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PREDICTATIVE HYPOTHESIS FOR PARASITE DISEASE OUTBREAKS OF ANISAKID NEMATODES

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ABSTRACT

The distribution pattern of ***Rostellascaris donapaulae*** were worked out from the stand point of prediction of disease outbreaks occurring in the water body in the Central West Coast of India at Goa.

INTRODUCTION

The contrast in parasitic behavioural ecology within the fish hosts of isothermal Central West Coast of India (Arabian Sea), Goa has provided a remarkable opportunity to investigate distribution patterns of nematodes of deep sea fishes as well as anisakid larvae in these fishes. The extent of the parasite-induced modifications of host growth, reproduction, and survivorship are not only delimited by the genotypes of the participants, but also environmental conditions. The parasite-induced host life history variation, thus advanced our understanding of host-parasite evolutionary biology. The subject of investigation were anisakid worms infesting deep sea fishes ***viz.*** sharks (***Rhincodon typus***) and constituents of benthic biotas***.*** The long term data have been utilized to develop futuristic models of disease outbreaks using modern computerized software applications.

MATERIALS & METHODS

The parasitological investigations were conducted during the two and a half years study, at Arabian Sea of Goa (Dona Paula beach), on some of the marine habitats catfishes as well as carps. This analysis is based on 64 months data on sharks upto July 2005. Netting and angling fishing methods were used to capture live fishes and finally brought to the laboratory for parasitological observations. These fishes underwent weighing freshly, sexually determined and their standard length measured. Different organs of alimentary canals such as oesophagus, stomach, small and large intestine, stripped mucous membranes of the oesophagus and stomach were examined for detection of helminthic infection or any embedded worms. Besides alimentary canal, other organs especially gall bladder, liver, heart muscles and gonads too were microscopically examined. For the purpose of analysis of ecological data and the water temperature at the collection site (Sea coasts of Dona Paula at Goa) an up-to-date record of the number of parasites in different months was maintained, recorded and presented as mean±SE. For morphological studies, the trematode and cestodes were stretched in lukewarm water, fixed in aqueous Bouin's solution, stained in haemalum or Borax carmine; dehydrated in a series of alcohols (50%, 70%, 90% and 100%), cleared in xylol and finally mounted in Canada balsam. The

nematodes were washed in normal saline; fixed in hot alcohol and glycerol (95:5), cleared in lactophenol and mounted in gycerine.

Dissolved Oxygen (DO) and pH of water were quantitatively estimated at the site of collection after APHA (1967) on samples collected fortnightly.

Statistical models: The following statistical models and techniques have been used for analyzing fish infection data and various environmental factors like DO, pH, temperature:-

(i) **Multiple Linear Model:** The dependent variable is a linear function of one or more Independent variables and a random error term.

(ii) **Linear Model with Seasonal Dummies:** Dummy variable are includes to incorporate seasonal affect in the model.

(iii) **Seasonal Indices:** Ratio to moving average method is used to obtain seasonal indices. Can be used to predict the periods more prone to infection.

(iv) **Periodic Model:** The dependent variable is expressed as sine (or cosine) function of time (or some other independent variable). These models are useful for prediction purposes when data show periodic behavior.

AR(1) Model: ARMA models proposed by Box and Jenkins are widely used for forecasting purposes. AR(1) models, in which the current observation is expressed as a linear function of observation of previous period and an error term, has been used to model DO, pH and temperature data. SYSTAT11 software was used to develop the predicative hypothesis for disease outbreaks.

Model of Infection data with time (t) as dependent variable: Since linear model does not provide good fit, we fitted periodic model defined as follows:

It=A+B.Sin (C.t)

Model for DO, pH and Temperature:-

AR(1)Model

DO(t)=Constant+AR*DO(t-1)

RESULTS & DISCUSSION

The comprehensive influence of ***R. (spinicaudatum) donapaulae*** infections in ***Rhincodon typus*** have been summarized for February 2003-January 2005 (Jaiswal, 2006 Unpublished D.Phil. Thesis). Maximum mean worm burden by male nematodes in male fishes was 5.33 and by female nematode were 4. It was 3.0 by male worms in female fishes and 4.0 by female nematodes in female fishes. The nemic range was 1-4 in both sexes of fish hosts as well as in total fishes. The distinct influence of winter period on distribution of male nematodes in male fishes depicted striking association to decreasing water temperature during winter period during 2003-2005 (Jaiswal, 2006 Unpublished D.Phil. Thesis). The findings could be correlated with the result of Chesunov (1986) that demonstrated fall in active feeding rate as well as nemic reproduction at enhanced temperature conditions. In a recent study Khan, Aziz, Afzal, Saher, Ali and Naqvi (2003) concluded the preferred temperature for ***Contracaecum*** larvae and ***Rhabdochona charaddensis*** in a variety of fishes ***viz. Cyprinus carpio***, ***Hypophthalmicthyes molitrix***, ***Ctenopharynogodon idella***, ***Cirrhinus mrigala*** and ***Labeo rohita*** to be 26-27°c that was in agreement of the findings of current investigations. Thereafter, the long term influence

Table 1. The results for Shark infection prevalence data by ***Rostellascaris (spinicaudatum) donapaulae***.

	Male Nematodes in male fish		**Female Nematodes** in male fish		**Female Nematodes** in female fish	
S.No.	IPMM		IPMF		IPFF	
	R-square = 0.725		R-square = 0.760		R-square = 0.848	
Parameter	Estimate	A.S.E.	Estimate	A.S.E.	Estimate	A.S.E.
A	29.548	2.414	31.244	2.247	35.102	1.939
B	-10.538	3.405	1.084	3.170	-8.808	2.718
C	-10.538	0.009	11.005	0.078	10.292	0.008

Table 2. The summary data on AR(1) models for pH and Water Temperature.

		Type	Estimate	A.S.E.
1.	**DO**	CONSTANT	3.424	0.258
		AR	0.509	0.119
2.	**pH**	CONSTANT	3.837	0.163
		AR	0.454	0.115
3.	**Temp**	CONSTANT	15.918	0.362
		AR	0.430	0.116

of hydrobiological and other environmental factors on biogeographic distribution of nematodes under study has induced the process of coevolution in deep sea fishes. These patterns were analyzed by the use of SYSTAT11 software to develop the predictive hypothesis for disease outbreaks by ***R. (s) donapaulae***.

Parasite species dispersal by same sex of parasites in identical sex of fish exhibited compatible cyclic periodicity (***i.e.*** male parasites in male sharks and female nematodes in female sharks). The results for shark infection prevalence data by ***Rostellascaris donapaulae*** are presented in Table 1. The data on AR(1) models for pH and Water Temperature have been defined in Table 2. DO had an overbearing influence on dispersal as well as abundance over time.

On the basis of the corresponding data on DO, pH and water temperature are also investigated and interrelationship between infection data and these environmental factors has been established. Thus, from our study we concluded that:

a. The cyclic behaviour of parasitic species occurrence has provided inputs to develop predictative hypothesis of futuristic outbreaks.
b. Long term data on parasite species distribution gives the advantage of developing estimate-based extinction indicators.

   Parasite species leaving a host after certain period of time might indicate possibility of extinction of that host species in forthcoming future.
c. Information on host-switching could be helpful to update:-

-i. Information on disease outbreak in newer host.
-ii. Assessment of wider host range of parasitic species.
-iii. Extinct host species evaluation.

Dep Var: IPMM Squared multiple R: 0.699
Adjusted squared multiple R: 0.662, F ratio:16.266

Effect	Coefficient	Std Error
DO	1.079	2.770
PH	4.953	3.976
TEMP	0.482	1.731
Q1(Spring)	31.988	63.745
Q2	12.060	32.729
Q3	8.130	21.066
Q4	7.812	15.855
Q5	4.287	12.344

Dep Var: IPFF Squared multiple R: 0.823
Adjusted squared multiple R: 0.801 F-ratio: 32.655

Effect	Coefficient	Std Error
DO	1.107	2.291
PH	1.053	0.288
TEMP	0.292	1.431
Q1(Spring)	43.441	52.720
Q2	22.305	27.069
Q3	15.014	17.422
Q4	10.416	13.113
Q5	8.090	10.209

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