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Metazoan Parasites of Some Arabian Gulf Fish, off Dammam, Saudi Arabia: 2-Associations of External and Internal Parasites

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Abstract: For investigation of the relationship between external -internal metazoan parasites (i.e. co-infestation), 80 fish samples representing eight different species, from Arabian Gulf, Dammam Area, Saudi Arabia were examined. The present work aims to study different associations between external and internal metazoan parasites. The current study revealed that: the highest rates of infestation were 48.8%, 38.8% and 22.5% by gill metazoan parasites, monogeneans and crustaceans, respectively. Insignificant positive correlations (P>0.05) are reported between total infection in gills and total infection in intestine of fish species: *G. ablongus, A. bifasciatus, N. japonicas* and *C. gymnostethus.* There is insignificant (P>0.05) weak correlation between gills and intestine total infection of different fish species. Conversely, there are highly significant (P<0.01) correlations between total incidence of parasites and each other in all fish species. The obtained different correlations were discussed.

Key words: Metazoan parasites · Co-infestation · Fish · Arabian Gulf

INTRODUCTION

Most hosts, particularly fish, are simultaneously or sequentially infested with several parasites. A key question is whether patterns of co-infestation arise because infestation by one parasite species affects susceptibility to others or because of natural differences between hosts [1, 2]. By modifying host physiology, behavior and survival, parasites can alter the influence of their host species on community functioning and structure [3-5].

Metazoan parasites such as monogeneans, crustaceans, digeneans and nematodes are considered as the major groups of fish parasites that causing harmful effect to their hosts [5, 6]. Most previous searches concerned with taxonomy or\and pathology of these parasites [7-9]. Co-infestations with multiple parasite species in hosts may lead to interspecific associations and subsequently shape the structure of a parasite community [10]. Though, rear works have focused on these relations in highly abundant parasite species or, in particular, investigated how the associations develop with time in hosts exposed to co-infesting parasite species for the first time. Host- metazoan parasites relationships were studied previously by the same authors [11]. The present study is the first record of co – infestation of external and internal metazoan parasites infesting the Arabian Gulf fish, off Dammam.

MATERIALS AND METHODS

Fish Samples: Fish were collected weekly during the spring months of 2011, out of Arabian Gulf, Dammam Area, Saudi Arabia. They were 10 individuals of 8 different fish species which belonging to 7 families.

Detection of Parasites: Fish were anaesthetized and in preparation for light microscopy, gills of examined fish were removed and put in natural seawater to remove any fish-gill mucus. Treatment, fixation and preservation

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of parasites were according to Ash and Orihel [12]. The following abbreviations were used: Monogenean (Monog.), crustaceans (Cr.), digeneans (Dig.) and nematodes (Nem.)

Statistical Analyses: Basic descriptive statistics were performed to calculate means. The comparison between means was tested for significance using the one-way ANOVA analysis. After completion of the above, means were analyzed for the development of Pearson's correlation matrix (2-tailed) of different variables. Also, Chi-Square (χ^2) was estimated. All statistical analyses were performed using a computer program of SPSS Inc. (version 17.0 for Windows) at the 0.05 level of significance.

RESULTS

Examination of 80 fish samples representing eight different species showed that 49 fish were infested with metazoan parasites at a rate of 61.3%, the highest percentage of infestation with gill metazoan parasites (i.e. mixed infestation; monogeneans and crustaceans) was 48.8%, with monogeneans was 38.8% and with crustaceans was 22.5%. While, the lowest percentages of incidence were 8.8 and 21.3% by nematodes and digeneans, respectively (Table 1).

There are highly significant differences in infestation percentages of Crustaceans (χ^2=24.200, P<0.01), Digeneans (χ^2=26.450, P<0.01) and nematodes (χ^2=54.450, P<0.01) between different fish species. Moreover, there are significant differences in infestation percentage of monogeneans (χ^2=54.450, P<0.05) between different fish species. The infestation with digeneans and Nematodes in intestine showed significant (P<0.05) and highly significant (P<0.01) differences, respectively, between different fish species (Table 2).

There are insignificant positive correlations (P>0.05) between total infection in gills and total infection in intestine of fish species: *G. ablongus, A. bifasciatus, N. japonicas* and *C. gymnostethus.* On the other hand, there are insignificant negative correlations (P>0.05) between total infection in gills and total infection in intestine of fish species: *L. nebulosus* and *N. tolu* (Table 3).

It was found that, there is insignificant (P>0.05) weak correlations (positive or negative) between different parasites spp., with the exception of the correlation between Monogenea and Crustacea in gills of *C. gymnostethus* fish where there is a significant positive correlation (r= 0.764, P<0.05) (Table 4).

There are highly significant (P<0.01) correlations between total incidence of parasites and each other in all fish species. Also, nematodes showed significant (P<0.05) correlations with digeneans, crustaceans and the sum of

Table 1: Total incidence and percent of infestation in the examined fish

Site	Infection	Positive n (%)	Negative n (%)
Intestine	Nem.	7 (8.8)	72 (90.0)
	Dig.	17 (21.3)	62 (77.5)
	Nem. & Dig.	20 (25.0)	59 (73.8)
Gills	Cr.	18 (22.5)	61 (76.3)
	Monog.	31 (38.8)	48 (60.0)
	Cr. & Monog.	39 (48.8)	40 (50.0)
All Combined		49 (61.3)	30 (37.5)

Table 2: Percent of parasite incidence in each examined fish species and Chi-Square (χ^2) significances comparison of the percent of incidence with different parasitic spp. in gills and intestine of different fish species

	Percent of Infestation (%)			
	Gills		Int.	
Fish species	Mono	Cr.	Di	Nem.
Gerres ablongus	50	0	50	0
Acanthopagrus bifasciatus	50	0	40	0
Liza alata	50	30	0	0
Lethriuns nebulosus	30	20	10	0
Nemipterus japonicas	40	30	20	30
Nemipterus tolu	30	20	10	0
Siganus rivulatus	40	50	0	0
Carangoide gymnostethus	20	30	40	40
Chi-Square (χ^2)	4.050	24.200	26.450	54.450
Sig.	(0.044)*	(0.000)**	(0.000)**	(0.000)**
F-value	0.504	1.671	2.583	4.314
Sig.	(0.828)	(0.130)	(0.020)*	(0.000)**

Chi-Square (χ^2) = Chi-Square test. (Sig.) = significance level. *Significant (P<0.05). **Highly significant (P<0.01).

Table 3: The correlation coefficients (r) between gills and intestine total infection of different fish species

Fish species	Correlation coefficient (r)	Significance level
G. ablongus	0.200	0.580
A. bifasciatus	0.408	0.242
Liza alata	0.000	0.000
L. nebulosus	-0.248	0.489
N. japonicas	0.477	0.163
N. tolu	-0.333	0.347
S. rivulatus	0.000	0.000
C. gymnostethus	0.569	0.086

Table 4: Pearson correlation matrix between different parasitic spp. in gills and intestine of different fish species

		Gills		Intestine	
Fish species		MONO	CR	DI	NEM
G. ablongus	Monog.	1.000			
	Cr.	0.000	0.000		
	Dig.	0.200	0.000	1.000	
	Nem.	0.000	0.000	0.000	0.000
A. bifasciatus	Monog.	1.000			
	Cr.	0.000	0.000		
	Dig.	0.408	0.000	1.000	
	Nem.	0.000	0.000	0.000	0.000
Liza alata	Monog.	1.000			
	Cr.	0.218	1.000		
	Dig.	0.000	0.000	0.000	
	Nem.	0.000	0.000	0.000	0.000
L. nebulosus	Monog.	1.000			
	Cr.	0.218	1.000		
	Dig.	-0.218	-0.167	1.000	
	Nem.	0.000	0.000	0.000	0.000
N. japonica	Monog.	1.000			
	Cr.	0.356	1.000		
	Dig.	0.102	0.218	1.000	
	Nem.	0.356	0.524	0.218	1.000
N. tolu	Monog.	1.000			
	Cr.	-0.327	1.000		
	Dig.	-0.218	-0.167	1.000	
	Nem.	0.000	0.000	0.000	0.000
S. rivulatus	Monog.	1.000			
	Cr.	0.408	1.000		
	Dig.	0.000	0.000	0.000	
	Nem.	0.000	0.000	0.000	0.000
C. gymnostethus	Monog.	1.000			
	Cr.	0.764*	1.000		
	Dig.	0.612	0.356	1.000	
	Nem.	0.612	0.356	0.583	1.000

*Correlation is significant at the 0.05 level (2-tailed).

Table 5: Pearson correlation matrix between the incidences with all parasites in all different fish species

Aspect	NEM	DIG	NEM+DIG	CR	MONOG	CR+MONOG
NEM	1.000					
	(80/0.000)†					
DIG	0.272*	1.000				
	(80/0.015)	(80/0.000)				
NEM+DIG	0.707**	0.873**	1.000			
	(80/0.000)	(80/0.000)	(80/0.000)			
CR	0.257*	-0.060	0.086	1.000		
	(80/0.021)	(80/0.595)	(80/0.448)	(80/0.000)		
MONOG	0.117	0.151	0.171	0.186	1.000	
	(80/0.302)	(80/0.180)	(80/0.130)	(80/0.099)	(80/0.000)	
CR+MONOG	0.235*	0.069	0.170	0.728**	0.809**	1.000
	(80/0.036)	(80/0.540)	(80/0.131)	(80/0.000)	(80/0.000)	(80/0.000)
All parasites	0.579**	0.554**	0.701**	0.577**	0.684**	0.822**
	(80/0.000)	(80/0.000)	(80/0.000)	(80/0.000)	(80/0.000)	(80/0.000)

†(Number/Significance level).
*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

crustaceans and monogeneans (r= 0.272, 0.257 and 0.235, respectively). On the other hand, monogeneans showed insignificant ($P>0.05$) correlations with nematodes, digeneans, crustaceans and the sum of nematodes and digeneans (r=0.117, 0.151, 0.186 and 0.171, respectively) (Table 5).

DISCUSSION

The relation between parasite life cycle, host, host-parasite and parasite-parasite associations are considered very complicated biological relations. In the present study, the highest rates of infestation were 48.8%, 38.8% and 22.5% by gill parasites (mixed infestation), monogeneans and crustaceans, respectively. These may be due to the nature of the monogenean life cycle which is considered as an important reason of high infestation rate in the gills of the examined fish, where it is distinct from other parasites by direct life cycle. While, most parasitic crustaceans are mostly spend part of their life cycle as particularly male ones, where the fertilized female are parasitic to lay their eggs and to maintain the continuation of their life and developmental stages in the water column [5].

In addition, host susceptibility and exposure are considered as determining infestation factors. As suggested before three factors play essential roles in host susceptibility and infestation levels among sympatric fish species: phylogenetic specificity (host–parasite co-evolution), exposure to parasites (encounter filter) and host suitability (compatibility filter) [2, 13, 14].

There are highly significant ($P<0.01$) correlations between total incidence of parasites and each other in all fish species. Conversely, there is insignificant weak correlation between gills and intestine total infection of different fish species. Insignificant positive correlations are reported between total infection in gills and total infection in intestine of fish species; *G. ablongus, A. bifasciatus, N. japonicas* and *C. gymnostethus*, it means that the infection in gills increases by increasing infection in intestine and vice versa). Firstly, these obtained results explain the importance of the size of the examined sample (fish and parasites) and the importance of host habitat such as sexual cycle, type of feeding that play role in the differences in the obtained results. However, factors controlling parasite species composition and infection levels are often ecological, not physiological or phylogenetic [15-18].

The lowest percent of incidence was 8.8and 21.3 by nematodes and digeneans, respectively. The incidence of digeneans and nematodes showed significant and highly significant differences between different fish species, respectively. Nematodes showed significant correlations with digeneans, crustaceans and gill parasites (Cr& Monog). Nematodes and digeneans have more complicated and another mode of infestations. In parasites acquired by ingestion (nematodes), host diet is the encounter filter and the main factor determining the number of parasite species and individuals to which a host is exposed [18-20]. The host range and geographical distribution of trematodes have also been altered through human intervention. Indeed, effects of human intervention are typically of greater magnitude and explain more variation in infection risk, than the effects associated with host and environmental factors more commonly considered in disease studies [2, 21]. The seasonal occurrences of digeneans on marine fish are not available. In some digenean infestations, fish acquire their parasites by direct cercariae penetration [5].

CONCLUSION

Each type of metazoan parasite has its own mode of life and seasonal activity. However, the weak positive correlation between different infestations rates may be attributed to direct or simple life cycle of parasites (i.e. monogeneans). which enhance the infestation by other ones through weakened the host to be susceptible to new infestation.

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