Global Veterinaria 9 (5): 600-605, 2012
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2012.9.5.6693

Metazoan Parasites of Some Arabian Gulf Fish, Off Dammam, Saudi Arabia: 1- External and Internal Parasite-Host Associations

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Abstract: The present fieldwork was conducted during the spring months of 2011 in Arabian Gulf, Dammam city, Saudi Arabia. A total of 80 fish representing eight species belonging to seven families were examined for the presence of metazoan parasites and parasite-host associations. The total percent of metazoan parasites infestation was 61.25% (49 out of 80 examined fish). The highest incidence of infestation was by Monogenea (38.8%) and the lowest ones by nematodes (8.8%). The prevalence of gills infestation has a high significant effect on Fulton's condition factor (K) in all fish under investigation while, in *Gerres ablongus,* the prevalence of intestine infestation has a high significant effect on K (r= -0.767, $P<0.01$). Different parasite-host parameters were discussed and showed that infestation in gills causes more illness to fish, or the infestation increases with decreasing the well-being of fish.

Key words: Fish・Metazoa・Parasites・Relationship・Arabian Gulf

INTRODUCTION

Like in any aquatic system, parasites play an important role in the ecology of marine ecosystems. They live at equilibrium in their aquatic hosts and introduce the most common lifestyle on the planet [1-3]. Parasites are ubiquitous, primarily surviving in a dynamic equilibrium with their host(s) and they are often overlooked in fish health assessments. Parasites presence becomes evident after a massive development, causing diseases and sometimes even leading to the mass mortality of infested hosts. Such events are often combined with biotic or abiotic changes in the environment. There is increasing evidence that parasites are an important element of marine biodiversity [4-6].

No doubt, parasites infesting fish have a direct or indirect effect on the human welfare. Besides infestation with living parasites, pathogens that are already dead or their remains within the fish tissue might harm the consumer by causing allergic reactions [7, 8]. Co-infestations, i.e. infestations of hosts by multiple parasite species are the rule in host-parasite interactions in nature. This infestation may lead to different types of intraspecific and interspecific associations, which may shape the structure of a parasite community [9-12].

Parasites constitute an important group of the marine biodiversity. There are relatively few marine studies concerning parasites in Arabian Gulf fish, especially parasite-host relationship. Previous studies focused primarily on parasites classification of fish from the eastern Gulf [13-19]. Therefore, the current research amid to investigate the correlation between the metazoan parasites incidence and different fish host parameters, taking in consideration their effect on fish health.

MATERIALS AND METHODS

Fish Samples: Samples were obtained from 80 fish, 10 of each of 8 different fish species which belong to 7 families, [20] collected from Arabian Gulf, Dammam city, Saudi Arabia during the spring months of 2011. Actual length (LA) and total length (LT) were recorded to the nearest mm using a measuring board. Whole wet weight (W) was measured using an electronic balance and recorded

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to the nearest gram. Fulton's condition factor is calculated according to Nash *et al*. [21] from the relationship between the weight of a fish and its length. The formula is of the form: $k = \frac{100 \times w}{L^3}$,

where,

K = Fulton's condition factor,
W = The weight of the fish and
L = Is the length (usually total length).

Detection of Parasites: Fish were anaesthetized and in preparation for light microscopy, gills of the examined fish were removed and put in natural seawater to remove any fish-gill mucus. Collection and permanent slide preparations for monogenean and crustacean parasites were carried out according to Lim [22]. The intestinal parasites were collected and identified using binocular microscopy. Samples were fixed in 10% formalin and washed repeatedly with distilled water to dilute and remove excess fixative. An acetic acid alum carmine preparation was used (10-30 min) for staining [23].

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. A Pearson correlation analysis was conducted to determine significant relationships among the mean prevalence of infestation by different metazoan parasites from gills and intestine of fish under investigation and biological parameters of different fish species. 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

The present work reports the results of a preliminary survey on the helminth parasites of some fish, caught mainly from Saudi waters; off Dammam in the Arabian Gulf. The mean of weight (W), total length (LT) and actual

Table 1: Fish species, maximum (Max), minimum (Min), mean± standard deviation (SD.) and K of the studied fish species. LT=total length, LA=actual length W=total mass

	W			LT			LA			K		
Fish	Max.	Min.	Mean± SD.	Max.	Min.	Mean± SD.	Max.	Min.	Mean± SD.	Max.	Min.	Mean± SD.
Gerres ablongus	260	158	208.4±30.27	30.5	23.5	27.86±2.25	23.3	18.0	20.80±1.97	1.348	0.80	0.981±0.194
Acanthopagrus bifasciatus	255	95.0	162.3±55.69	28.5	22.5	25.00±1.69	25.5	19.5	22.05±1.85	1.305	0.830	1.007±0.188
Liza alata	380	110	276.5±73.44	35.0	22.5	29.04±3.97	31.5	18.5	24.04±3.48	1.755	0.772	1.160±0.377
Lethriuns nebulosus	315	135	209±60.09	30.5	22.0	25.95±2.82	26.5	19.5	21.90±2.92	1.718	0.814	1.201±0.287
Nemipterus japonicas	245	98.0	167.4±47.46	26.5	19.5	23.47±2.21	23.0	17.0	19.70±1.92	1.887	0.725	1.328±0.440
Nemipterus tolu	354	52.0	177.1±97.85	32.0	18.0	24.80±4.69	29.5	15.0	21.90±4.88	1.339	0.813	1.058±0.207
Siganus rivulatus	230	58.0	157.5±61.19	29.5	16.5	24.43±4.57	32.4	13.8	21.57±5.49	1.392	0.874	1.055±0.199
Carangoide gymnostethus	445	125	299.6±112.06	38.0	21.5	29.90±6.05	34.5	17.5	26.50±6.36	1.618	0.665	1.136±0.310
Total	445	52.0	207.23±85.20	38.0	16.5	26.31±4.25	34.5	13.8	22.31±4.27	1.887	0.665	1.116±0.296

Table 2: The percent of incidence in different investigated fish species

			Gills			Intestine			
Fish family	Fish species	n	Monog.	Crust.	Monog. & Crust	Dig.	Nem.	Dig. & Nem.	Total % of infestation
Gerreidae	*G. ablongus*	10	50.0	00.0	50.0	50.0	0.0	50.00	60.0
Sparidae	*A. bifasciatus*	10	50.0	50.0	50.0	40.0	0.0	40.00	70.0
Mugilidae	*Liza alata*	10	50.0	30.0	40.0	0.0	0.0	0.00	60.0
Lithrinidae	*L. nebulosus*	10	30.0	20.0	40.0	10.0	0.0	10.00	50.0
Nemipteridae	*N. japonicas*	10	40.0	30.0	50.0	20.0	30.0	40.00	70.0
	N. tolu	10	30.0	20.0	50.0	10.0	0.0	10.00	60.0
Siganidae	*S. rivulatus*	10	40.0	50.0	60.0	0.0	0.0	0.00	60.0
Carangidae	*C. gymnostethus*	10	20.0	30.0	30.0	40.0	40.0	50.00	60.0
Total	80	38.8	22.5	48.8	21.3	8.8	25.0	61.25	

Table 3: Pearson correlation coefficients between mean of total lengths (LT), actual lengths (LA), weight (W) and Fulton's condition factors (K) of different investigated fish species

G. ablongus		LT	LA	W	K
	Monog.	0.291	-0.054	-0.251	-0.589
	Cr.	0.000	0.000	0.000	0.000
	Dig.	0.628	0.289	0.063	-0.767**
	Nem.	0.000	0.000	0.000	0.000
A. bifasciatus	Monog.	-0.434	-0.485	-0.736*	-0.870**
	Cr.	0.000	0.000	0.000	0.000
	Dig.	-0.443	-0.431	-0.615	-0.637*
	Nem.	0.000	0.000	0.000	0.000
Liza alata	Monog.	0.223	0.254	-0.291	-0.643*
	Cr.	0.769**	0.778**	0.343	-0.606
	Dig.	0.000	0.000	0.000	0.000
	Nem.	0.000	0.000	0.000	0.000
L.nebulosus	Monog.	0.216	0.063	-0.325	-0.727*
	Cr.	0.196	0.153	-0.298	-0.606
	Dig.	0.193	-0.048	0.269	0.030
	Nem.	0.000	0.000	0.000	0.000
N. japonicas	Monog.	0.402	0.022	-0.692*	-0.885**
	Cr.	0.322	0.288	-0.360	-0.561
	Dig.	0.246	0.082	-0.182	-0.273
	Nem.	0.427	0.408	-0.190	-0.528
N. tolu	Monog.	-0.682*	-0.670*	-0.734*	-0.527
	Cr.	0.360	0.335	0.094	-0.491
	Dig.	0.540	0.548	0.635*	-0.081
	Nem.	0.000	0.000	0.000	0.000
S. rivulatus	Monog.	0.389	0.185	0.165	-0.660*
	Crus.	0.606	0.694*	0.360	-0.837**
	Dig.	0.000	0.000	0.000	0.000
	Nem.	0.000	0.000	0.000	0.000
C. gymnostethus	Monog.	0.596	0.497	0.214	-0.750*
	Crus.	0.771**	0.687*	0.423	-0.865**
	Dig.	-0.092	-0.203	-0.490	-0.480
	Nem.	0.192	0.101	-0.189	-0.604

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed)

length (LA) and condition factor (K) of the examined fish were 207.23±85.20 gm, 26.31±4.25 cm, 22.31±4.27 cm and 1.116±0.296 respectively (Table 1).

The total incidence of metazoan parasites infestation among the investigated fish was 61.25% (49 out of 80 examined fish). The highest incidences were by Monogenea (Monog.) and Crustacea (Cr.); 38.8 and 22.5% respectively. The lowest ones were 8.8% by nematodes (Nem.) and 21.3% by Digenea (Dig.) (Table 2).

The prevalence of infestation of digeneans showed a highly significant negative correlations with K (r= -0.767, P<0.01) from *G. ablongus*. The prevalence of infestation of Monog. and Dig. showed a highly significant and significant negative correlations with K (r= -0.870, P<0.01; r= -0.637, P<0.05, respectively). Also, the prevalence of infestation of monogeneans showed a significant negative correlations with W (r= -0.736, P<0.05) from *A. bifasciatus* (Table3).

The prevalence of infestation of Monog. showed a high significant and significant negative correlations with K in *N. japonicas*, *Liza alata* and *L. nebulosus* (r= -0.885, P<0.01; r= -0.643, P<0.05 and r= -0.727, P<0.05 respectively). On the same manner, the prevalence of infestation of Monog. showed a significant negative correlation with weight (r= -0.692, P<0.05) in *N. japonicas*, while Crustacea (Cr.) showed a highly significant positive correlations with LT and LA (r= 0.769, P<0.01; r= -0.778, P<0.01 respectively), i.e. Cr. infestation increases with increasing fish length from *Liza alata* (Table 3).

The prevalence of infestation of Monog. showed a significant negative correlations with LT, LA and W (r= -0.682, -0.670 and -0.734, P<0.01, respectively) and insignificant negative correlation with K (r= -0.527, P>0.05). Dig. showed a significant positive correlation with weight (r=0.635, P<0.05) from *N. tolu* (Table 3).

The prevalence of infestation of Monog. and Cr. from *S. rivulatus* showed a significant and highly significant negative correlations with K (r= -0.660, P<0.01; r=-0.837, P<0.01, respectively) while, Cr. showed a significant positive correlations with AL (r=0.694, P<0.05) (Table 3).

In *C. gymnostethus*, monogeneans showed a significant negative correlation with K (r= -0.750, P<0.05). Crustaceans showed highly significant and a significant positive correlations with LT and LA (r=0.771, P<0.01 and r=0.687, P<0.05, respectively) and highly significant negative correlation with K (r= -0.865, P<0.01). Nematodes showed insignificant negative and positive correlations with K, (r= -0.604, P>0.05) (Table 3).

There are highly significant (P<0.01) differences in weight, total length and the prevalence of infestation of nematodes infestation between different fish species. There are a significant (P<0.05) differences in actual length and the prevalence of digeneans infestation between different fish species (Table 4).

A Pearson correlation analysis was conducted to show the effect of infestation in gills and intestine on well-being (K) of the investigated fish species. It was found that, infestation in gills has a highly negative significant effect on K in all fish species (r= -0.870, P<0.01), with the exception of *G. ablongus* where infestation in intestine has a highly negative significant effect on K (r= -0.767, P<0.01). Also, infestation in intestine shared in the effect on K in *A. bifasciatus.*

Table 4: Pearson correlation coefficients between mean of total lengths (LT), actual lengths (LA), weight (W) and condition factors (K) vs. mean incidence of monogenea (Mong.), crustecea (Cr.), Digenea (Dig.) and Nematoda (Nem.) infesting different investigated fish species

					Infestation			
					Gills		Int.	
Fish species	W	LT	LA	K	Monog.	Cr.	Dig.	Nem.
G. ablongus	208	27.9	20.8	0.981	0.5	0.0	0.5	0.0
A. bifasciatus	162	25.0	22.1	1.007	0.5	0.0	0.4	0.0
Liza alata	277	29.0	24.0	1.160	0.5	0.3	0.0	0.0
L. nebulosus	209	26.0	21.9	1.201	0.3	0.2	0.1	0.0
N. japonicas	167	23.5	19.7	1.328	0.4	0.3	0.2	0.3
N. tolu	177	24.8	21.9	1.058	0.3	0.2	0.1	0.0
S. rivulatus	158	24.4	21.6	1.055	0.4	0.5	0.0	0.0
C. gymnostethus	300	29.9	26.5	1.136	0.2	0.3	0.4	0.4
F-value	5.643	3.787	2.775	1.564	0.504	1.671	2.583	4.314
Sig.	(0.000)**	(0.001)**	(0.013)*	(0.160)	(0.828)	(0.130)	(0.020)*	(0.000)**

F-value = ANOVA's *F*-test. (Sig.) = significance level. *Significant (P<0.05). **Highly significant (P<0.01).

Table 5: Pearson correlation coefficients between total incidence of metazoan parasites at sites of infestations (gills and intestine) and K of different fish species under investigation

	K	
Fish name	Gill infestation	Intestine infestation
G. ablongus	-0.589	-0.767**
A. bifasciatus	-0.870**	-0.637*
Liza alata	-0.800**	0.000
L nebulosus	-0.858**	0.030
N. japonicas	-0.884**	-0.524
N. tolu	-0.876**	-0.081
S. rivulatus	-0.893**	0.000
C.gymnostethus	-0.863**	-0.609

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Where, infestation in gills has a highly significant greater effect on cf. (r= -0.870, P<0.01), besides another effect comes from infestation in intestine (r= -0.637, P<0.05). Infestation in intestine has also an effect on K but insignificant in the rest of the investigated fish (Table 4).

The prevalence of infestation in gills has a highly significant effect on K in *Liza alata*, *L nebulosus*, *N. japonicas*, *N. tolu*, *S. rivulatus* and *C.gymnostethus*, (r= -0.800, P<0.01; r= -0.858, P<0.01; r= -0.884, P<0.01; r= -0.876, P<0.01; r= -0.893, P<0.01 and r= -0.863, P<0.01), respectively. While only in *G. ablongus*, the prevalence of intestine infestation has a highly significant effect on K (r= -0.767, P<0.01) (Table 5).

DISCUSSION

In many fish health assessments, the role of parasites on fish health cannot be ignored. They are generally a source of concern when it affects the fish species of popularity, or causing harmful effects on the economy or recreational activities, or commercial fisheries. The present study revealed that the total incidence of metazoan parasites infestation among the investigated fish was 61.25% and the highest was by Monog. (38.8 %). The lowest incidence was 8.8% by nematodes. An intensity range is most useful to compare different species from the same site or the same species from multiple sites [24]. The prevalence of infestation of Dig. was positively correlated with host length (P≤ 0.01); such increase in the infestation level with the increase in fish size is due to the accumulation of parasites [25, 26].

The high levels of infection may be consider as indicators of ecosystem stress where, incidence with heavy parasitic infection in fish has been reported globally because fish serves as reservoir and intermediate host to most stages of metazoan parasites [27]. Furthermore, both abiotic factors and host factors can affect even the earliest stage of monogenean parasites [28, 29]. In heavily polluted water bodies, there is a strong relationship between a high prevalence of parasites and the condition of fish. A poor state of fish health is the result of enhanced effects of the parasites on fish harmed by the direct effects of pollution, rather than of the primary effect of the parasites themselves.

Despite the fact that many host-monogenean systems appear well adapted, several reports have described high pathogenicity of certain host species due to monogeneans not only in aquaculture systems but also in natural lakes, rivers and seas. Thus, dramatic decreases of wild fish stocks due to heavy and uncontrolled infestation by monogeneans are known from the Aral Sea [8].

Host may act as stimuli to induce feeding, maturation, mating and finally production of offspring are important elements of the parasite's life. Therefore host factors may induce proper feeding, absorption of nutrients, maturation and reproduction [30, 31].

The present data showed that monogeneans showed a significant negative correlation with K in most fish under investigation and the prevalence of infestation in gills has a highly significant negative effect on K, except in *G. ablongus*, the prevalence of infestation of intestine has a highly significant effect on K. (i.e. the infestation in gills causes more illness to the fish, or the infestation increases with decreasing the well-being of the fish). Where, various gill parasites injuries lead to respiratory and excretory disorders in fish, leading to slow movement and increase in susceptibility to other parasites such as intestinal parasites. This may reflect the importance of gill parasites especially monogeneans.

CONCLUSION

Parasites that infest gills are serious because it opens the gate to infestation with other parasites. Monogenean parasites are of particular importance in the branchial morbidity, due to their rapid reproduction and ability to infest first ages of fish. Therefore, more comprehensive searches in larger scale about the reasons, especially environmental ones, which led to the spread of these parasites in this region of the Arabian Gulf are needed.

ACKNOWLEDGMENTS

The author expresses his appreciation to Mr. Ahmad Awad for his skillful technical assistance, helping in collecting fish samples and measurements.

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