mercury-in-glass thermometers.

Sampling of the fish specimen and Parasitological examination

Fish specimens (1076) of the two fish Mugilidae were collected from the Lagos Lagoon, directly from the fishermen. The collected fish were transported in ice boxes to the laboratory and examined for parasites. In station 1 (Makoko) a total number of 486 fishwas examined (*Mugil cephalus* (179) and *Liza falcipinnis* (307). In station 2 (Unilag), a total number of 385 fish were examined (*Mugil cephalus* (116) and *Liza falcipinnis* (269) and station 3 (Mcqiun), a total number of 205 were examined out of which *Mugil cephalus* were 73 and *Liza falcipinnis* were 132 respectively.The weight of the fish were taken with the digital weighing balance and recorded.

The standard length (SL), the total length (TL) and the fork length (FL) were measured with the aid of meter rule. The host species was identified using Fisher et al. (1987). Collected copepods were fixed and preserved in ethanol (70%). Before being dissected, they were cleared and stained in lactophenol. Copepods on gills were studied using stereo and light microscopy. Parasites species identification was based on morphological features according to Yamaguti (1963), Vassiliades, (1975), Kabata (1979) (Skryabin *et al* 1982), Ben-Hasseine, (1983), Kabré (1997), Kabre *et al*(1997), and Ho and Kim (2004) and (Moravec,(2007).

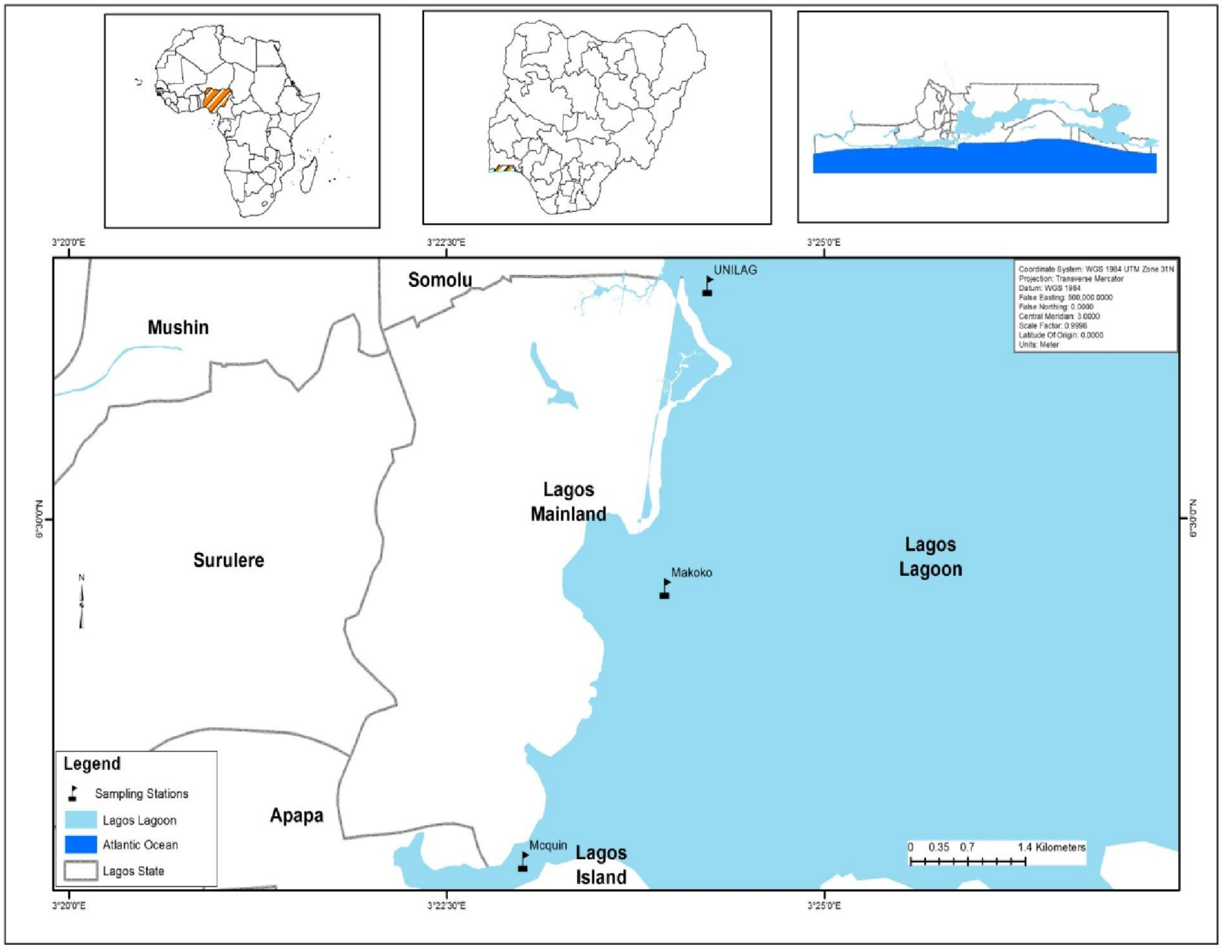

Fig.1: Map of the study area showing the sampling sites

Lagos lagoon Area	Longitude	Latitude
Stations		
Mcquin	3^0 23'0.594"E	$6^0$27'57.686"N
Makoko	3^0 23'56.829"E	$6^0$29'34.733"N
Unilag	3^0 24'13.996"E	$6^0$31'22.977"N

Data analysis

The parasitological terms follow Bush *et al*. (1997): prevalence (P) is the number of fish infected with one or more individuals of a particular parasite species (or taxonomic group) divided by the number of hosts examined (expressed as a percentage):

Prevalence

$$= \frac{No\ of\ hosts\ infested}{No\ of\ hosts\ examined} X\,100$$

Intensity (of infection, I) is the number of individuals of a particular parasite species in a single infected host (expressed as a numerical range); mean intensity (of infection, MI) is the average intensity, or the total number of parasites of a particular species found in a sample divided by the number of infected hosts:

Mean intensity =

$$\frac{Total\ number\ of\ a\ particular\ parasite}{Number\ of\ infected\ hosts}$$

ANOVA test, using statistical software (SPSS) was also done on MC and LF to know the significant difference of copepod parasites infestation in each station.

3. Results

Physicochemical parameters of study areas

The physicochemical parameters recorded at the three stations during rainy and dry seasons are presented in Table 1.During the rainy season, the salinity level was zero in stations1 (Makoko) and 2 (Unilag) while 0.6parts per thousand salinity level was recorded at Mcquin (station 3). In the three stations, the dry season had salinity range of 11.40‰$_0$ at station1 to 29‰$_0$ at station 3 (Table 1). Generally low conductivity levels were recorded from all stations during rainy season, whereas relatively high levels, which ranged from 19.50 mScm-1 at station 11 to 46.50 mScm-1 at station were obtained in the dry season (Table 1). On the other hand, every station had higher turbidity, pH and DO levels during rainy than dry season (Table 1).

A total number of 957 copepods parasites were found in all the stations: station 1(*Mugil cephalus* -151, *Liza falcipinnis* -299), Station 2 (*Mugil cephalus* -98, *Liza falcipinnis* - 240 and the third station (*Mugil cephalus* 56, *Liza falcipinnis* - 113). Table 2 below shows the total Number of Copepods found in the stations studied and owed the abundance of Copepod parasite in the gills of Mugilidae (*Mugil cephalus* and *Liza falcipinnis*) from Lagos lagoon Nigeria.

Table 1: Spatial and seasonal distributions of the physico-chemical parameters in some parts of Lagos Lagoon.

Stations	**T (^{o}C)**		**pH**		**Cond. (mScm-1)**		**Turb. (NTU)**		**Sal. (ppt)**		**DO (Mg/l)**	
	RS	**DS**	**RS**	**DS**	**RS**	**DS**	**RS**	**DS**	**RS**	**DS**	**RS**	**DS**
1	29	28	9.1	8.1	0.84	46	78	10	0	11.4	11.2	8.0
2	29	27	8.9	8.0	1.0	46.5	366	10	0	26.5	13.6	13.2
3	28	28.5	9.0	8.1	0.64	45.8	126	10	0.6	29	18.4	8.4

WT: Water temperature; Cond: Conductivity ; Turb: Turbidity; Sal.: Salinity; DO: Dissolved oxygen; RS: Rainy season; DS: Dry season.

Table 2: **Total Number of Copepods found in the stations studied**

MONTHS	Makoko		Unilag		Mcquin		
	M.C	L.F	M.C	L.F	M.C	L.F	
Dec	22	39	18	32	4	13	
Jan	24	42	10	29	7	10	
Feb	20	37	10	17	8	19	
Mar	23	35	20	34	5	15	
Apr	12	38	6	42	10	21	
May	24	40	14	31	9	8	
June	9	38	12	28	10	17	
July	27	30	8	27	3	10	
Total	151	299	98	240	56	113	957

Table 3: **Abundance of Copepod parasite in the gills of Mugilidae (*Mugil cephalus* and *Liza falcipinnis)* from Lagos lagoon Nigeria**

Location	No of Fish Examined		Total	No of Infested Fish		% Number of Fishes Infested	No of Copepod Parasite		% Parasite Prevalance		Total % Parasite Prevalence
	M.C	L.F		M.C	L.F		M.C	L.F	M.C	L.F	
Makoko	179	307	486	170	290	94.65	151	299	35.14	64.86	94.86
Unilag	116	269	385	110	258	95.58	98	240	28.99	71.01	87.79
Mcquin	73	132	205	65	125	92.68	56	113	33.92	66.08	83.41

In all the three stations, percentage of copepod parasites prevalence was much higher in *Liza falcipinnis* than *Mugil cephalus* (Table 3*)*. In Makoko LF (64.86%, MC (35.14%), Unilag LF (71.01%), MC (28.99%) and in Lagos-harbour LF (66.08%), MC (33.92%). Total percentage copepod parasite was highest in Makoko (94.86%), followed by Unilag(87.79%) and least in Mcquin (83.41%) (Table 3).

Further analysis was carried out to investigate the prevalence rate of copepods during dry and raining season. The prevalence rate during dry season is; Makoko (0.92), Unilag (0.91), and Mcquin (0.81). The prevalence rate during the rainy season is Makoko (0.98), Unilag (0.84) and Mcquin (0.81). It is clearly shown in the analysis that the prevalence rate is higher in the rainy season than dry season. Makoko shows highest percentage of parasite prevalence than other stations (Table 4).

Table 4: Prevalence rate of copepod during Dry and Rainy season

Season	Location	No of fish examined		No of copepods		% of Parasite prevalence		Total % parasite prevalence
		M.C	L.F	M.C	L.F	M.C	L.F	
Dry	Makoko	97	166	89	153	0.3678	0.6322	0.9202
	Unilag	58	128	58	112	0.3411	0.6588	0.9138
	Mcquin	37	64	24	57	0.2963	0.7037	0.8149
Rainy	Makoko	82	141	72	146	0.3303	0.6698	0.9776
	Unilag	58	141	40	128	0.2381	0.7619	0.8442
	Mcquin	40	68	32	56	0.5714	0.4286	0.8148

Figures 2-7 shows graphs of parasitic copepods *(E.Latus,N.bora* and,*E.Lizae*) fonnd in both LF and MC in all the stations.

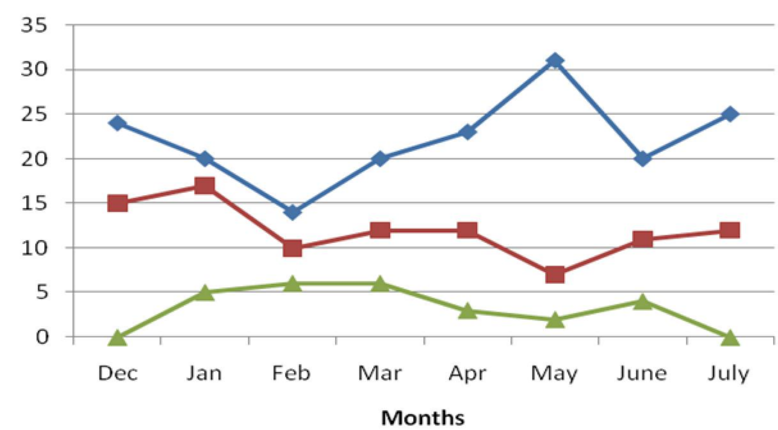

Fig.2 Copepod species of M.C at Makoko

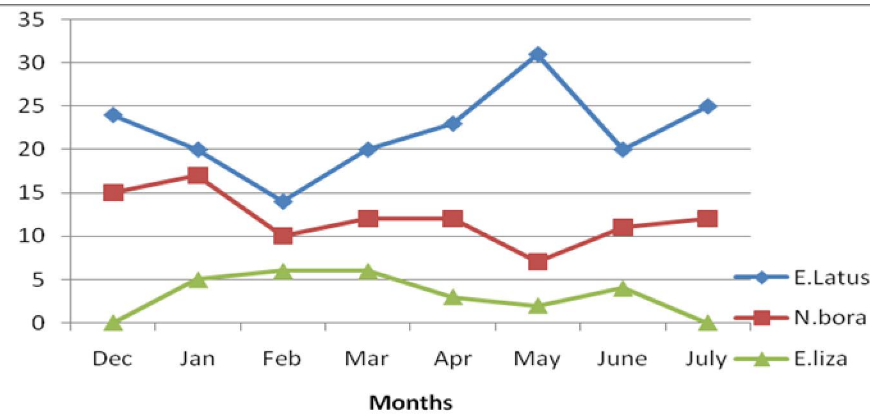

Fig.3 Copepod species of L.F at Makoko

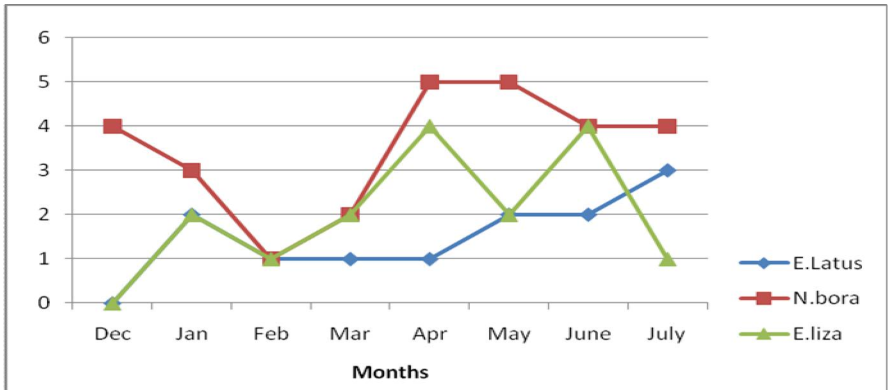

Fig.4 Copepod species of MC at Mcquin

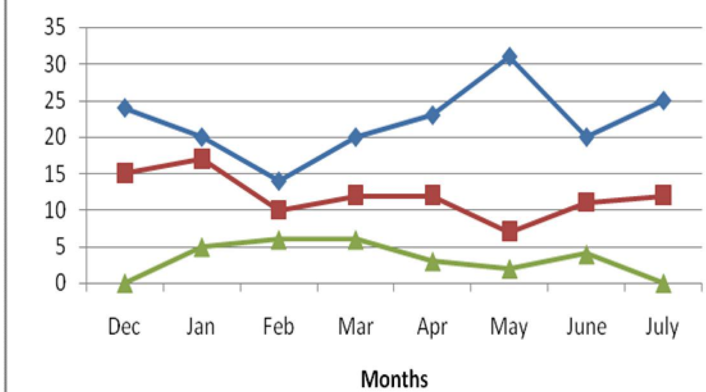

Fig.5 Copepod species of L.F at Mcquin

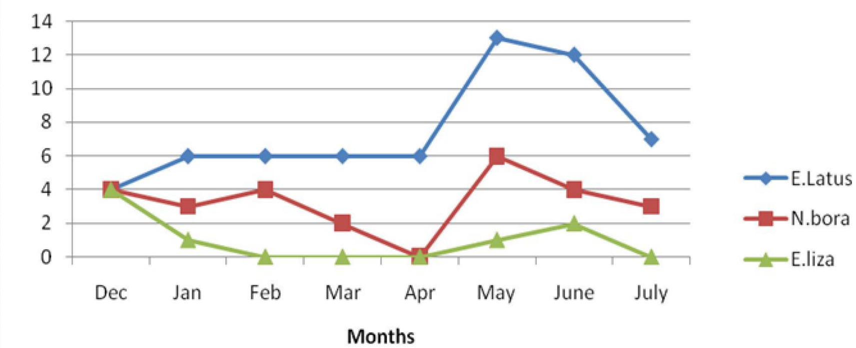

Fig.6 copepod species of M.C at Unilag

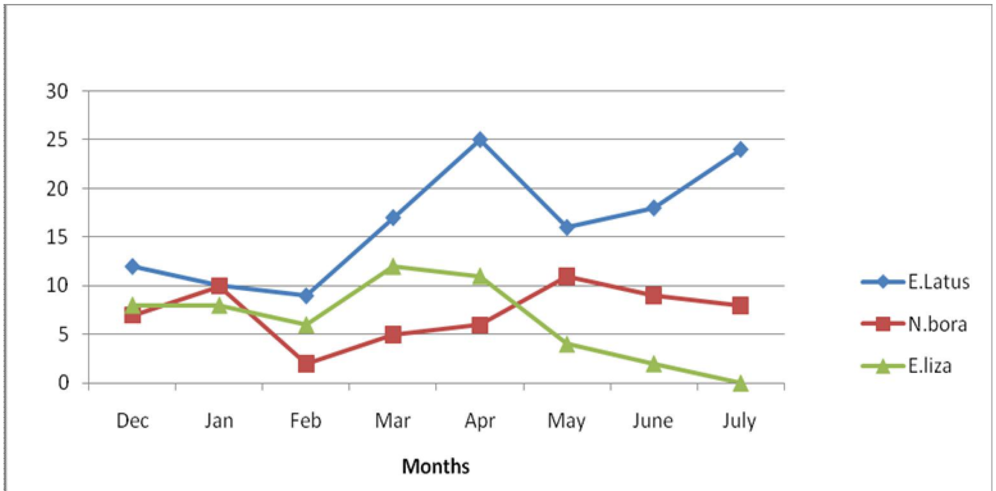

Fig.7 Copepod species of L.F at Unilag

Table 5: Prevalence rate of copepod species of Makoko

%	E.Latus	N.bora	E.liza	E.Latus	N.bora	E.liza
Makoko	MC	MC	MC	LF	LF	LF
Dry	7.33	4.44	2.22	17.33	12.00	3.78
Rain	11.33	6.22	2.00	22.00	9.33	2.00

Table 6: Prevalence rate Copepods species of Unilag

%	E.Latus	N.bora	E.liza	E.Latus	N.bora	E.liza
Unilag	MC	MC	MC	LF	LF	LF
Dry	6.587	3.892	1.497	14.371	7.186	10.180
Rain	11.377	3.892	0.898	24.850	10.180	5.090

Table 7: Prevalence rate Copepods species of Lagos harbour

	E.Latus	N.bora	E.liza	E.Latus	N.bora	E.liza
Mcquin	MC	MC	MC	LF	LF	LF
Dry	2.367	5.917	2.959	9.467	11.243	4.734
Rain	4.734	10.651	6.509	13.018	19.527	8.876

In Makoko, *E.Latus* shows the highest percentage prevalence both in the dry season and rainy season (MC,7.33%,LF17.33%) and (MC,11.33%,LF 22.00%) (Table 5).In Unilag, *E.Latus* shows highest percentage prevalence dry season (MC,6.587,LF,14.371) and at rainy season (MC 11.377,LF,24.850(Table 6)),while in Mcquin, N.bora shows highest percentage rate both in dry season MC(5.917 and LF,11.243), and in rainy season (MC.10.61% and LF, 19.527%)(Table 7).

3. Discussion

The seasonal variations in physicochemical parameters in Lagos lagoon indicate the great influence rainfall has on the physicochemical hydrology of tropical waters (Okogwu and Ugwumba, 2006; Onyema 2009).The 0--0.6parts per thousand salinity level recorded at the three stations during raining season typifies fresh water condition while a typical estuarine salinity condition was recorded during dry season showing the effect of rainfall on the salinity profile of the Lagos Lagoon. The rains could have had dilution effect on the Lagoon water as well as increased the level of freshwater discharge from the river basins into the Lagoon. The relatively low conductivity levels recorded during wet season could also be attributed to the dilution effect of the rains during the season. This as well as the similarity in salinity and conductivity variation patterns during dry season, indicates that ionic salts accounts mostly for conductivity of the Lagos Lagoon (Ogunwenmo and Osuala, 2004; Edokpayi and Nkwoji, 2007; Onyema and Nkwoji, 2009). The relatively high turbidity of the wet season could be attributed to high level of particulate matters brought into the lagoon from surface run-offs by flood during the season. Relatively high DO levels during the wet season could be as a result of high water current and turbulence that characterise the season (Adebisi, 1981).

Fish parasites have been repeatedly reported to be a major threat to the development of fisheries, both in the wild and culture system especially in mariculture due to severe parasite and disease outbreaks. The present study of the mugilidae,*Mugil cephalus* and *Liza falcipinnis* from Lagos lagoon, Nigeria, revealed very high population of copepod parasites.

The findings of this research agrees with De Pereci (2000) who discovered 63.3% of the mugilidae fish infested with copepod parasites. Vinoth *et al*. (2010) in his report on infestation of copepod parasites in the food fishes of Vellar estuary, Southeast coast of India, also discovered maximum copepoda parasite infestation in *M. cephalus* and *L. calcarifer.* The highest total percentage copepod parasites recorded in Makoko (98.46%), might have been caused by organic pollution resulting from human settlement.

A seasonal comparison revealed some species that showed variation in prevalence and intensity of infection between the dry and the rainy season. In this research,highest copepod parasites was recorded during the rainy season than dry season. Tores and Bareiro,(2003) in his work also revealed higher no of copepod parasites during rainy season.

This research shows that the copepod parasites found belong to the family Ergasilidae, but genus ergasilus copepods (*Ergasilus lizae* and *Ergasilus latus)* had the highest frequency of occurrence and relative abundance than genus Nipergasilus (*Nipergasilus bora)*. Valles-Rios *et al* (2000), recorded 72% of copepods (*Ergasilus versicolar)* from stripped *Mugil cephalus Wilson,1911*. Vinoth, (2010), also reported higher infestation prevalence and moderate intensity caused by genus ergasilus copepods, *E.atafonensis* followed by *E.Lizae*. In his article, he observed considerable variation in the respiratory area owing to the attachment of parasites in the infected fishes. The infested fish had extremely pale gills, indicating the gill rakers were seriously lost, apical damage and out off gill lamellae. According to Vinnobaba, 2007, pathological changes induced by the Ergasilid infections would adversely affect the proper functioning of the gills of host fish. Ergasilids attached to gill filaments produce small foci of erosion; apparently feeding involves excretion of proteolytic enzymes for external digestion. Such erosion processes occur in *E. megacheir* infections in cichlids and *E. lizae* infections in grey mullets (Fryer, 1968a) Erosion and degradation processes may extend beyond the epithelial lining, resulting in obstructed branchial blood vessels. Irritation often results in responsive hyperplasia of the epithelium, which, as infection is prolonged, may extend over large areas of the gills, causing fusion and embedding of lamellae, with a resulting decrease in the respiratory function of the gills (Kabata, 1970; Paperna & Zwerner, 1981). Raibaut *et al.,* (1975) proved that, *E. lizae*, whose entirely free larval development takes place in brackish waters, infests mullets while they remain in this brackish environment. Ben Mansour and Ben Hassine, (1997), Caro *et al*. (1997), indicated that migratory fishes with environment change are characterized by a high parasitic richness compared with sedentary.

Vinobaba (2007) in his investigation on histopathological changes induced by ergasilid parasitic infections on the gills of economically important fishes (*Mugil cephalus* inclusive) from Batticaloa lagoon,Sri Lanka, intensity of infection ranged from 0 to 30 ergasilids per host fish. Histopathological investigations of infected gills showed extensive tissue damage due to attachment and feeding of ergaslids. *Ergasilus* sp attached close to the base of the filaments near the gill arch and the pressure exerted by the parasite attached to the lateral margin of the gill filaments induced atrophy of the secondary lamellae. Tissue reactions included hyperplasia and mucous cell proliferation of the gill epithelium and damaged primary and secondary lamellae. Considerably high numbers of eosinophilic granular cells and rodlet cells were noticed in the gills of the infected fish. In his findings on seasonal parasitic prevalence and mean intensity, he also,reported that mass mortalities of the fish inhabiting Batticaloa lagoon, which occurred during April and May 2004 may be attributed to the infection of the fish gills by these ergasilids. According to Halisch,1940; Kabata,1970, heavy infections are likely to occur in crowded fishponds. Establishment of ergasilids in fishponds, however, depends largely on the ability of larvae to survive and develop to infective stages within ponds.

In low-saline ponds, along Israel's Mediterranean coast, epizootics of *Ergasilus lizae* during the winters of 1966 through 1968 resulted in considerable losses. In one pond, ten to seventy individuals infested each of over 90% of the 100 g specimens of *Mugil cephalus* (Lahav & Sarig, 1967; Sarig, 1971).Records provided by M. Lahav of the Fish Disease Laboratory at Nir David, Israel, as reported by Perpena and Overstreet(1981), revealed that in other ponds, 70-80 g fish each harboured 100-200 of the copepods, and 250 g fish possessed 1500-2000 individuals. During critical periods, many fish were found dead each day and those still living were so weak that they died when netted. These emaciated mullet had recessed abdomens. Yashouv, 1972,reported reduction in the number of harvested fish was about 50% of those stocked, rather than the expected 90 % as a result of this infestation. Even though *M. capito*, *Tilapia aurea* and carp accompanied *M cephalus*, only *M cephalus* was involved in mortalities. Individual *M. capito* had about nine copepods compared with 100-120 on the emaciated *M. cephalus*.

The highest frequency of occurrence and relative abundance of *Nipergasilus bora* found in Mcquin may be to its closeness to the sea. Ben Hassine,1983 in his work on copepod parasites of mugilidae from the meditarrranean of France and Tunisia, reported *Nipergasilus bora,*

Finally, the result of this study showed high level of copepod parasites infestation especially ergasilid copepods in mugilidae fish *(Mugil cephalus* and *Liza falcipinnis*) from Lagos lagoon.This which can cause serious fish health problems, fish mortalities and consequent production loss.

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