INFESTATION OF ECTOPARASITES ON NILE TILAPIA (*OREOCHROMIS NILOTICUS)* IN AQUACULTURE PRODUCTION IN THE ASHANTI REGION, GHANA

THESIS

Presented in Partial Fulfillment of the Requirements for the Master of Science in International Fisheries Management

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To my family, am highly indebted to you all for the encouragement you gave me throughout my two years in Tromsø. You always saw the best in me and helped me to realize them. God bless you for the good work.

DEDICATION

To my brother, Kingsley Aseidu-Asare and my dearly beloved fiancé, Agyaaku Nkansa.

ABSTRACT

A survey was carried out to investigate the prevalence and mean intensities of ectoparasites infestation on the gills and skin mucus of Nile tilapia (*Oreochromis niloticus*) in some selected fish farms in the Ashanti region of Ghana. Pond water quality was also determined. Oral on-farm interviews on pond management practices were carried out on the farms.

The results obtained revealed three types of ectoparasites namely; *Trichodina* sp., monogeneans and *Tetrahymena* sp. of which the first two were prevalent on most farms. *Tetrahymena* sp. was found on one farm.

The physico-chemical parameters and management practices were very similar in all farms. There were no strong relationships between ectoparasite prevalence and intensity and the physico-chemical properties and the management practices on the farms. the ectoparasites occurrences in infected farms might have been due to a chance effect. The general low prevalence and intensities of ectoparasites recorded in the infected farms is an indication that the Nile tilapia has a biotic mechanism which might have enabled it to reduce the growth rate of ectoparasite intra-population.

The ectoparasites do not seem to pose a threat for the aquaculture industry in the Ashanti region as observed in this study, but measures have to be taken to secure the industry from unforeseen incidents, for instance in the introduction of non-endemic parasite species in the future.

CHAPTER ONE

INTRODUCTION

1.1 Global overview of Aquaculture

Aquaculture has emerged as an important industrial force of environmental, economical and social change in many regions in the world. Farming of species such as Atlantic salmon (Norway, United Kingdom, Chile, Canada and New Zealand), carp and tropical shrimps in Asia and South America among others has contributed immensely to food security /quality and income in these areas (Huitric et al. 2002; Kaushik 1999; Naylor et al. 2000; Shang et al. 1998; Yoshiyama 1999).

Aquaculture has been an important vector in the introduction, transfer, and spread of aquatic diseases and parasites (Klinger & Floyd 2002). Aquaculture does not create disease as such, but stress related to the environmental conditions such as overcrowding, poor hygiene, temperature variations etc greatly favor disease outbreaks and transmission in the facilities (Folke & Kautsky 1992)

The combination of factors involved in the emergence of each epidemic in the industry is unique, but a variety of common factors such as evolution from non-pathogenic micro-organisms, interactions between cultured and wild fish populations, all other human mediated movements of aquaculture commodities among others seem to be apparent. In addition, the recent increase in globalization of trade in live aquatic animals and their products in the form of broodstock, fry and fingerlings and enhancement of marine and coastal areas through stocking aquatic animals raised in hatcheries cannot be over emphasized (Bondad-Reantaso et al. 2005; Kamal & Mair 2005; McVicar 1997; Murray & Peeler 2005; Sepulveda et al. 2004).

The high risk of disease transmission and parasite infestations among species has increased the level of uncertainty which farm managers have to contend with to develop the industry (Pozio & Rosa 2005). The majority of the disease-causing pathogens are

protozoans, monogenetic trematodes and parasitic crustaceans (e.g. salmon lice in farmed Atlantic salmon in Norway and Ireland), most of which have direct life cycles and reproduce rapidly under unfavorable pond conditions (Al-Rasheid et al. 2000; Basson & As 1994; Van As & Basson 1987).
In Ghana, fishing is the most important direct and indirect employment generating activity in the entire coastal zone of length of about 528 km. In addition, fish is the single most important source of protein and has been reported to contribute 60 % of the national daily animal protein consumption in Ghana (FAO 1999). It has been estimated that the fishery sub-sector supports about 1.5 million people, and fish and fish products contributed 21% (US $56 million) to the nations non-traditional export earnings in 1997 (FAO 1998).

There is growing evidence that both marine and inland fishery is being exploited beyond its sustainable limit. The Fishery department in Ghana estimated in 1998 an annual fish requirement of 736 000 Mt. of which the nation's resources can provide about 453 000 Mt, thus leaving an unsatisfied demand of almost 300 000 Mt. /yr. This led the Government to promote aquaculture and other culture based fisheries in many communities to boost fish production, as the other protein sources such as meat and chicken are expensive and unaffordable to the growing population (Moehl et al. 1999).

1.2 Aquaculture in Ghana

Aquaculture is not a traditional practice in Ghana as it is in most Asian countries. The primary purpose of engaging in this practice is basically dependent on the individual's social status, thus predominantly practiced on either small-scale or semi-intensive. In spite of the Government's aquaculture objectives in its 'Vision 2020' (A national development policy framework 1996-2020) to increase food production, food security, alleviate poverty and the expansion and diversification of high-value exports of aquatic organisms among others, much has not been achieved so far (MOA 1998). The slow growth of the sector facilitated the rapid dissociation of the Department of Fisheries from the Ministry of Agriculture (MOA) into an independent entity known officially as Ministry of Fisheries.

Under the new ministry, recent studies are being carried out to examine the whole process of production in aquaculture and identify the inhibiting factors that might be contributing to its slow growth. Most of the on-going research has been focused on the development of new strains of fish, media and environmental conditions in the area with less attention on the impact of disease pathogens in these cultures.

In Ghana, the aquaculture is based on only two species of fish: the Nile tilapia, *Orechromis niloticus* and African catfish, *Claris gariepinus* (Moehl et al. 2004). The incidence of ectoparasites such as *Trichodina* sp., *Chillodinella* sp., monogeneans etc have been found to be higher among the Nile tilapia than in the catfish, as the latter is more hardier and have a higher disease resistance than the former (Dontwi 2004).

This has generated a lot of concern for the aquaculture industry and hence the Veterinary Departments of Ghana and the Ministry of Fisheries have collaborated in several research and campaigns in the regions to educate farmers on ectoparasites in order to sustain the Nile tilapia stocks, which is the most cultured species in Ghana due to its fast growth and prolific nature (Ofori et al. 2005). The growth rate of the Nile tilapia has been reported to increase with favorable environmental factors and good farm practices which reduce their susceptibility to disease-causing pathogens (Popma & Masser 1999).

Findings from surveys conducted in the northern sector of Ghana to determine and control fish diseases revealed that parasites (ectoparasites) dominated the disease causing pathogens in fish farms (Dontwi 2004; Post 1987). The species of the genus *Trichodina*, (phylum *ciliophora*), genus *Chilodinella* and subclass Monogenea (phylum Platyhelminthes) identified on the Nile tilapia (*Orechromis niloticus*) are among the commonest ectoparasites which could cause a major health problem in future for the fishing industry (Dontwi 2004).

1.3 Ectoparasites of Nile tilapia

Species of the genus *Trichodina* are the most common ciliates present on the skin and gills of pond-reared fish (Dickerson & Clark 1996; Lom 1995). The body is saucer or bell-shaped. The anterior side of the body possesses an attachment organ known as adhesive or sucking disk (Post 1987). Low numbers of *Trichodina* sp. are not harmful, but when fish are crowded or stressed, and water quality deteriorates, the parasite multiplies rapidly and causes serious damage. Infested fishes do not eat well, become weak and thus also susceptible to opportunistic bacterial pathogens present in the water. Many studies have reported infestation of Nile tilapia by different species of *Trichodina* (Lom 1995; Lom & Dykova 1992).

Monogeneans (flatworms) are commonly found on the gills, skin and fins of fish (Barker & Cone 2000; Klinger & Floyd 2002; Whittington et al. 2000). The two most common genera of monogeneans that infect freshwater fish are the *Gyrodactylus* and *Dactylogyrus*. They differ in their mode of reproductive strategies and their method of attachment to the host fish (thus host- and site-specific) (Post 1987). *Gyrodactylus* are generally found on the skin and fins of fish and are viviparous. *Dactylogyrus* prefers to attach to gills and produce eggs that are released (Koskivaara et al. 1991). Some adult monogeneans remain permanently attached to a single site on the host (Whittington et al. 2000). Adult monogeneans attach to the host by a specially adapted structure on the posterior end called a haptor (opisthaptor) (Post 1987). The organ possesses sucking valves in some species, but hooks are always present. Skin or gill damage from hooks on the opishaptor serves as entry for opportunistic disease causing organisms. Infested fishes lose appetite and scales in areas where flukes are attached. Infected gills may look swollen and pale and have increased respiratory activity (Klinger & Floyd 2002; Whittington et al. 2000).

The direct life cycles and ability to reproduce in a wide range of temperatures of the above-mentioned ectoparasites enhances transmission rates and hence an increase in intensities within a short time on the host (Cone 1995). Studies have also shown that the presence of ectoparasites on fish stocks in ponds is an indication of poor husbandry practices and environmental conditions (Barker & Cone 2000; Cone 1995; Klinger & Floyd 2002; Lom 1995). Advancement in parasitology has revealed some specific species and genus of ectoparasites of aquatic fishes and the factors which influences their occurrences on their host. Parasitological knowledge has been useful in the development of the aquaculture industry in many parts of the world through the production of vaccines, antibiotics and introduction of bio-security measures to minimize the fish mortalities and boost global food fish.

In Ghana on the other hand, there is currently very little knowledge on the distribution and abundance of pathogens in aquatic ecosystems. This makes it difficult to identify the groups of disease-causing organisms in aquaculture in order to develop preventive and control measures. These concerns about fish diseases have existed for years but however little scientific evidence is available on the subject.

On the basis of this, the present study will seek to answer the following questions to enable future projections to be made in aquaculture industry in Ghana.

- What ectoparasites are common to tilapia in Ashanti region, Ghana?
- Do these ectoparasites pose a major threat to the tilapia aquaculture industry in Ghana?
- Do the environmental factors and routine farm management practices influence the occurrence of these ectoparasites?
- How will this present knowledge affect tilapia aquaculture in the future?

CHAPTER TWO

MATERIALS AND METHODS

2.1. Study site and duration of sampling

Data for this study was collected from fourteen (14) selected fish farms from five districts namely; Ahafo-Ano South, Atwima, Kumasi, Kwabre and Bosomtwe-Atwima within the Ashanti Region of Ghana (Fig. 1). The sites are located in the semi-deciduous rain forest with a bimodal rainfall pattern. The major rainy season stretches from mid-March to end of July. The minor seasons begin in September and ends in mid-November. The sizes of pond range between 100 m^2- 4000 m^2. The study lasted for a period of one month, (2^{nd} of July to 1^{st} of August, 2005).

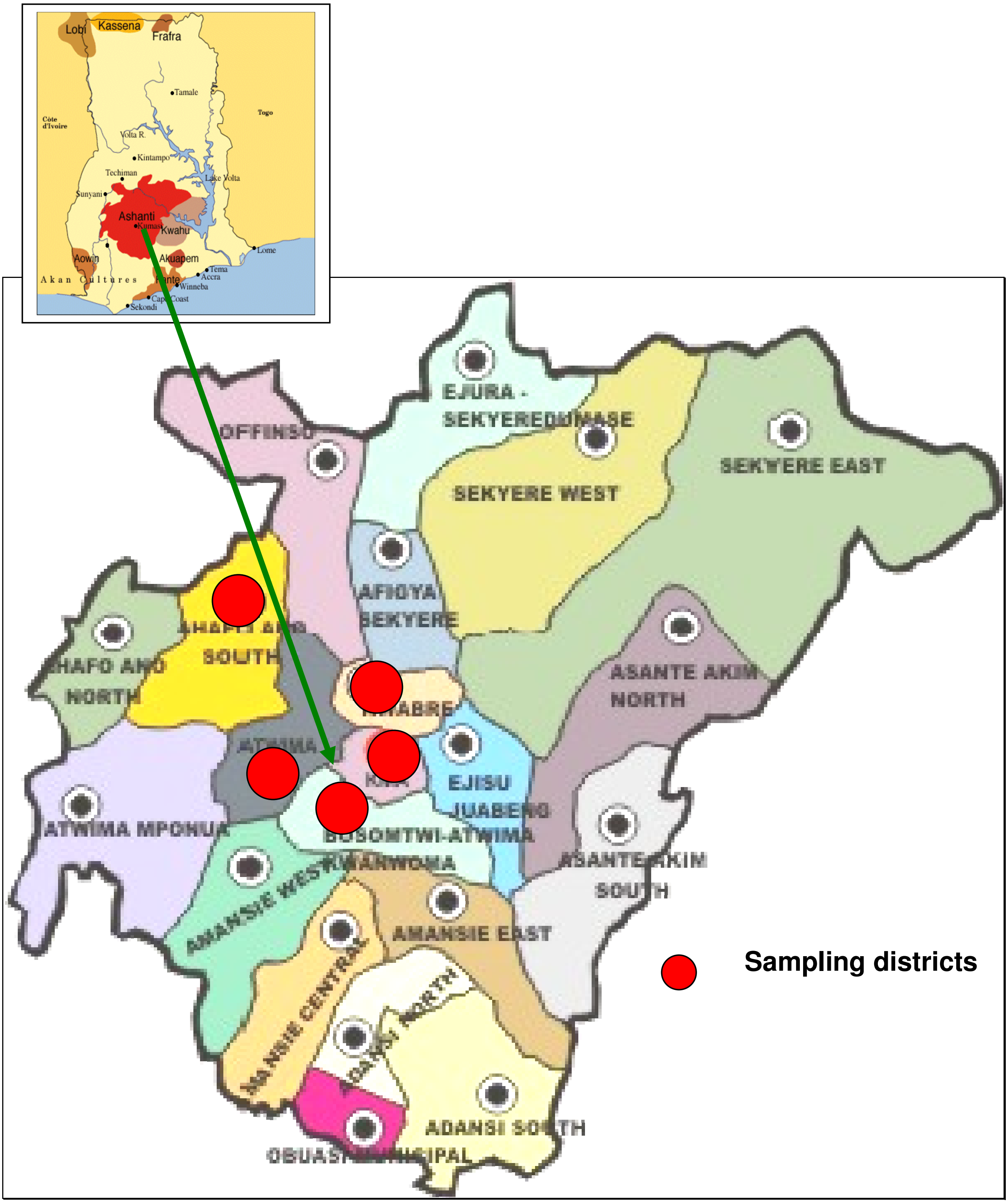

Figure 1: Map showing the sampling districts within the Ashanti region of Ghana

2.2. Source of experimental material and processing of samples

Ten live fishes were sampled randomly from the ponds with a cast net at each farm. Fish sampled were within a certain size and weight range of 14 cm - 18 cm and 40 g - 60 g, respectively, to make samples comparable between farms. Most fish farmers carried out similar management practices according to the on-farm oral interviews. Fish samples collected were kept in clean empty containers filled with pond water to sustain the fish prior to laboratory analyses.

A maximum of four (4) fishes were kept in each container to allow fishes to have sufficient space to move within the containers. The gills and mucus of each fish was examined for parasites. Water samples were taken from the ponds and tested for dissolved oxygen, pH, ammonia and hardness (Teichert-Coddington & Green 1993). The temperature of the water from individual ponds in the selected farms was not recorded.

2.3. Examination procedure

2.3.1. Gill

In the laboratory, the operculum was removed to expose the gills. A section of the first gill lamellae after the operculum on the left side was cut using dissecting scissors. The rest of the lamellae and the gill arch were discarded. The specimen was thinly spread on a slide and a drop of distilled water was added. Specimen was then covered with a cover slip and examined under the microscope with a magnification of 60X for parasites (monogeneans and *Trichodina* sp.). The same procedure was repeated for all fish samples to ensure consistency in the results.

2.3.2. Skin mucus

The body mucus from the caudal part (upper dorsal area between the anal fin and the caudal fin) of the fish was scraped with cover glass. Scraping was carried out carefully to avoid the scales in order to increase the visibility of small protozoans. Mucus was then placed on a glass slide with a drop of distilled water, then cover glass. The specimen was then examined under the microscope for ectoparasites.

Ectoparasites found on the specimen were identified and the numbers counted. Examination of fish gills and mucus for parasites were done on the same day the fishes were sampled as some ectoparasites may either leave or die after the host is dead. The procedure was repeated for all fish samples. Results obtained from gill and skin mucus examination are presented in Table 1.

2.4. Chemical analysis of pond water

The water samples taken from the ponds in the selected farms were analyzed for pH, dissolved oxygen, ammonia and hardness using proposed standard methods with apparatuses from Hach Chemical Company (Hach 1987). The bottles containing water samples were airtight to prevent atmospheric oxygen dissolving into it before analysis in the laboratory.

Table 1: Number of fish examined, pond size and parasites from the farms

FARM NO	POND SIZE (M2)	NO OF FISH EXAMINED	PARASITE PRESENT	
			Gills	**Skin mucus**
1	242-352	20	*Trichodina* sp.	*Trichodina* sp.
2	100	10	*Trichodina* sp.	monogeneans
3	200-600	20	*Trichodina* sp. monogeneans	monogeneans
4	525-1716	30	monogeneans *Trichodina* sp.	
5	2000	10		monogeneans
6	315-800	20	*Trichodina* sp.	monogeneans
7	545	10	*Trichodina* sp.	*Trichodina* sp. monogeneans
8	725	10	*Trichodina* sp.	monogeneans
9	200-645	30	*Trichodina* sp.	monogeneans
10	800	10	*Trichodina* sp.	
11	400-700	20	*Trichodina* sp. Algae content	monogeneans *Trichodina* sp.
12	4000	10	*Trichodina* sp.	monogeneans
13	1500-2000	20	*Trichodina* sp. monogeneans	*Trichodina* sp.
14	300-425	20	*Trichodina* sp.	

2.5 Handling and statistical analysis of data

All the data were analyzed for the prevalence and mean intensity. The prevalence (%) of the ectoparasites was estimated as the ratio between the number of infected fish and the number of examined fish expressed in percentages. The mean intensity (M.I) was determined as the ratio between the total number of parasites in a sample and the number of infected fish in a sample. Prevalence (P) and mean intensity (M.I) were represented in bar graphs and intensity plots for the individual farms respectively using Microsoft excel**.** The relationship between the physico-chemical properties of the pond water and parasite intensities were illustrated in X-Y plots in Microsoft excel.

2.6 Discussion of methods

The present study allows further research into the infestation of ectoparasites in Nile tilapia ponds as the scope of this study is limited. This is due to the fact that fish farms from other regions could not be sampled to make substantive comparisons and conclusions as a result of the short time frame.

Capture and handling of Nile tilapia before and during ectoparasites examination could have led to the dislodging of some ectoparasites from fish. Transportation of several fish in the same tank may have resulted in transmission of parasites between individuals, thus, un-infected became infected. The real prevalence in the farms might have been lower than what was recorded.

Fish samples taken from ponds were subject to sampling errors as a sample may not be exactly the same in all respects as the population from which it was drawn (Fowler & Mangione 1990). The prevalence and intensity of ectoparasites may have been underestimated since only particular portions of the skin mucus and gills were examined. Ectoparasites are also known to inhabit the fins and eyes of the host (Molnar 1987). The values obtained from the analyses of pond water might be underestimated as respiration by micro-organisms reduces the amount of oxygen present in water held in a container prior to the analyses.

There is limited data on fish ectoparasites in Ghana (Dontwi 2004). Existing literature on the ectoparasites of the Nile tilapia and fishes generally in Africa needs to be studied more as findings reported are few as compared to other disease causing pathogens (Al-Rasheid et al. 2000; Ampofo & Clerk 2002).

CHAPTER THREE

RESULTS

Two protozoan and group of metazoan ectoparasites, namely *Trichodina* sp. (ciliate), monogeneans and *Tetrahymena* sp. (ciliate) were recorded from the gills and skin mucus of the Nile tilapia in the survey. The first two ectoparasites were present in almost all selected fish farms.

3.1. Parasites on gills

3.1.1. Prevalence

Trichodina sp. was recorded in all except one farm and monogeneans in only three (Fig. 2). The prevalence of *Trichodina* sp. peaked at 55 % on farm 11 and the lowest on farm 1. Monogeneans peaked at 15 % on farm 13 with both farms 3 and 4 had prevalence of 10 %. No ectoparasites were observed on the gills of tilapia in farm 5.

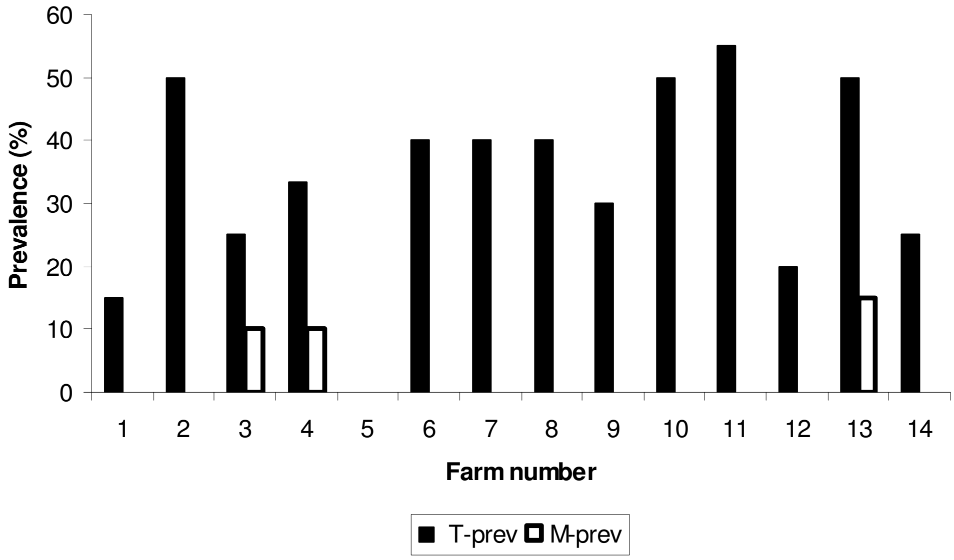

Figure 2: Prevalence (%) of *Trichodina* sp. (T-prev) and monogeneans (M-prev) on the gill sample of Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected fish farms in the Ashanti Region of Ghana.

3.1.2. Mean intensity

The mean intensity of *Trichodina* sp. on the gills was higher than that of the monogeneans in all farms except one (Fig. 3). The two parasite species had the highest intensity of 0.5 on farms 12 and 3, respectively. Tilapias from farm 3 had the highest intensity of ectoparasites, whereas the same intensity was observed on farms 4 and 13 (Fig. 3).

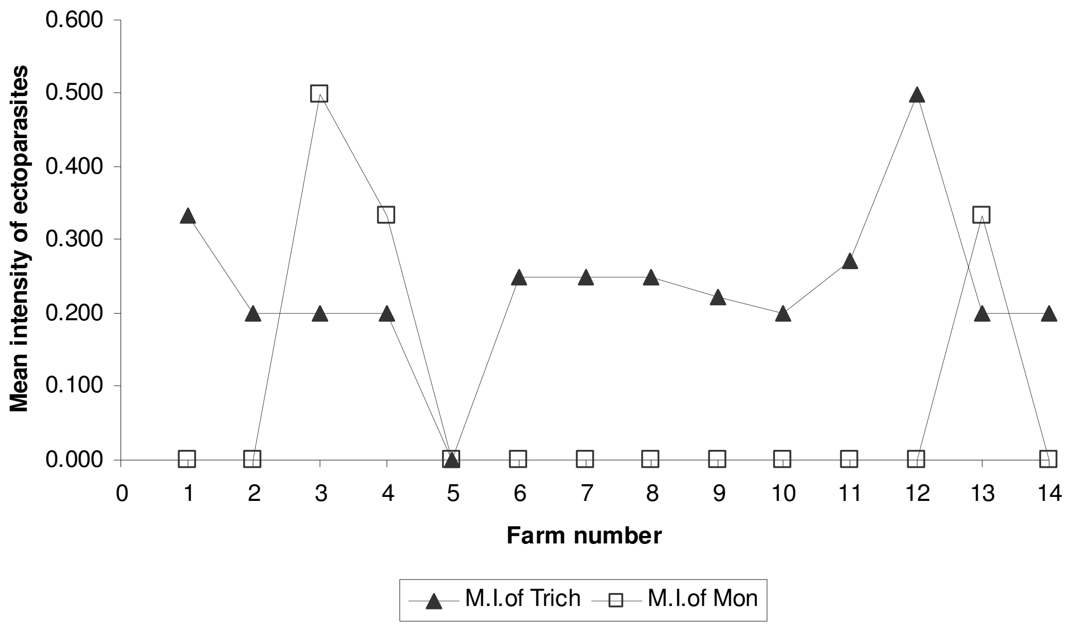

Figure 3: Mean intensities of *Trichodina* sp. (dark triangles) and monogeneans (empty squares) on the gill sample of Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected fish farms in the Ashanti Region of Ghana.

3.2. Parasites on skin mucus

3.2.1. Prevalence

Monogeneans were observed in skin mucus samples in all except four farms (Fig. 4). *Trichodina* sp. was found in four farms and *Tetrahymena* sp. was recorded on farm 3. Two co-occurring parasite species were recorded in only three farms. Highest prevalence of the monogeneans was at 50 % and the lowest at 15 % (Fig. 4). *Trichodina* sp. peaked at 25 % and was lowest at 5 %. Ectoparasites were absent on the skin of tilapias in farms 4, 10 and 14.

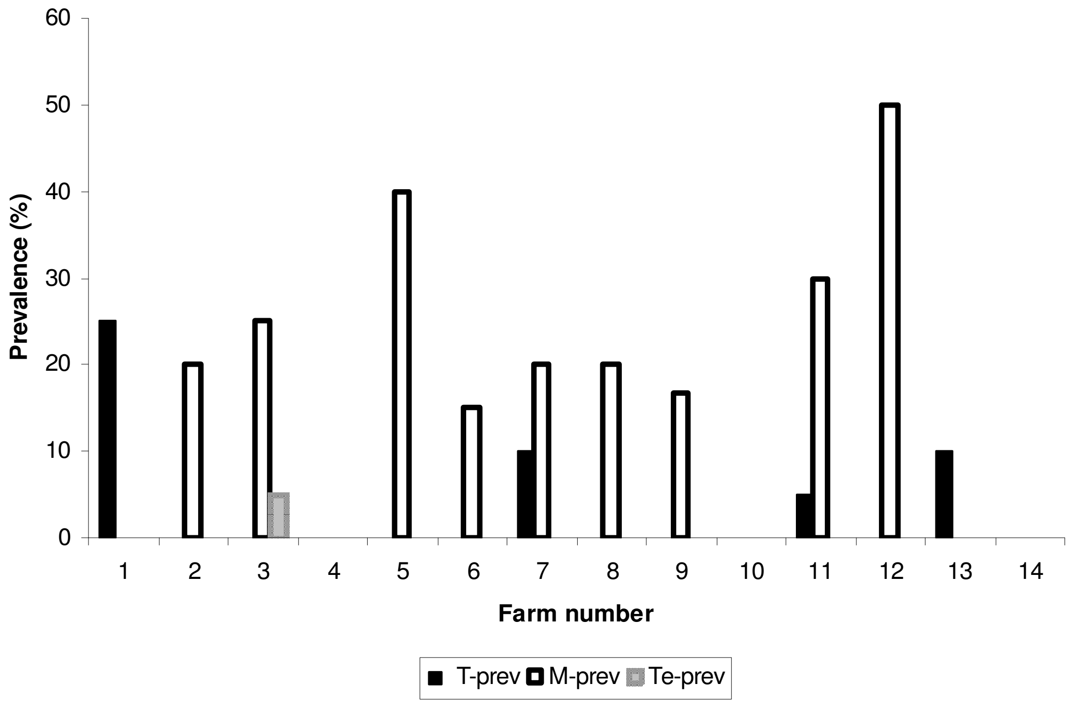

Figure 4: Prevalence (%) of *Trichodina* sp. (T-prev), monogeneans (M-prev) and *Tetrahymena* sp. (Te-prev) in the samples of skin mucus of Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected fish farms in the Ashanti Region of Ghana.

3.2.2. Mean intensity

In the four farms with *Trichodina* sp., the intensities in the skin mucus samples varied between 0.2 and 1 (Fig. 5). Intensity of monogeneans in the infected farms ranged between 0.2-0.5. A high intensity of *Tetrahymena* sp. was recorded on one farm.

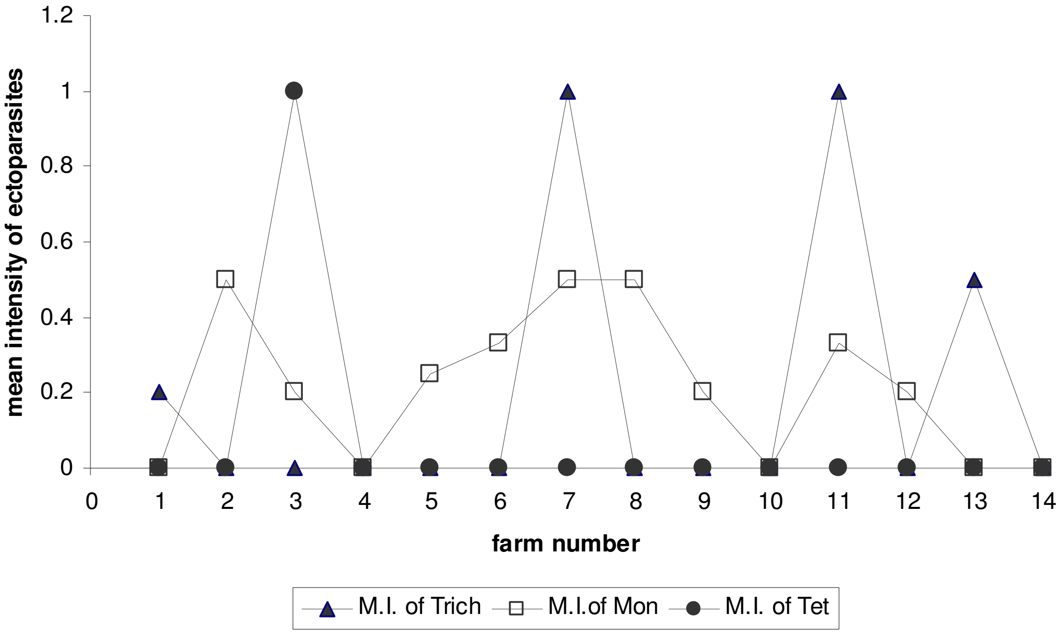

Figure 5: Mean intensities of *Trichodina* sp. (M.I. of Trich), monogeneans (M.I. of Mon) and *Tetrahymena* sp. (M.I. of Tet) in the skin mucus samples from Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected fish farms in the Ashanti Region of Ghana.

3.3. Relationships between physico-chemical properties of pond water and parasite intensities

The table below shows the data on the physico-chemical properties of the pond water from each farm.

Table 2: Physico-chemical data of pond water from farms

FARM NO	PH	OXYGEN	HARDNESS	AMMONIA VALUES
1	7,2	3,5	102,6	0,015
2	7,0	3	85,5	0,008
3	7,5	3	94,05	0,043
4	7,5	2	68,4	high
5	7,2	1	102,6	0,012
6	7,1	1.5	76,95	0,014
7	7,2	4	51,3	0,012
8	7,8	3	102,6	0,034
9	7,23	2,7	57	0,011
10	8,0	2	51,3	0,1
11	7,5	3	128,3	0,185
12	7,2	2	51,3	High
13	7,7	3	102,6	High
14	7,4	4	68,4	0,015

Values obtained in the analyses of the pond water for pH, dissolved oxygen, hardness and ammonia were represented in the X-Y scatter plot in relation with mean intensity of ectoparasites from the farms in the figures below.

3.3.1. pH

The relation between the intensity of monogeneans and *Trichodina* sp. in the gill sample and the pH of pond water was weak (Fig. 6). Although the monogeneans regression line shows a relationship, the intensity was only for three infected farms to draw a valid relationship for all farms. A similar trend was observed with regard to parasites from the skin mucus too (Fig. 7).

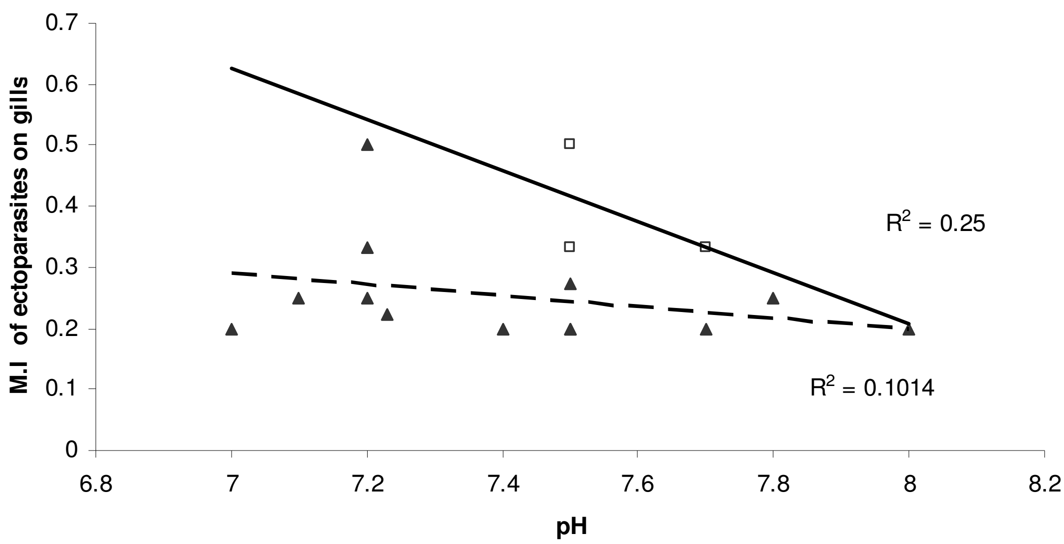

Figure 6: Relationship between pH of pond water from each farm and the mean intensity of *Trichodina* sp (dark triangles) and monogeneans (empty squares) identified on the gill samples from Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected farms in the Ashanti region of Ghana. Indented line with R^2 = 0.1014: regression line for *Trichodina* sp., straight line with R^2 = 0.25: regression line for monogeneans.

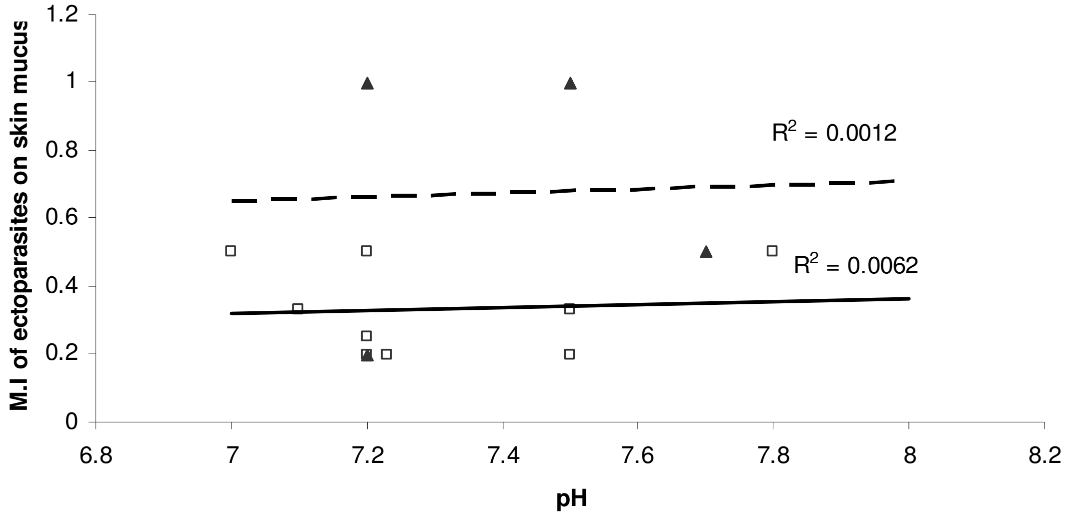

Figure 7: Relationship between pH of pond water from each farm and the mean intensity of *Trichodina* sp. (dark triangles) and monogeneans (empty squares) identified in the skin mucus samples from Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected farms in the Ashanti region of Ghana. Indented line with $R^2 = 0.0012$: regression line for *Trichodina* sp., straight line with $R^2 = 0.0062$: regression line for monogeneans.

3.3.2. Dissolved oxygen

No clear positive or negative relationship was observed between the intensity of monogeneans and *Trichodina* sp. in the gill and skin mucus samples and dissolved oxygen in the pond water in the different farms (Fig 8 & 9). The intensity of monogeneans in the gill samples from the few infected farms can not be a valid relationship for all farms.

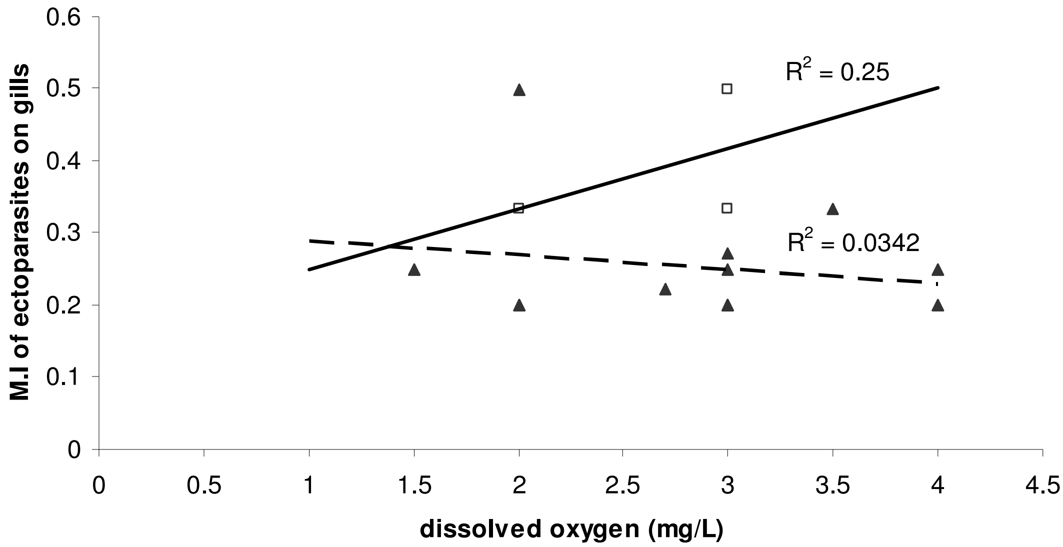

Figure 8: Relationship between dissolved oxygen in pond water from each farm and the mean intensity of *Trichodina* sp. (dark triangles) and monogeneans (empty squares) identified in the gill samples from Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected farms in the Ashanti region of Ghana. Indented line with R^2 = 0.0342: regression line for *Trichodina* sp., straight line with R^2 = 0.25: regression line for monogeneans.

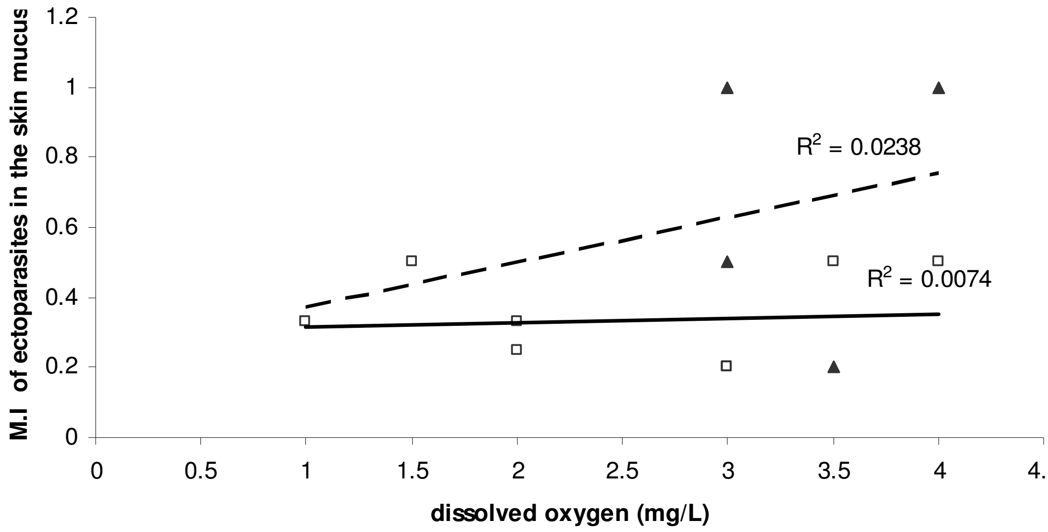

Fig 9: Relationship between dissolved oxygen in pond water from each farm and the mean intensity of *Trichodina* sp. (dark triangles) and monogeneans (empty squares) identified in the skin mucus samples from Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected farms in the Ashanti region of Ghana. Indented line with R^2 = 0.0238: regression line for *Trichodina* sp., straight line with R^2 = 0.0074: regression line for monogeneans.

3.3.3. Hardness

No distinct positive or negative relationship was observed between the intensity of *Trichodina* sp. and monogeneans in the gill and skin mucus samples and hardness of the pond water in the different farms (Fig. 10 &11). The relationship exhibited between hardness and intensity of monogeneans in the skin mucus sample is a weak to draw a valid relationship for the infected farms (Fig. 11).

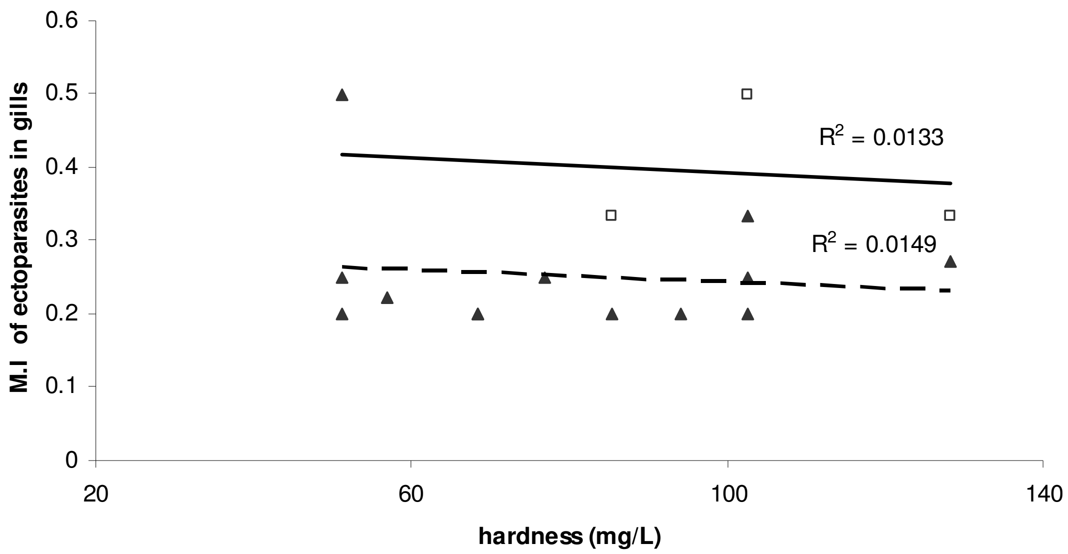

Figure 10: Relationship between hardness of pond water from each farm and the mean intensity of *Trichodina* sp. (dark triangles) and monogeneans (empty squares) identified on the gill samples from Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected farms in the Ashanti region of Ghana. Indented line with R^2 = 0.0149: regression line for *Trichodina* sp., straight line with R^2 = 0.0133: regression line for monogeneans.

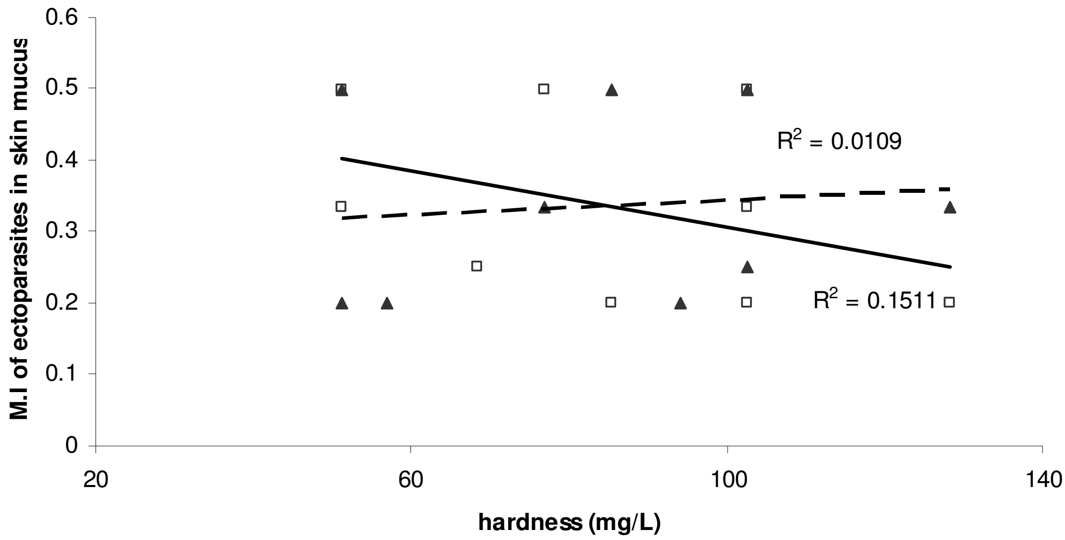

Figure 11: Relationship between hardness of pond water from each farm and the mean intensity of *Trichodina* sp. (dark triangles) and monogeneans (empty squares) identified in the skin mucus samples from Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected farms in the Ashanti region of Ghana. Indented line with $R^2 = 0.0109$: regression line for *Trichodina* sp., straight line with $R^2 = 0.1511$: regression line for monogeneans.

3.3.4. Ammonia

Although, the intensities of monogeneans in the gill and Trichodina sp. in the skin mucus samples showed some relationship with ammonia in pond water, intensities were very low in the few infected farms to establish a strong relationship for all farms (Fig 12 &13).

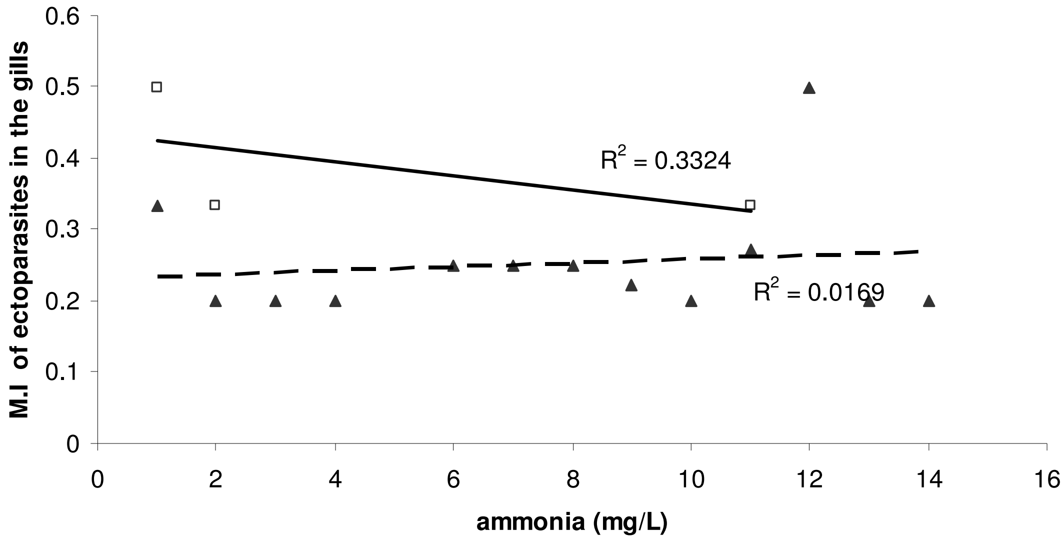

Figure 12: Relationship between ammonia in pond water from each farm and the mean intensity of *Trichodina* sp. (dark triangles) and monogeneans (empty squares) identified in the gill sample from Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected farms in the Ashanti region of Ghana. Indented line with $R^2 = 0.0169$: regression line for *Trichodina* sp., straight line with $R^2 = 0.3324$: regression line for monogeneans.

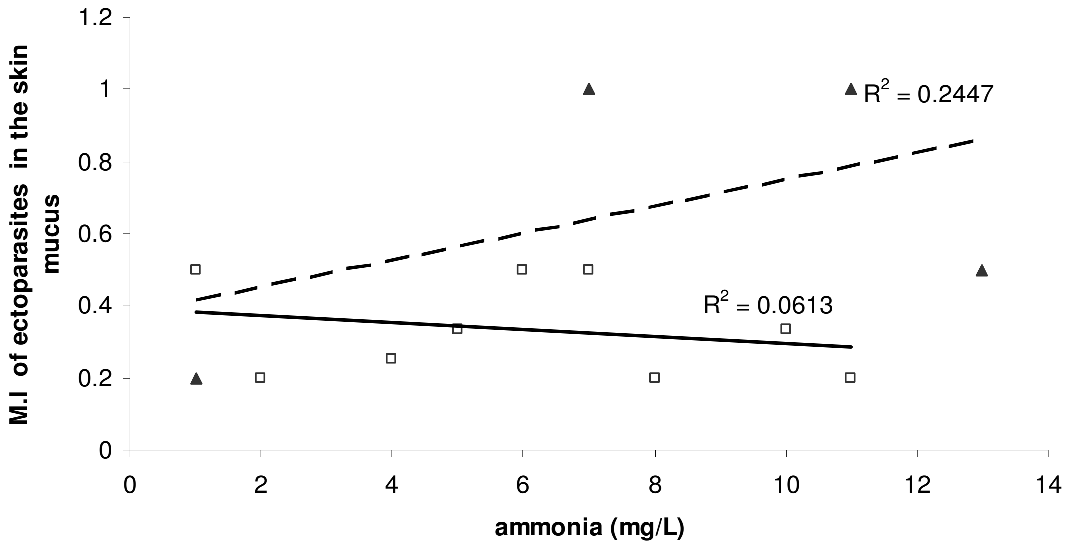

Figure 13: Relationship between ammonia in pond water from each farm and the mean intensity of *Trichodina* sp. (dark triangles), and monogeneans (empty squares) identified in the skin mucus samples from Nile tilapia (*Oreochromis niloticus*) sampled in July and August, 2005 from selected farms in the Ashanti region of Ghana. Indented line with R^2 = 0.2447: regression line for *Trichodina* sp., straight line with R^2 = 0.0613: regression line for monogeneans.

CHAPTER FOUR

DISCUSSION

4.1 Occurrence of ectoparasites in farms

The results from the present study showed that the ectoparasites, *Trichodina* sp., *Tetrahymena* sp. and monogeneans were not found in all farms. In general, the infected farms exhibited low prevalences and intensities of ectoparasites. Possible explanations might be given for the occurrence of ectoparasites in some farms.

The recorded ectoparasites could have originated from infected hatcheries where frys and fingerlings used to stock ponds have been raised. Poor hatchery conditions provide excellent breeding environments for ectoparasites as intra population transmission rates becomes high such facilities (Kearn 2004; Wiegertjes & Flik 2004). In addition, fingerlings have under-developed immune systems, which renders the natural repellant ability of the skin and gill surface non-functional and results in increased susceptibility to ectoparasites which in many cases serve as mechanical vectors to viral and bacterial infections (Barker & Cone 2000; Lom 1995; Paperna 1996). When such fingerlings are used in stocking either a newly established or already existing farm, the parasites may be transmitted into ponds to cause an outbreak.

Infected brood stocks might also transfer ectoparasites from farm to farm when their fingerlings are used to stock un-infected ponds (Bondad-Reantaso et al. 2005; Murray & Peeler 2005). Ectoparasites from previous stocks which inhabited a pond may also be transmitted to new stocks to continue their infestation when pond water are neither drained nor dried out. This might have been a common problem for the farms where water used for filling ponds was scarce. Fish samples from the infected farms showed no visible signs of skin lesions or tissue damage in the study.

4.2 Prevalence and intensities of ectoparasites in infected farms

4.2.1 Suitability of Nile tilapia

There was a profound variability in the prevalence and intensity of ectoparasites between gills and skin mucus samples from the Nile tilapia. In the current investigation, the *Trichodina* sp. was more prevalent on the gill samples than on the skin mucus samples which were dominated by the monogeneans. The few ectoparasite groups observed were similar in the infected farms. This might confirm reports by several authors that most ectoparasites parasitizing freshwater fishes tend to establish a line of specialization (host specificity) towards a more exclusive niche on the host fish (Buchmann & Lindenstrom 2002; Huyse et al. 2003; Lambert & El Gharbi 1995; Van As & Basson 1987; Whittington et al. 2000).

Host-specificity of ectoparasites may result from a combination of physiological, chemical, genetic, and ecological factors (Hargis 1957). Among *Trichodina* sp., a high degree of host specificity is a feature of some, but not all species. For instance, it has been found that many *Trichodina* sp. usually parasitize the gills of the host, whereas a minority live only as skin parasites (Al-Rasheid et al. 2000; Lom 1995; Van As & Basson 1987). The presence of the adhesive disc with prominent denticles for attachment unto the host in *Trichodina* sp. also determines its taxonomy.

In the case of the skin parasites, monogeneans had higher intensities than the other ectoparasites in this study. Monogeneans, particularly the specialists, are characterized by specialized attachment organs (opishaptor) on the host surface (Simkova et al. 2001). The morphology of the opishaptor on the host and the habitat in which it is found can be used to identify the species of monogeneans. Unlike the *Trichodina* sp., monogeneans (except *Gyrodactylus*) produce free-swimming larvae that facilitate their transmission in ponds (Whittington et al. 2000). Several classical works on monogeneans have reported that parasites are easily attracted to their specific host by means of detecting chemical substances released from the host (Wiegertjes & Flik 2004). This might confirmed the current results in which the monogeneans were more prevalent in the skin mucus than the other ectoparasites.

Although, the types of parasites were not identified into species of generalists and specialists in the present study, the distribution of the ectoparasites in the farms may support the postulate which states that generalist parasites exploiting many hosts may achieve a lower abundance and prevalence than the specialist parasites (Poulin 1998) .
The occurence of *Tetrahymena* sp. in only one farm confirm earlier findings that the parasite rarely occurs in few host species (Klinger & Floyd 2002).

4.2.2 Hardiness of Nile tilapia

Although Nile tilapia has been reported to have a relatively higher resistance to parasitic diseases than other common fresh water cultured fish, especially at optimum temperatures, the fingerlings and young fishes are the most susceptible to infections under stressful conditions (Paperna 1996; Popma & Masser 1999). Many studies have reported a negative correlation between large host body size and parasite abundance (Poulin & Morand 2000; Sasal et al. 1997). Large body size fishes, usually long-lived fishes have well developed immunity against the proliferation of ectoparasites (Winemiller & Rose 1992). In this study, differences in the size of fish sampled between farms were standardized to eliminate biases in the results but the small size Nile tilapia sampled might have affected the prevalence and intensity of ectoparasites recorded.

The results from gill and skin mucus samples of the Nile tilapia, with a short-live span of 5 - 6 months were expected to have had high populations of ectoparasites on the farms to confirm earlier findings on parasite epidemics on many farms (Hartvigsen & Halvorsen 1994) . The low prevalences and intensities observed on infected farms indicated that the Nile tilapia might possess an in-built ability to control growth rate of the infra populations below detrimental levels in the farms (Popma & Masser 1999).

4.3 Management and physico-chemical properties of the pond water

The management practices carried out in the farms is parallel to the success of the aquaculture industry. The low fish production that has been reported by the aquaculture industry in Ghana was as a result of poor management and siting of ponds (Ofori et al. 2005). Oral interviews conducted with farm managers in this study showed that management practices were similar between the farms.

Most farmers did not provide supplementary commercial feeds to the Nile tilapia due to the high cost of feed. In addition, farmers rarely drain ponds before stocking with new fingerlings and frys which could have facilitated the easy spread of parasites and other disease-causing pathogens to young new stocks which may be vulnerable due to stress of transportation and under-developed immunity (Paperna 1996). The application of manures into ponds was dependent on its availability and their amounts used were not quantified to check algal blooms and their effect on the quality of pond water and fish health. The results of the current work did not clearly show any relation of parasite intensity and prevalence to the management measures on the farms.

However, slight differences in physico-chemical conditions between some farms might be attributed to the different stocking densities in the ponds. Stocking density of fish in ponds is important in relation to parasite abundance (Pan 2000; Snieszko 1974; Stickney 1979). High stocking density in ponds affects the water quality which results from deficient oxygen levels, increased ammonia levels and lack of water flows among others. These conditions in densely populated ponds increase stress on fish from competition for limited space, food, oxygen. In general, parasites intensities become high on fishes under stress as transmission rates are enhanced when natural immunity is suppressed or low (Davydov et al. 1990; Li 1989; Yi 2000).

In the present study, the physico-chemical properties did not seem to influence parasite infection when the results from the farms were compared.

4.4 Conclusion

The results from the present study with a similar occurrence of ectoparasite groups has showed that both environmental factors and routine management practices carried out on farms did not have any clear relationship to neither prevalence nor intensities of ectoparasites namely, *Trichodina* sp., monogeneans and *Tetrahymena* sp. The occurrence of these ectoparasites on the infected farms might have been due to a chance effect.

It is also concluded that ectoparasites of the Nile tilapia in the Ashanti region might not pose a great threat to aquaculture development since the tilapia seems to be a hardy fish which is able to resist the growth rate of infrapopulations of ectoparasites on infected farms.

I recommend that further study on the Nile tilapia should be carried out to investigate the biotic factors that boost its immune mechanism to reduce infrapopulations of ectoparasites. However, keeping up good sanitary conditions in the hatcheries and farms might also improve the water quality of ponds which might inhibit parasite populations. Routine treatments of hatchery facilities should be encouraged in farms through workshops and campaigns in farming communities. Farmers should be educated on the importance of draining ponds in between stockings to destroy some parasites from previous stocks.

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