The impacts of ecological factors on prevalence, mean intensity and seasonal changes of the monogenean gill parasite, *Microcotyloides* sp., infesting the *Terapon puta* fish inhabiting coastal region of Mediterranean Sea at Damietta region

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**KEYWORDS**
Monogenean parasite; *Microcotyloides*; *Terapon puta*, Ecological factors

**Abstract** The present study has revealed, for the first time, the presence of the monogenean parasite, *Microcotyloides* sp., on the gills of the small scaled terapon fish, *Terapon puta*, inhabiting the coastal region of the Mediterranean Sea near Damietta province, Egypt. This work was carried out between May 2006 and April 2007. A total sample of 180 fish specimens, 15 fish a month, were examined. Seasonally, the prevalence and mean intensity of the *Microcotyloides* sp. are found to be 84% and 3.38 parasite/infected fish, respectively. The prevalence of the *Microcotyloides* sp. reached its maximum value of 92% in summer and a minimum value of 69% during autumn. The mean intensity of the *Microcotyloides* sp. increased to its maximum value of 5 parasite/infected fish during spring; declined dramatically to reach 3.44 parasite/infected fish during summer and recorded its lowest value, 2.97 parasite/infected fish during winter. Monthly fluctuation in the prevalence of the *Microcotyloides* sp. recorded two peaks during the year, the first time in February and the second one in July. Monthly fluctuation in the mean intensity of the *Microcotyloides* sp. showed its highest value, 7.41 parasite/infected fish, in May while its lowest one, 2.2 parasite/infected fish, was recorded in January. The present study has revealed that the correlation between the mean intensity of the *Microcotyloides* sp. and the body weight of *T. puta* fish is positive. The mean

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intensity of the Microcotyloides sp. is positively correlated with each temperature and pH of water but negatively correlated with the salinity of water. To signify the results, statistical analysis using ANOVA’s and Chi-squared tests were applied.

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Introduction

Monogeneans are widespread throughout freshwater and marine habitats. Polypisthocotyleans are pathogenic to economically important fish around the world (Hayward, 2004; Hutoson et al., 2007). Little studies have been concerned with seasonal changes (El-Naggar and Khidr, 1986, 1988; Khidr, 1990) and the impact of ecological factors (El-Naggar et al., 2004, 2005) on monogenean parasites of Egyptian fish. Environmental temperature is an important variable, both for the host and the parasite (McCarty, 2001; Xenopoulos et al., 2005).

The present study aims to examine the prevalence, monthly fluctuation and seasonal changes of monogenean parasite infesting the gills of small scaled terapon fish, Terapon puta. It was also necessary to investigate the effects of some environmental parameters (e.g. temperature, hydrogen ion concentration and salinity) and body weight on the infestation level of the parasite.

Materials and methods

Study area and host collection

A total sample of 180 fish was collected from the coastal water of Mediterranean Sea near Damietta city, during the period from May 2006 to April 2007. The weight of each fish was recorded (ranging from 5 to 30 g) and the parasites were counted for each infected fish.

Collection of monogeneans

For identification of the monogenean gill parasite, at least 10 living specimens of the parasite were placed individually on glass slides with a drop of filtered sea water and a cover slip placed over the parasite. Excess water was removed using a filter paper. The whole mount was examined using a phase contrast microscope under oil immersion at ×100 magnification according to El-Naggar and Khidr (1986).

Collection of water samples

Water temperature, hydrogen ion concentration (pH) and salinity were measured at the fish collection site every month from May 2006 to April 2007.

Water temperature

Water temperature (°C) was recorded with a simple thermometer.

Hydrogen ion concentration (pH)

Each water sample was estimated electrometrically in the same day of sampling with a standardized Orion electrode.

Water salinity

The water samples were collected in labeled, tightly-stoppered bottles and stored until examined in the laboratory. Water salinity was measured with an Aqua salinometer which was standardized by using distilled water as zero salinity and commercially obtained salinity kits.

The statistical analysis

Calculations of the prevalence and mean intensity of the parasites were performed using the SPSS program (version 8.0.0). The prevalence (%) is the percentage of the total number of fish infested out of the total number of fish examined. The mean intensity is the number of parasites in the total number of infected fish.

The significance of differences between prevalence values was calculated using Chi-squared tests. Variations in mean intensity in relation to temperature, pH and salinity were analyzed statistically using (ANOVA) based on a General Linear Model and correlation coefficient.

Results

During the investigation period from May 2006 to April 2007, the prevalence and mean intensity of the monogenean gill parasite, Microcotyloides sp. are shown in (Table 1 and Fig. 1), which reveal that the prevalence and mean intensity were 84% and 3.38 parasite/infected fish respectively.

Chi-square test (Table 1) reveals significant differences in the prevalence of Microcotyloides sp. (t = 12.07, P = 0.007) and mean intensity (t = 10.9, P = 0.012).

Table 1 and Fig. 3 revealed that the mean intensity of the Microcotyloides sp. was low during winter, 2.97 parasite/
infected fish; increased to a maximum value of 5 parasite/infected fish during spring and declined dramatically to reach 3.44 parasite/infected fish during summer.

Statistical analysis using Chi-square test showed that the mean intensity was significant in differences among seasons ($t = 10.9$, $P = 0.012$).

Table 2 and Fig. 4 have shown that the prevalence of the *Microcotyloides* sp. parasite was 85% in May, increased to reach a maximum value of 100% in July and then declined dramatically to reach a minimal value of 50% in October. It increases again to reach another maximal value of 100% in February, then fluctuates in March and April recording 79% and 95%, respectively.

Statistical analysis (Table 2) using Chi-square test revealed that the differences in the prevalence among different months were highly significant ($t = 29.963$, $P = 0.002$).

The mean intensity was high (7.41) in May, decreased to reach 3.67 in November, then increased again in December recording 6 and decreased again to 2.2 in January.

Table 1  Seasonal changes, prevalence and mean intensity of *Microcotyloides* sp. infesting the gills of *T. puta* at Damietta shore.

<table>
<thead>
<tr>
<th></th>
<th>Winter</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
<th>All</th>
<th>Chi</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence%</td>
<td>0.89</td>
<td>0.87</td>
<td>0.92</td>
<td>0.69</td>
<td>0.84</td>
<td>12.07</td>
<td>0.007</td>
</tr>
<tr>
<td>Mean intensity</td>
<td>2.97</td>
<td>5</td>
<td>3.44</td>
<td>3.67</td>
<td>3.83</td>
<td>10.9</td>
<td>0.012</td>
</tr>
</tbody>
</table>

Figure 1  Overall prevalence and mean intensity of *Microcotyloides* sp. infesting the gills of *Terapon puta*.

Figure 2  Seasonal changes in the prevalence of *Microcotyloide* sp. infesting the gills of *T. puta* at Damietta shore.

Figure 3  Seasonal changes in the mean intensity of *Microcotyloide* sp. infesting the gills of *T. puta* at Damietta shore.
Table 2  Monthly fluctuations in the prevalence and mean intensity of *Microcotyloides* sp. infesting *T. puta*.

<table>
<thead>
<tr>
<th></th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>March</th>
<th>April</th>
<th>Chi</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence %</td>
<td>85</td>
<td>95</td>
<td>100</td>
<td>80</td>
<td>85</td>
<td>50</td>
<td>60</td>
<td>63</td>
<td>84</td>
<td>100</td>
<td>79</td>
<td>95</td>
<td>29.96</td>
<td>0.002</td>
</tr>
<tr>
<td>Mean intensity</td>
<td>7.41</td>
<td>3.47</td>
<td>3.15</td>
<td>3.75</td>
<td>3.71</td>
<td>3.5</td>
<td>3.67</td>
<td>6</td>
<td>2.2</td>
<td>2.67</td>
<td>2.91</td>
<td>4.05</td>
<td>32.96</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Figure 4  Month fluctuation in the prevalence of *Microcotyloide* sp. infesting the gills of *T. puta* at Damietta shore.

Figure 5  Month fluctuation in the mean intensity of *Microcotyloide* sp. infesting the gills of *T. puta* at Damietta shore.
finally increased steadily to reach 4.5 in April as shown in Table 2 and Fig. 5.

Statistical analysis (Table 2) using Chi-square test revealed that the differences in the mean intensity among different months were highly significant ($t = 32.959, P = 0.001$).

The relationship between the host body weight and the mean intensity of Microcotyloides sp.

According to the linear regression correlation, the response pattern indicated that the mean intensity of the Microcotyloides sp. and the body weight of T. puta were positively correlated (Fig. 6).

Statistical analysis (using linear regression, Table 3) revealed the presence of a significant positive correlation between the mean intensity (infestation level) of the Microcotyloides sp. and the body weight of T. puta ($P = 0.01$).

Correlation between water temperature and mean intensity of Microcotyloides sp.

According to the output of the Person Correlation Coefficient, the mean intensity of the Microcotyloides sp. was positively correlated with water temperature where their mean intensity appeared to increase with the increase in water temperature. As shown in (Table 4), the relationship was significant ($P = 0.262$).

Correlation between hydrogen ion concentration (pH) of the water and mean intensity of Microcotyloides sp.

According to the output of Person Correlation Coefficient, the mean intensity of the Microcotyloides sp. was positively correlated with the hydrogen ion concentration (pH) of water. As shown in (Table 4), the relationship was non-significant ($P = 0.104$).

Correlation between water salinity and mean intensity of Microcotyloides sp.

According to the output of the Person Correlation Coefficient, the mean intensity of the Microcotyloides sp. was negatively correlated with the salinity of water. As shown in (Table 4), the relationship was significant ($P = 0.004$).
Discussion

The present study has revealed, for the first time, the presence of the polyophtochylean monogenean parasite, the Microcotyloides sp. on the gills of the small scaled terapon fish, T. puta, caught from the Mediterranean Sea near Damietta city, Egypt, with a prevalence of 84% and mean intensity level of 3.38 per infected fish. Also, seasonal patterns of monogenean infection on the fish and the factors influencing them have attracted some attention (Siddall et al., 1997; Bagge and Valtonen, 1999; Pietrock et al., 1999). The present study indicates a positive linear correlation between numbers of the Microcotyloides sp. and increasing host weight, water temperature and pH-values of the water, but it was negatively correlated with water salinity.

Generally, Microcotyloides reproduce continuously throughout the year. However, the present study on the seasonal occurrence of Microcotyloides sp. revealed that there is a strict influence of temperature on the prevalence and intensity of infestations which generates a definite seasonal cycle of the parasite. The infection prevalence remained above 84% and mean intensity levels showed a slight fluctuation as the size of the fish increased. Statistical analysis has revealed the presence of significant changes among months as well as among seasons. In general, the mean intensity increased during the spring when temperatures are high, and decreased when temperatures are low. These results were confirmed when the correlation of the relationship between the temperatures and the mean intensity of these parasites were studied.

El-Naggar and Khidr (1986) suggested that the intensity of cichlidogyrids on the Nile Tilapia spp. during spring and summer seasons was related to water temperature; high water temperature favouring a short induction period; rapid growth and high egg production. El-Naggar (1994) studied the population dynamics of six monogeneans infecting the gills and nasal fossae of Clarias lazera (= C. gariepinus) in two differing water quality stations in Egypt. He found that four monogeneans namely Quadracanthus aegypticus, Q. clariadis clariadis, Q. kearni and the Gyrodactylus sp. reached their highest prevalence in spring at both localities and their maximum intensity in spring at Mansouria Canal. Moreover, similar maximum peaks of the prevalence and mean intensity values of Paraquadacanthus nasalis were recorded in spring at the same locality. However, the lowest infestation levels for the majority of these monogeneans were reached in cold seasons at both localities (El-Naggar, 1994).

The present study of the Microcotyloides sp. and the other studies of the monogenean cichlidogyrids in Damietta Branch of the River Nile by El-Naggar and Khidr (1986) indicated that the temperature may not be the only controlling factor in the population dynamics of these gill parasites. It is not uncommon for these parasites to show peaks of abundance during the cold season. Also, El-Naggar and Khidr (1986) suggested that peaks in abundance of parasites at relatively low temperatures may occur because such temperatures reduce well antibodies production by the host but above the minimum temperature required for parasite reproduction.

Oztruk and Alutnel (2006) found that prevalence and mean intensity level of the parasite varied in different host fish size. Dactylogyrus coumo was particularly found on smaller host fish specimens and its prevalence was observed higher on such specimens than bigger ones (58.8% and 9.1%). Also they observed that Dactylogyrus coumo was found on all sizes of host fish with slightly changing prevalence between 21.5% and 6.9%. While D. crucifer existed in all host fish size, its mean intensity and prevalence reached its maximum level on the biggest host fish size.

Buchmann (1989) found a significant positive correlation between total body length of the host Anguilla anguilla and the load of the monogenean Pseudodactylogyrus anguillae. Furthermore, Khidr (1990) found that the prevalence and mean intensity of Enterogyrus cichlidarum infecting the stomach of Tilapia spp. were higher in larger fish than in the smaller ones.

Major factors affecting the seasonal prevalence and mean intensity of gyrodactylids include abiotic factors like water temperature, and host related factors, such as behavior, sex, age, resistance and mortality (Bakke et al., 2002; Ozer et al., 2004). Temperature is often stated to be one of the most important abiotic factors in determining monthly fluctuations of monogeneans and their seasonal dynamics (Ernst et al., 2005).

Yagishita et al. (2009) tested the hypothesis of two distantly related fish Liza vaigiensis and Teraopn jarbue. These fish acclimated to cycling temperatures approaching 40 °C will display higher temperature than groups acclimated to a lower constant temperature of 37 °C. Both fish are hyper thermal specialists (Eme and Bennett, 2009; Bennett, 2010) which spend that first year in shallow water, protected by sea grass and mangrove.

According to Koyun (2011), the prevalence and intensity level of the Dactylogyrus species showed changes in water temperature in the study area not constant, that is, they changed sharply during different seasons. Also, mean intensity of infection with dactylogyrids was depending on the parasite species; the years and seasons, and host fish species. From the date presented in this study, the mean intensity of the parasite was highest in summer and spring. Similarly, the present study reveals also the highest level in spring. This coincides with the observations made by Singhal et al. (1986) who recorded a positive relationship between the infestation level of the Gyrodactylus sp. and the pH-value. It can be suggested that D. extensus can tolerate relatively low pH-values and they are acclimatized in a considerable manner to tolerate this condition.

Statistical analysis of the present study has indicated that the relationship between the water salinity and the mean intensity was negatively correlated with the Microcotyloides sp., it is obviously noticed that the Microcotyloides sp. is less tolerant (sensitive) to salinity changes. This result agrees with Buchmann (1997) that observed Gyrodactylus derjavini was less salinity tolerant than Gyrodactylus salaries.

Many laboratory studies demonstrated the negative impacts of chlorides on the survival and population growth of ecto-parasites of fish (Chan and Wu, 1984; Buchmann et al., 1987; Crespo et al., 1995). They found that the long-term treatment with sodium chloride reduced the intensity of infection of the European eel, A. anguilla by the monogeneans P. anguillae and P. bini. The authors found that sodium chloride was highly efficient in the control of Cichlidogyrus infestation.

References


