

STUDIES ON PARASITIC INFESTATION OF *NEMATOPALAEEMON TENUIPES*
HENDERSON, BY *BOPYRUS SQUILLARUM* LATREILLE AT BOMBAY
PART I EFFECTS ON SIZE AND GROWTH OF *N. TENUIPES*

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ABSTRACT

1.78% of *Nematopalaemon tenuipes* Henderson were found to be infected by the branchial isopod parasite *Bopyrus squillarum* Latreille at Bombay. Both the sexes of *N. tenuipes* were equally infected and they showed two peaks of infection - May and October, in all the three years from 1979 to 1981. The peaks of infection were observed to coincide with the peak recruitment of *N. tenuipes*. The infected individuals were small, mostly below 50 mm in length. The size of the host and its parasite also showed a positive correlation. The parasite affected the growth by 34% and made the host stunted and weak in appearance which was reflected in their length-weight relationship showing significant differences. Death appears to be caused by the slow attrition caused by the blocking of the branchial surface by the parasite.

INTRODUCTION

EPICARIDEAN bopyrid isopod are among the commonly occurring ectoparasites of the shrimps. During the course of investigations on biology of the marine palaemonid shrimp *Nematopalaemon tenuipes* Henderson at Bombay, *Bopyrus squillarum* Latreille was often noticed harbouring on branchial chamber under the carapace. *N. tenuipes* is a small sized, but economically important non-penaeid prawn occurring in enormous abundance along the northwest coast of India. Kunju (1967) estimated that on an average nearly 2,055 tonnes of *N. tenuipes* constituting 32.56% of the total prawns is landed at Bombay alone.

Occurrence and incidence of parasitism of the prawns by the bopyrid parasites in Indian waters have been reported by Chopra (1923, 1930), Menon (1953), Kunju (1956, 1981), Sawant and Kewalramani (1964) and Thomas (1977). Sawant and Kewalramani (1964) recorded *P. tenuipes* Henderson [now *N. tenuipes* Henderson (Holthuis, 1950)] as a new host for the parasite *B. squillarum* and Kunju

(1981) gave a brief account of the bopyrid infection in *N. tenuipes* in Bombay waters.

Many parasitological problems concerning marine organisms are assuming attention as the parasites and pathogens affect survival of the organisms in natural or cultivated population (Sinderman, 1985). Although *N. tenuipes* is not considered as a cultivable species, its infection by the parasite in natural waters is of considerable importance and therefore it is attempted to bring out a detailed account of its parasitic infection in this investigation, with particular reference to size and growth.

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MATERIAL AND METHODS

Weekly samples of *N. tenuipes* were collected for biological studies from Sassoon Dock and Versova, the major fish landing centres of Bombay where *N. tenuipes* is landed almost throughout the year by the bag net units. The samples were preserved in 5% formalin and later exa-

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mined for size, sex, maturity and weight. The specimens which showed a distinct swelling of the branchial region of the carapace were parasitized and hence were preserved separately for further analysis. For length-weight relationship the individual prawns were carefully blotted and weighed sex-wise in a single pan semimicro balance. The infected specimens were also weighed after careful removal of the parasite.

RESULTS

Among the 18,900 specimens of *N. tenuipes* examined during the years 1979-81, 337 individuals (1.78%) were found to be infected by *B. squillarum*. Generally only one parasite was noticed in either left or right branchial cavity under the carapace, but in two instances there were two parasites lodging in both the branchial

males and females of *N. tenuipes* are nearly equally infected and there is no preference by the parasite to either sex in contrast to *Leander styliferus* in which parasitism was twice as common in males than in females (Kunju, 1956).

It was observed that infected *N. tenuipes* occurred in almost all the month with two distinct peaks, one in May and the other in October every year with the exception of a minor peak in March, 1980 (Fig. 1).

Size: Size of the infected *N. tenuipes* ranged from 19 to 50 mm although infected individuals beyond 47 mm were very rare and those beyond 50 mm were never encountered during the present investigation. Monthly mean size of the normal and infected *N. tenuipes* is shown in Fig. 3. The mean size of the infected individuals is lower than the normal in most of the

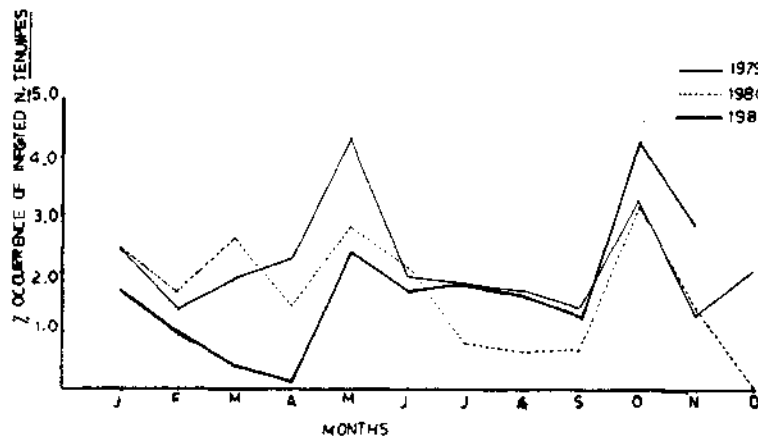


Fig. 1. Monthwise incidence of parasitism in *N. tenuipes*.

chambers simultaneously. The yearwise infestation of the parasite (Table 1) ranged from 1.43% in 1981 to 2.20% in 1979. Kunju (1981) found incidence of parasitism at Bombay varying from 0.7 to 1.50% during 1960-68. The sex-wise break-up of incidence of parasitic invasion shown in Table 1 indicates that

months except from December to February when mean size of the normal individuals has fallen due to recruitment of young *N. tenuipes* as small as 12 mm in total length. An inverse relationship ($r = -0.41$) has been obtained (Fig. 4) between the monthly mean size and the monthly percentage of infection *i. e.* more the

TABLE 1. *Monthwise occurrence of infected N. tenuipes*

Month	1979				1980			
	Males		Females		Males		Females	
	Nos. Examined	Nos. infected	Nos. Examined	Nos. infected	Nos. Examined	Nos. infected	Nos. Examined	Nos. infected
January	311	7 (2.25)	304	8 (2.63)	224	5 (2.23)	312	8 (2.56)
February	184	5 (2.71)	256	1 (0.39)	307	8 (2.61)	466	5 (1.07)
March	428	9 (2.10)	349	6 (1.17)	237	5 (2.11)	308	9 (2.92)
April	387	10 (2.59)	335	6 (1.79)	456	8 (1.75)	395	4 (1.01)
May	314	10 (3.18)	376	20 (5.32)	513	14 (2.73)	420	12 (2.86)
June	222	7 (3.15)	242	2 (0.83)	162	6 (3.70)	125	-
July	287	3 (1.05)	154	5 (3.25)	130	-	124	2 (1.61)
August	256	4 (1.56)	157	3 (1.91)	141	-	179	2 (1.11)
September	244	3 (1.23)	186	3 (1.61)	173	1 (0.58)	272	2 (0.74)
October	138	7 (5.07)	139	2 (1.44)	150	5 (3.33)	226	7 (3.10)
November	79	-	321	5 (1.56)	147	2 (1.36)	140	2 (1.43)
December	356	10 (2.81)	373	5 (1.34)	139	-	204	-
Total	3206	75 (2.34)	3192	66 (2.07)	2779	54 (1.94)	3171	53 (1.67)

percentage infection, lower the size of the host.

The size of the adult female *B. squillarum* was found to be 7.0 mm in greatest length and 50 mm across the level of the third thoracic somite. The body is markedly asymmetrical and the axis is strongly turned to right or left according to the size of host on which the parasite is attached. Once they attained 3 mm size the females were always found to carry eggs in the brood pouch attached to the underside of the thorax. The male *B. squillarum* is diminutive, only 1.5 mm in length and always found between the posterior pleopods of the female.

The female bopyrid parasite was always found in juxtaposition with the gills of the host, causing prominent enlargement of the carapace and leaving little space in the branchial chamber for the circulation of water for respiratory purpose. A fully grown parasite has been found to occupy nearly 80-90% of the branchial chamber of one side. The noticeable size of female *B. squillarum* parasitising on *N. tenuipes* was 2.0 mm and those smaller in length perhaps went unnoticed as they did not cause the prominent swelling in the branchial cavity of the carapace of the host. Size of the parasite ranged from 2.0 to 7.0 mm and it was found to be related to the size of the host (Fig. 4). The incidence of infection

during 1979, 1980 and 1981 (with percentages in parenthesis)

		1981				Total	
Males		Females		Males		Females	
Nos. Examined	Nos. infected	Nos. Examined	Nos. infected	Nos. Examined	Nos. infected	Nos. Examined	Nos. infected
399	6 (1.50)	294	6 (2.04)	934	18 (1.93)	910	22 (2.42)
470	4 (0.85)	460	5 (1.09)	961	17 (1.77)	1182	11 (0.93)
327	2 (0.61)	195	-	992	16 (1.61)	852	15 (1.76)
471	1 (0.21)	462	-	1314	19 (1.45)	1192	10 (0.83)
413	10 (2.42)	265	6 (2.26)	1240	34 (2.74)	1061	38 (3.58)
501	9 (1.80)	211	3 (1.42)	885	22 (2.49)	578	5 (0.87)
319	7 (2.19)	232	3 (1.29)	736	10 (1.36)	510	10 (1.96)
296	6 (2.03)	198	2 (1.01)	693	6 (0.87)	534	7 (2.62)
285	2 (0.70)	280	5 (1.43)	702	6 (0.85)	738	10 (1.22)
199	5 (2.51)	105	8 (7.62)	487	17 (3.49)	470	17 (3.62)
45	-	60	3 (5.00)	271	2 (0.74)	521	10 (1.92)
-	-	-	-	560	10 (1.79)	577	5 (0.87)
3725	52 (1.40)	2762	41 (1.48)	9775	177 (1.81)	9125	160 (1.75)

was maximum when size of the host is between 30 and 35 mm and the average size of the parasite at this stage is about 5.0 mm.

LENGTH-WEIGHT RELATIONSHIP

The parasitised individuals appeared weak and slender than the normal ones. This is reflected in their length - weight relationship. The equations obtained separately for normal and parasitised males and females are as follows:

Male (Normal) : $W=0.0000157L^{2.8323}$

Male (Parasitised) : $W=0.0000644L^{2.3992}$

Famale (Normal) : $W=0.0000189L^{2.7832}$

Female (Parasitised) : $W=0.000067L^{2.394}$

The variations in regression lines were tested (Table 2) by the analysis of covariance (Snedecor, 1961) and it was found that the differences in the regression lines of the normal and parasitised males and females were significant at 1% and 5% level respectively.

Growth: As the number of infected *N. tenuipes* occurring per month were quite, limited, both male and female infected individuals

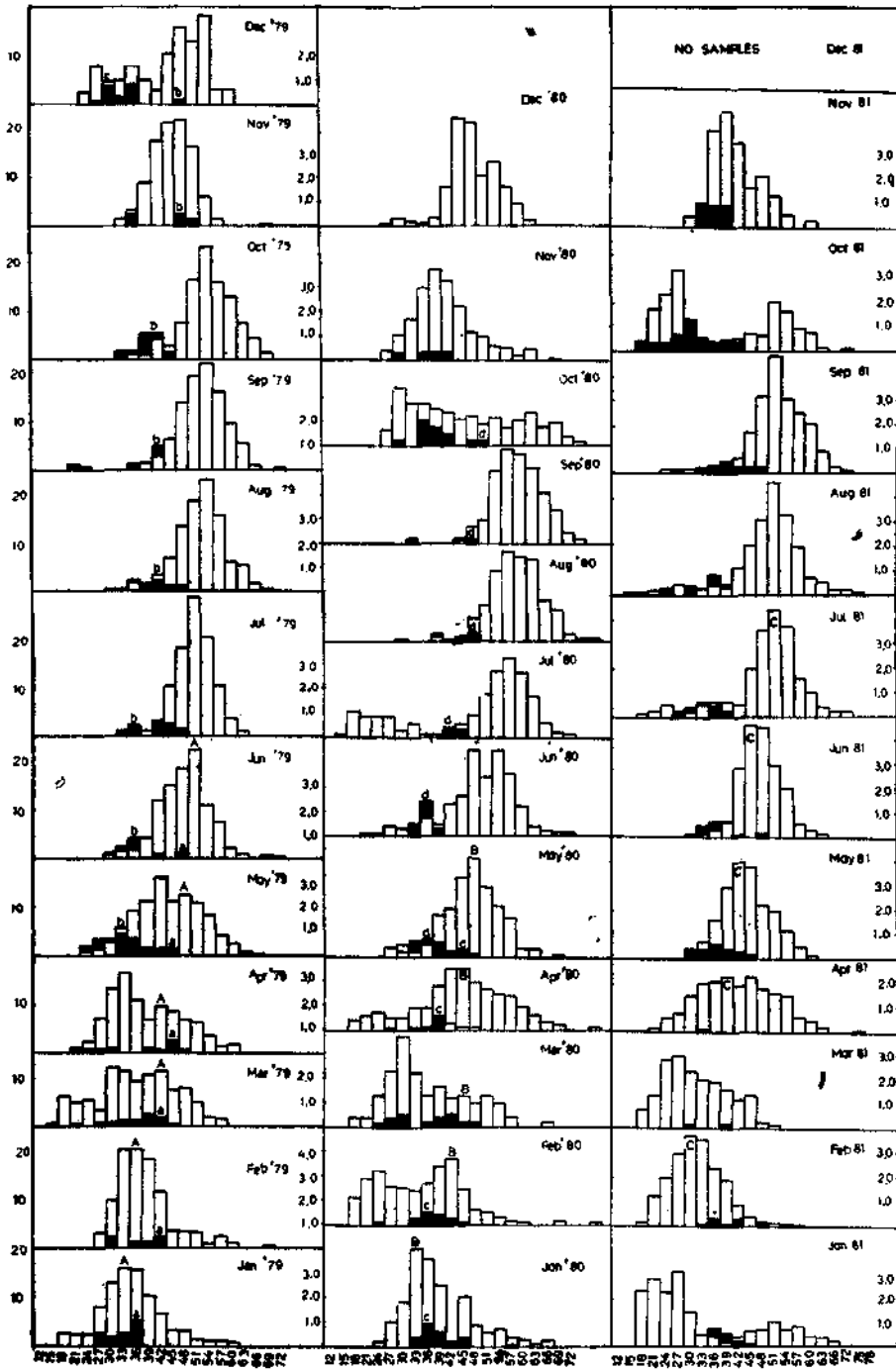


Fig. 2. Monthwise size distribution of normal (blank of columns) and infected (filled columns).

were pooled together for the growth studies. The normal individuals were also pooled together for the sake of comparing growth rates although it has been shown (Kunju, 1981) that there is a distinct difference between growth rates of male and female *N. tenuipes*.

Only limited number of modal chains (Fig. 2) were traceable among infected individuals. The mode 'a' at 36 mm in January, 1977 shifts

mm in February, 1981 shifts to 51 mm in July, 1981 showing a growth of 21 mm in 5 months. The average rate for both the sexes together for the normal *N. tenuipes* is thus found to be 3.92 mm per month.

DISCUSSION

Chopra (1923) observed that the number of infected palaemonid prawns exceeded the num-

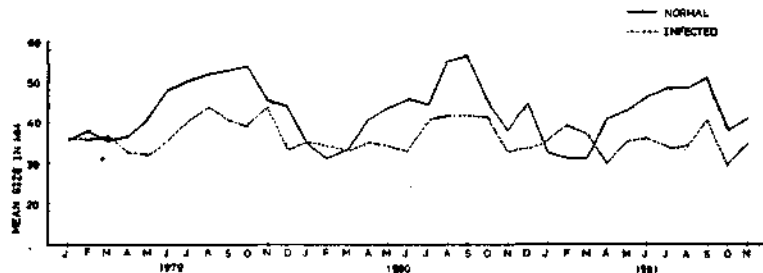


Fig. 3. Monthly mean size of normal and parasitised *N. tenuipes*.

to 48 mm in June, 1979 thereby registering a growth of 12 mm in 5 months while the mode 'b' at 33 mm in May, 1979 moves to 48 mm in December, 1979, the growth increment being 15 mm in 7 months. The mode 'c' at 30 mm in December, 1979 attains 45 mm in May, 1980 increasing in length by 15 mm in 5 months. The mode 'd' at 36 mm in May, 1980 moves to 51 mm in October, 1980 showing a growth of 15 mm in 5 months. Thus the average rate of growth works out to be 2.59 mm per month for the infected *P. tenuipes*.

Since growth increments for the parasitised individuals could be traced in the size range 33 to 50 mm, only comparable size range is used in tracing the growth of the normal *P. tenuipes*. The mode 'A' at 36 mm in February, 1979 shifts to 51 mm in June, 1979 thereby registering growth of 15 mm in 4 months; while the mode 'B' at 33 mm in January, 1980 moves to 48 mm in May, 1980, the growth increment being 15 mm in 4 months. The mode 'C' at 30

mm in February, 1981 shifts to 51 mm in July, 1981 showing a growth of 21 mm in 5 months. The average rate for both the sexes together for the normal *N. tenuipes* is thus found to be 3.92 mm per month. Although it has not been mentioned, the percentage of infected prawns must be well above 50%. Kunju (1956) however, stated that nearly 9.9% of *Leander styliferus* were infected in Hoogly and Matla Estuary of the Gangetic region. Thomas (1977) also found incidence of parasitism in *Penaeus semisulcatus* by the bopyrid varying from 0.23 to 4.55%. The present study however, shows that incidence of parasitism in *N. tenuipes* was relatively lower. But it shows nearly two fold increase as compared to Kunju's (1981) observations from 1961 to 1968 in the same area.

Rathke (Giard, 1888) first noted that only females of *Palaemon* were infected by the bopyrid parasite, but he mistook (Hiraiwa and Sato, 1939) parasitised male individuals for females as a result of feminisation. However, Allen (1966) observed that the bopyrid parasite *Hemiarthrus abdominalis* was found to attach only to the females of *Spirontocaris lilljeborgii*

and *Eualus pustolus*. Kunju (1956) and Thomas (1977) also found respectively that the incidence of parasitism in *Palaemon styliferus* and in *Penaeus semisulcatus* was more among females than males, but the present study shows that there is no such preferential invasion of the parasite in either sex of the host, in fact the incidence of parasitism was found to be slightly more among males as number of infected males during the three years was 1.81% as compared to 1.75% for females.

reflected in the length-weight relationship and dies due to slow attrition or falls an easy prey to various pelagic fishes.

The two peaks of infestation in May and in October to be related to the recruitment of young *N. tenuipes* rather than the breeding activity of the parasite as the females of *B. squillarum* were found to carry eggs in their brood pouch throughout the year, Kunju (1981) showed that *N. tenuipes* breeds round the year,

TABLE 2. Analysis of covariance for testing differences in regression in length-weight data of *N. tenuipes*

Individuals	Degree of freedom	Corrected sum of square and products			Regression coefficient	Deviation from regression S. S.		Mean square	F Value	Remarks
		X^2	XY	Y^2		D.f.	$\frac{\sum y^2 - \frac{(\sum XY)^2}{\sum X^2}}$			
Male (Normal)	110	2.4065	6.8157	19.8306	2.8323	109	0.5271	0.004836	—	—
Male (Parasitised)	89	0.5839	1.4001	3.7340	2.3978	88	0.3774	0.004288	—	—
						197	0.3774	0.004591	—	—
Pooled	199	2.9904	8.2158	23.5646	2.7474	198	0.9926	0.00501	—	—
Difference beth. slopes						1	0.0881	0.0081	19.19	Significant at 1%
Female (Normal)	157	4.5998	12.8023	36.3593	2.7832	156	0.7276	0.004664	—	—
Female (Parasitized)	26	0.1171	0.2805	0.7211	2.3954	25	0.0492	0.001968	—	—
Pooled	183	4.7169	13.0828	37.0828	2.7736	182	0.7963	0.004375	—	—
Difference Dif. Beth. slopes.						1	0.0195	0.0195	4.5433	Significant at 5%

The size of normal *N. tenuipes* during the present investigation for males was found to range from 17 to 64 mm and for females 17 to 76 mm with individuals below 17 mm as indeterminates although recorded maximum size is 76 and 96 mm respectively (Anon., 1975). The infected individuals never occurred beyond 50 mm size. This suggests that by the time the host reaches this length it becomes weak as

but has two breeding peaks, a primary one from July to October and a secondary in March - April. The present study is also in accordance with it. It is possible that the young recruits of the size 15-20 mm are more susceptible to the parasitic invasion. Pike (1960) also found that bopyrid parasite breeds all the year round, yet the infection takes place over a period of two months early in the life of the host *Pan-*

dalus spp. Thus young recruits of 15-20 mm size get invaded by the free living bopyridian (Cameron, 1956) larvae of *B. squillarum* in July - September and March - April which, however, become noticeable only in October and May. This is also supported by the direct relation between the size of the host and the parasite as well as by the inverse relationship found between the monthly mean size and the occurrence of the infected *N. tenuipes*. i. e.,

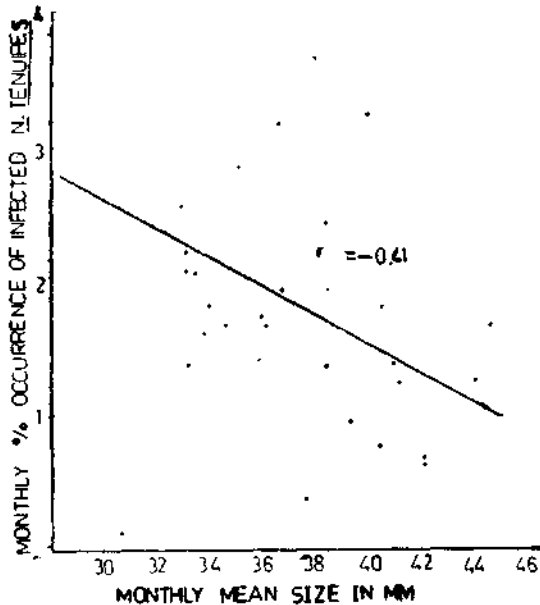


Fig. 4. Relationship between monthly mean size and monthly occurrence of infected *N. tenuipes*.

whenever there was rise in infected individuals the mean size of them is seen to fall.

Kunju (1981) found that the two sexes of *N. tenuipes* grow at different rates, the average growth rates being 3.92 mm per month for females and 3.00 mm per month for males at Sassoon Dock. The present material comprising of samples from Sassoon Dock shows comparable growth rate of 3.92 mm per month for the males and females to-

gether. The parasitised *N. tenuipes* however, showed retarded growth rate of 2.59 mm per month which is 33.98 percent lower than the normal. Thus the recruits in the size group 33

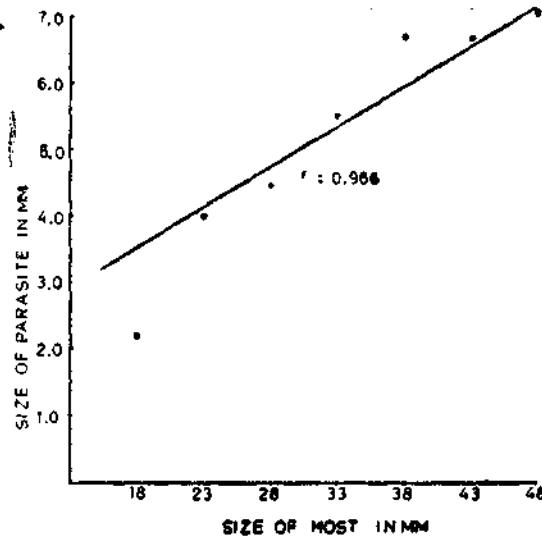


Fig. 5. Relationship between the size of host *N. tenuipes* and the size of parasite *B. squillarum*.

mm in April, 1979 grow to attain 54 mm in August, 1979 whereas the parasitised individuals of the same brood size lag at 42 mm which is clearly reflected by decline in their mean size from 52.5 mm to 44.0 mm in August, 1979. If it is assumed that the bopyridean larvae have invaded the host at 21-30 mm size (mean size 25 mm) in February or in early March then the fall in mean size in August works out to be 35.42 % which is almost in accordance with the 33.98% decline in growth of the infected individuals.

Sawant and Kewalramani (1964) stated that the parasite caused a 7 mm tumour in the branchial chamber of the host, but since all the bopyrids cause a pronounced swelling on the side of the cephalothorax through the presence of the females in the host's gill chamber, the term tumour appears to wrongly used as

there is no neoplasia observed in the branchial chamber.

It is known that parasites do not cause immediate death of their host. The bopyrid parasites are blood suckers (Cameron, 1956) and also do not cause sudden death. *B. squillarum*

causes slow death in *N. tenuipes* not merely by sucking the blood from the branchial chamber, but also by blocking 80-90% of the surface area of the gills, thus reducing the respiratory efficiency and causing retarded growth which is manifested in stunted and weak appearance of the host.

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