

ECTOCOMMENSALS AND PARASITES OF SHRIMP

FROM TEXAS REARING PONDS

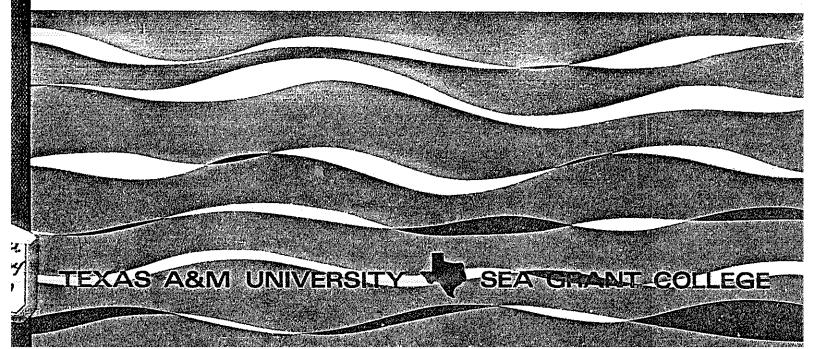
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ABSTRACT

Five species of penaeid and one of palemonid shrimp from Texas coastal rearing ponds, investigated during 1972-73, were found to host ectocommensals and parasites. New ectocommensal relationships and the nature of ectocommensal associations are discussed. Similarities and differences among shrimp species with respect to ectocommensal and parasite occurrence are also discussed.

ACKNOWLEDGEMENTS

I am grateful to Mr. Hoyt Holcomb and Dr. Fred Conte for taking their time to collect and ship the samples of shrimp that made this study possible. Further gratitude is extended to them and Dr. Jack Parker for use of water chemistry data presented herein. Thanks are extended to Dr. Robin M. Overstreet of the Gulf Coast Research Laboratory, Ocean Springs, Mississippi, for reviewing the paper.

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INTRODUCTION

Ectocommensals and parasites can become economically important in shrimp culture when heavy infestations occur as a result of rearing intensive numbers or other environmental alterations that accompany artificial cultivation of shrimp. This paper documents the occurrence of ectocommensals and parasites on or in five species of penaeid shrimp and one palemonid shrimp from Texas coastal rearing ponds during 1972-1973. New host-ectocommensal relationships and relationships between burdens of exotic and native shrimp are discussed.

Overstreet (1973) has reviewed and contributed to information concerning parasites and ectocommensals of commercial shrimp in a study of brown, white and pink shrimp from sites in the coastal states of Georgia through Texas. Earlier reports concerning parasites of reared penaeids have included those by Villella et al. (1970) and Johnson et al. (1973). Hutton et al. (1959), Kruse (1959), Sprague (1970) and Couch (1971) discuss parasites and ectocommensals of commercial shrimp without emphasis on reared hosts.

MATERIALS AND METHODS

Texas A&M University's experimental shrimp culture project in Brazoria County, Texas, provided specimens for the investigations carried out in 1972 and in 1973. The facility consists of twenty 0.2 ha ponds that have an average depth of 1 meter. Water is pumped through the ponds continually during the summer months and

until harvest. A sock filter (31 count mesh) is used at the entry points. During normal operation, the entering water comes directly from Wharton Camp Bayou; but when salinities become low due to excessive rainfall, this supply is cut off and the water is recirculated. For description of the Brazoria county facility, see article by Holcomb and Parker (in press). Shrimp obtained from these ponds in 1972 included <u>Penaeus setiferus</u>, <u>P. vannamei</u>, <u>P. occidentalis</u> and <u>P. aztecus</u>.

The material was obtained from formalin-preserved field samples taken throughout the growing season by project biologists. A specimen of each shrimp was selected from each weekly sample and subsequently examined.

In 1973, additional specimens were obtained from the Texas A&M University shrimp culture project at Corpus Christi, Texas. The Corpus Christi facility consists of three ponds with areas of 0.05, 0.1 and 0.2 ha ponds, respectively, and with average depth of 1 meter. The ponds receive a continuous flow of water filtered by a sock at the intake. Outflow is through a stand pipe. With the exception of a brief period of pump breakdown, water continued its flow throughout the summer rearing period until harvest. Specimens of P. vannamei and P. stylorostris were removed by seining from the ponds, placed wet into plastic bags, then placed into an insulated carton supplied with crushed ice, and shipped to the laboratory by bus for examination. This procedure was carried out several times throughout the growing season.

Shrimp from the Brazoria county project, in 1973, included \underline{P} . vannamei and \underline{P} . setiferus. Shrimp specimens were obtained at the

time of sampling by the project biologists. Specimens were obtained from each pond at each sampling and placed into 10% formalin. Conditions of water flow were similar in 1972 and 1973 in that water was circulated through the ponds, but without introduction of bay water into the system for periods when bay water became low in salinity. Water chemistry differed between years, primarily as a result of heavy rainfall in 1973. In 1973, salinity values were often below 10 ppt, but in 1972, they were in the range of 11 to 28 ppt. The pH was lower in 1973 (6.0-7.3) compared to 1972 (7.5-8.3). Ammonia levels were generally higher in 1973 (up to 3 ppm) than in 1972 (up to 1.5 ppm).

Water chemistry determinations for the Corpus Christi ponds showed salinities of 8 to 40 ppt, pH values of 7.4 to 8.3, and ammonia levels of less than 1.85.

Shrimp specimen examination consisted of clipping and subsequent wet-mount preparations of several pleopods and the distal portion of a uropod. The intestine was also removed, teased apart and wet-mount prepared. This method of examination was adopted after examinations of numerous specimens produced no additional parasites or ectocommensals in or on other body parts. For 1973 shrimp, at least 3 shrimp from each pond were examined from each sampling.

Palemonetes pugio was a noticeable resident in the Brazoria county ponds. During 1973, specimens of this small shrimp were collected by the field staff when they happened to be in the sein at the time of sampling. In all cases, penaeid shrimp specimens were selected at random at the pond site.

RESULTS

Ectocommensals that occurred with relative frequency on penaeid shrimp were Zoothammium sp. (figure 1), Epistylis sp. (figure 2), Acineta (figure 3) and filamentous bacteria (figure 4).

Less frequent was a species of Lagenophrys (figure 5). Commonly encountered in some shrimp were trophozoites of Nematopsis peneai

Sprague (figure 6). These results are tabulated in Table 1.

When it occurred, Zoothamnium sp. was typically located on the gills of shrimp and occasionally on the exterior in very light numbers. The converse was experienced for Epistylis sp. and Acineta sp. was rarely found on the gills. Filamentous bacteria were frequently seen on the shrimp and tended to concentrate on the body areas beset with setules. In rare instances, when the burden was very heavy, this type of bacteria was noted to be on the gills. With moderate to heavy infestations, no bacteria of this type were observed on the gills.

Lagenophrys sp. (figure 6) was noted on the surface of

Palemonetes pugio, P. setiferus and P. vannamei. These ectocom
mensals were commonly found on exterior surfaces of the body that

were suited (flat) for attachment of their unique tests.

Nematopsis peneai was very common in the intestine. The stage that was found was usually a small trophozoite as shown in figure 6.

The isopod parasite, <u>Probopyrus pandalicola</u> (Packard), was commonly encountered on specimens of <u>Palemonetes pugio</u> (figure 7). This parasite was not noticed on any of the Penaeus spp.

In September of 1973, the shrimp began to take on a brownish discoloration that was associated with atrophy of the tips of the gill filaments (figure 8). The condition began with only a few tips being affected, and progressed until most were affected and the gills took on a blackened appearance to the naked eye (figure 9). Microscopically, no viable organism was detected as contributing to the condition. No hyphae were detected and bacterial isolates that were obtained by gill swabs showed nothing unique. Evidence of chitinoclastic bacteria action was noticed on the exterior of a few shrimp (figure 10), but the condition on the gills was not especially similar. Discussion of this condition will be detained until further data is gathered.

Table 1. Ectocommensals and parasites in shrimp species from rearing ponds in Texas

	Filamentous Bacteria	1	ļ	1	1	!	i	ļ	1		B.Lt.		B, Lt.		ļ	1	1	l	1	!	ļ	j	i	1	1	1	1	•
biont 1	Lagenophrys sp.	1	1	1	;	1	}	ļ	;	1	1		1		. [ţ	1	}	į	1		1	ł	1	1	ļ	}	1
on by sym	Nematopsis penaeus		1	1	!	ļ	- 1	***	!	1	ł	i 1	1		.	ļ	ŧ		ł	1	ļ,	1	1	1	ŀ	!	į	ŀ
f infecti	Acineta sp.		B.Lt.	B,Lt.	. †	B,Lt.	B,Lt-M	.	B,V.Lt.	B,Lt.	. !	1	ļ		1	i i	1	1	1	ļ	·¦	1	!	!	1	1	44	i i
Site and degree of infection by symblont	Epistylis sp.	B,V.Lt.	B,Lt.	B,Lt.	1	B, Lt.	B,Lt.	B,Lt.	i 1	B,Lt.]	1	l 1		1	B, V. Lt.	ľ	B,Lt.	!	1	B,Lt.	1	ŀ	B,Lt.	1	ļ	1	1
Site a	Zoothamnium sp.	1	G,Lt.		Serie bridge	ļ	G,Lt.	G,Lt.	I	l i	ļ	ł	1		1	!	ļ	G,Lt.	ļ]	G,Lt.	!	G,V.Lt.	Î Î	G, Lt.	1	1	!
	Avg. Size	67	65	80	86	88	96	103	109	109	113	113	113		26	41	52	99	80	98	93	. 98	105	109	112	116	20	23
	Sample Date	7-13-72	7-20-72	7-27-72	8- 3-72	8- 9-72	8-17-72	8-24-72	9- 7-72	9-14-72	9-21-72	9-28-72	10- 5-72		7-14-72	7-20-72	7-27-72	8- 3-72	8- 9-72	8-17-72	8-24-72	8-31-72	9- 7-72	9-14-72	9-21-72	9-28-72	4-26-72	5- 4-72
	No.	H		H		H	ᆏ	ᆏ	H	H		-	႕		7	 1	, 1		Н		Н	, -	1	H	Н	Н	ᅱ	Н
	Location 2	BC-1	Ξ	=	=	=	=	=	£	=	Ξ	=	=	C*	Series	=	=	= .	=	=	Ξ	z	Ξ	= -	=	_ c =	Series	=
	Species of Shrimp	P. vannamei	=	=	=	E	2	=	Ξ	=	=	F		P. occiden-		=	=	1	=	E.	=	=	=	=	Ε	=	P. aztecus)

Table 1 continued	inued		•						,	
					Site and o	degree of		infection by symbiont	ont 1	
Species of Shrimp	Location 2	No.	Sample Date	Avg. Size mm	Zoothamnium sp.	Epistylis sp.	Acineta sp.	Nematopsis penaeus	Lagenophrys sp.	Filamentous Bacteria
P. aztecus	Series 3		5-11-72	47]		an na		
	=	H	5-18-72	57		B,Lt.	ł	ĺ	ł	ł
=	=	H	5-25-72	29	G,Lt.	B,Lt.	ľ	I,Lt.	1.	ŀ
=	=	ᆏ	6 - 1 - 72	9/	<u> </u>	i	1	I,Lt.	ł	ţ
: :	= :	 :	6- 8-72	98	G,Lt.	B'Lt.	1	I,Lt.	!	¦
	_ :	, - 1	6-15-72	96	1	B,Lt,	1	I,Lt.	}	l l
	= =	, -	6-22-72	101	G,Lt-M;B,Lt.	B,It.	B,Lt.	I,Lt.	1	B,Lt.
: =	: =	⊢ ,	7-6-72	104		B,Lt.	B,Lt.	I, Lt.	!	İ
: :	: =		7-13-72	105	G,Lt;B,Lt.	G,I.t.	B,Lt.	I,Lt.	ļ	!
D sotiforns	3000		2/-02-/	T08	G,Lt.	ъ, Lt	<u> </u>	!	ļ	i I
11 36 17 67 09	2011 11	-l	7-13-72	מ ע ל	i +	D, L.C.	! !		1	1
=	=	ન	7-20-72	7.5	, pr.	р, L.г.	<u> </u>	1, LT.		1 1
=	1	ı ₁₁	7-27-72	85	ļ	B.It.	}	I.Lt.	! !	 •
=	=		8- 3-72	16		1	B.Lt.	I,M-H	1	ļ 1
=	=	⊣	8- 9-72	66	1	B,Lt.	.	I,Lt.	1	;
=	Ξ	H	8-17-72	101	1	1	B,Lt.	I,Lt.	ļ	}
= :	pa.	H	8-26-72	105) 	B,Lt.	1	I,Lt.	1	ŀ
= :	Ξ:	Н.	8-31-72	107	G,Lt.	B,Lt.	B,Lt.	I,Lt.	l	1
= :	- ;	-	9- 7-72	113	G,Lt.	B,Lt.	1	!	ļ	!
	۳ =	Н	9-14-72	114	G, Lt.	B,Lt.	B,Lt.	i i	İ	į
P. vannamei	CO	σ	7-19-73	77	1	B,Lt.	1	ţ		1
<u> </u>	B-2	ຕຸ	8-23-73	99	ţ		1	ļ	***	1
	B-4	m	8-23-73	73	}	B, V.Lt.	1	ļ	i	B, Lt.
den .	B5	ന	8-23-73	72	!	B,V.Lt.	1	ļ	!	B,Lt.
= :	B-7	က	8-23-73	40	1	B, V.Lt.	B,Lt.	1	;	B,Lt.
= :	B-9	m	8-23-73	54	; ;	B,V.Lt.	ļ		1	1
Ξ :	B-10	က	8-23-73	62	ļ 	>	G,V.Lt.	1	1	1
=	B-12	ന	8-23-73	63	ï	B,V.Lt.	!	1	1	;

Table 1 continued	nued	,								
					Site and	degree of	infection	by symbiont	ont	
Species of Shrimp	Location ²	No.	Sample Date	Avg. Size mm	Zoothamnium sp.	Epistylis sp.	Acineta sp.	Nematopsis penaeus	Lagenophrys sp.	Filamentous Bacteria
									٠	
P. vannamei	B-15	3	23-7	59	I	B,Lt.	B,Lt.	Î	1	i
=	B-16	ന	23-7	22	ŀ	B, Lt.	B,Lt.	ļ	1	1
=	B-18	ო	23-7	62		B,V.Lt.	. !	1	ļ	1
=	Stockers	20	14-7	∞	1	1	. 1	1	. [ļ
P. setiferus	B-1	m	8-23-73	98	!	B,Lt.	1	I,Lt.	1	!
=	B-3	e	23-7	44		B,Lt.	ł	I,V.Lt.	1	}
=	B-6	æ	23-7	59	;	B,Lt.	;	I, Lt.	1	B.Lt.
=	B-8	က	23-7	52	;	B,Lt.	ļ	I,Lt.	!	~
=	B-11	3	23-7	32	I	B,Lt.	ŀ	I,Lt.	}	ļ
=	B-13	ო	23-7	45	.]	B,Lt.	B.V.Lt.	•		B.Lt.
±	B-14	ო	23-7	56	!	B,Lt.	.	I.Lt.	}	^
	B-17	ന	23-7	47	ļ	B,V.Lt.	1	I,Lt.	!]
Ξ :	B-19	ന	(F)	35	G,Lt.	•	i	I,Lt.	ļ	. B,Lt.
	B-20	ന	~	38	į	•	1	•	i	.
P. vannamei	B-2	ო	\sim	98		•	1	. 1		1
= :	B-4	ო	9-27-73	80	!	B,Lt.	i	ľ		B,Lt.
= ;	B-5	m	\sim	65	i	:	!	!	ł,	B,Lt.
: :	B-7	m	\sim	.65	i	ļ	!		1	B,Lt.
= :	B-9	m	\sim	57		1	ļ	i	!	
Ξ.	B-10	m	\sim	73	ļ	NAME OF A	!	ļ	1	B.Lt.
=	B-12	ന	7	29	i	-	ļ	, 1	!	
: .	B-15	ന	\sim	71	I	B,Lt.	I,	!	1	B.Lt.
=	B-16	ന	\sim	98	1	B,M.	!	·	į	B.Lt.
	B-18	က	~	69	1	B,V.Lt.	1		ļ	B.V.Lt.
P. setiferus	B-1	സ	\sim	53	!	B,M.	В,Н.	ļ	B.H.	B.V.Lt.
Ξ :	B-3	ന	9-27-73	65	1	B,Lt.	B,Lt.	1	•	B.M.
= :	B-6	ന	\sim	57	1	B,Lt.	,	I,Lt.	1	1
Ε:	B-8	m	9-27-73	55	1	1	Ē Ĺ		[1
ji pa	B-11	က	9-27-73	77		B,Lt.	B,Lt.	I,Lt.	B,Lt.	B,Lt.

Table 1 continued

					Site and	degree of	f infection	by	symbiont 1	
Species of Shrimp	Location ²	No.	Sample Date	Avg. Size mm	Zoothamnium sp.	Epistylis sp.	Acineta sp.	Nematopsis penaeus	Lagenophrys sp.	Filamentous Bacteria
P. setiferus	B-13	с 0	9-27-73	09	!	B,Lt.	ļ	I,Lt.	B, Lt.	B,Lt.
er ter	B-14	നേര	9-27-73	60				H, Lt.	; ;	1 1
1.	B-19	സ	9-27-73	58		1	. 1	H, H.	.]	}
Ξ	B-20	က	-27-	72	ł	i	1	I,Lt.	1	ļ
P. vannamei	B-2	ന	7	83	ļ	ł	l	1		1
=	B~4	ო	ı	97	}	B,Lt.	B,V.Lt.	}	1 .	В,М-Н
=	B-5	က	7	80	G, Lt.	B,Lt.	B, Lt.	1	в,м.	B,Lt.
=	B-7	m	10-25-73	68	G, Lt; B, V. Lt.	B,Lt.	B,Lt.	;	ļ	B,Lt.
=	B-9	ന	10-25-73	. 98	B,V.Lt.	1		Ì	1	l
Ξ	B-10	ო	10-25-73	87	G, Lt.	B,Lt.	ļ	1	!	B, Lt-M
=	B-12	3	\circ	88	1	1	B,Lt.	Į Į	1	‡
= :	B-15	ᠻ	\mathbf{c}	93	;	B, V.Lt.	B, Lt-M	1	!	B,Lt.
=	B-16	ന	-22-	93	i i	B,Lt.	1	1	1]
	B-18	က	10-25-73	88		B,Lt.	1			B,Lt.
P. setiferus	B-1	ന	-25-7	62	Į i	B,Lt.	B,Lt,	I,Lt.	. !	B,Lt.
	B3	ო	7	88	G,Lt.	B, V. Lt.	B,Lt.	1]	B,Lt.
=	B-8	m	10-25-73	. 29	;	1	!	1	1	1
=	B-11	ന	-25-7	75	G,Lt.	B,Lt.	B,Lt.	I,M.	1	B,Lt.
=	B-13	ന	-25-7	65	G,Lt.	B,Lt.	B,Lt.	I, It.	}	B, Lt.
=	B-14	ന	-25-7	98	!	!	!	!	ļ	!
=	B-17	n	-25-7	63	ļ	ļ	!	I,Lt.	!	i
	B-19	ന	-25-7	. 65	G,Lt,	B,Lt.	1	I,Lt.	j	B,Lt.
P. pugio	B-8	, - 1	7	25	i	1	1	, 	1	!
	B-11		7	. 25		1	ì	***	1	ļ
P. pugio	B-2	Н	9-27-73	30	1	B,Lt.	1	1	B,Lt.	!
· '	B-12	ന	-3	28	1	!	ļ	1	1	1
P. pugio	B-8	4	9-27-73	35	1	}	!	ŀ	ļ	ł
	B-18	H	9-27-73	50	1	1	!	!	}	l

Table 1 continued

same in one field of view=M.; 1000 or more on a wet-mount and for filamentous bacteria in one field of view=H. or colonies see=V.Lt.; 10-100 individuals or colonies seen on wet-mount and for filamentous bacteria the same in one field of view=Lt.; 100-1000 individuals or colonies seen on wet-mount and for filamentous bacteria the Site of infestation: G=Gills; B=Body surfaces; I=Intestine. Degree of infestation: One or two individuals

Table 1 continued

2 Pond identities are given by the letters B and CC representing Brazoria County and Corpus Christi ponds respectively, followed by a number that represents the pond number at said facility. post-larval shrimp examined at the time of stocking. 3 Series means that sample was picked at random from a lot of specimens that represented a series of ponds in which that species of shrimp was cultured.

⁴Samples of shrimp that had individuals harboring Probopyrus pandalicola (Packard).

DISCUSSION

New Ectocommensal Relationships

Organisms belonging to the genera Acineta and Lagenophrys have not been previously reported in penaeid shrimp. Couch (1967), and Sprague and Couch (1971), have reported species of both of these genera on the gills of the Blue crab, Callinectes sapidus. Lagenophrys spp. and Acineta spp. have been found on an array of other decapod hosts, according to a synopsis by Sprague and Couch (1971).

The Acineta sp. that was observed in the present study showed preference for exterior body surfaces over gills as a site of attachment. Only rarely was one of the organisms found on the gills. The same was observed for Lagenophrys sp.

Zoothamnium sp. and Epistylis sp.

Overstreet (1973) and Johnson et al. (in press) charged Zoothamnium sp. as a responsible agent for shrimp mortality when shrimp were heavily burdened and in low oxygen situations. Johnson (1972) erroneously reported Epistylis sp. as the responsible agent for shrimp mortality in such a situation and later, Johnson et al. (in press) documented Zoothamnium sp. as the responsible agent for that case of mortality. Johnson (1972) was misled because of the presence of both Zoothamnium sp. and Epistylis sp. on the same shrimp specimens. Overstreet (1973) mentioned the presence of species of both genera on shrimp, and indicated that Epistylis sp. were found primarily on appendages rather than on gill filaments. By examination of Johnson's earlier material as well as the results presented

herein, it becomes apparent that for some shrimp species the gills are favored sites of attachment for Zoothamnium sp. and the exoskeleton and appendages are favored by Epistylis sp. It is probable that because of this attachment preferentiality, Zoothamnium sp. will continue to be more important as an overburdening organism than will Epistylis sp. Villella et al. (1970) reported Zoothamnium from gills and external body parts of P. duorarum, a species of shrimp that was not examined in this study. Specimens from the mass mortality of P. aztecus reported by Johnson et al. (in press) and Johnson (1972) showed the gills heavily infested with Zoothamnium sp. and the external body parts having moderate infestations of both Zoothamnium sp. and Epistylis sp.

The importance of <u>Zoothamnium</u> sp. as an overburdening organism is also supported by recent data that demonstrates the possibility of high intensity of infestation by <u>Zoothamnium</u> sp. (Johnson et al., in press; Overstreet 1973; Villella et al., 1970).

Exotic and Native Shrimp

The exotic shrimp species, <u>P. vannamei</u> and <u>P. occidentalis</u>, were used in the culture experiments. Water for the rearing units was passed from the bay through the units and back to the bay. Consequently, there was concern over introduction of exotic disease agents that might pass from the exotic shrimp to wild shrimp stocks. Other concerns were passage of disease agents from wild stocks to the exotic shrimp and possible interchange between the exotic and native domestic stocks within the system, since recirculation exposed them to the same water.

Shrimp were given a check at the time of shipment. A series of 10 or 20 was examined. No parasites or commensals were noticed on or in the shrimp at the time of these checks.

Nematopsis penaeus and Nosema nelsoni were recorded from the native shrimp in the rearing ponds, but never the exotics (Table 1).

Nosema nelsoni was noticed only once in a P. setiferus. No exotics were noticed to host a microsporidian.

Nematopsis penaeus was noted to be usually present in the native species, but the exotics did not host it or any other gregarine.

Acineta sp., Epistylis sp. and Zoothamnium sp. were organisms that apparently were not selective in finding shrimp associates.

Acineta sp. had not been recorded until now and might be suspected to be an ectocommensal that was introduced with the exotics. However, this was not the case, since it had been observed on P. aztecus during this investigation, at the Brazoria county station, a year before the introduction of the exotics.

A similar observation recorded for the filamentous bacteria and the Lagenophrys sp. indicates that these were not introduced.

Overstreet (personal communication) informed me, even though not mentioned in his 1973 paper, that he has observed a filamentous bacteria, possibly <u>Leucothrix mucor</u>, on the gills and appendages of brown and white shrimp in Mississippi and adjacent areas.

Penaeus spp. - Palemonetes pugio Relationships

<u>Palemonetes pugio</u> was a noticeable resident in the Brazoria county ponds. During 1973, specimens of this small shrimp were collected by field staff when they happened to be in the sein at

the time of sampling. Six samples of <u>P</u>. <u>pugio</u> were collected in this manner. The purpose of the examination of <u>Palemonetes pugio</u> was to obtain information on interspecies occurrence of ectocommensals and parasites. The isopod, <u>Probopyrus pandalicola</u> was noted on 6 of 11 <u>P</u>. <u>pugio</u> that were examined. That this parasite was found exclusively on <u>P</u>. <u>pugio</u> and not on any of the <u>Penaeus</u> spp. lends strength to the idea that <u>P</u>. <u>pandalicola</u> has <u>Palemonetes</u> spp. as preferred hosts. Statements concerning other parasites or ectocommensals would be premature because of the limited data.

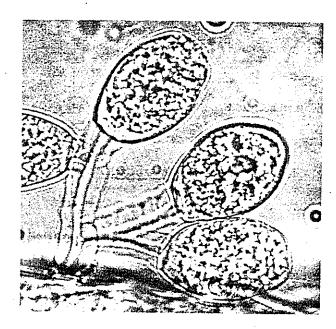
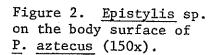
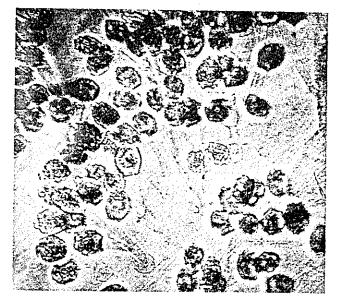


Figure 1. Zoothamnium sp. on a gill of P. aztecus (600x).





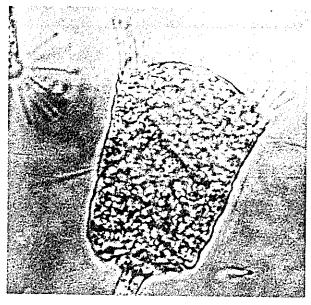


Figure 3. Acineta sp. on the body surface of P. van-namei (600x).

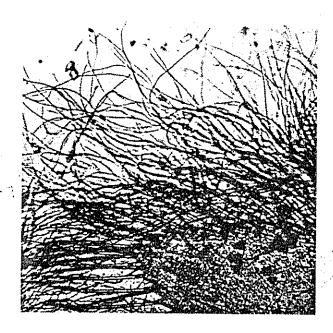
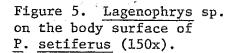
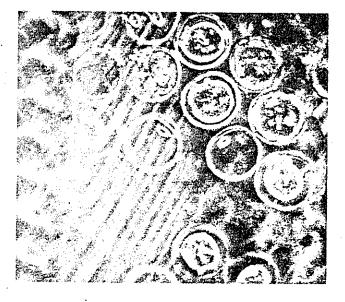


Figure 4. Filamentous bacteria on a pleopod of P. vannamei (60x).





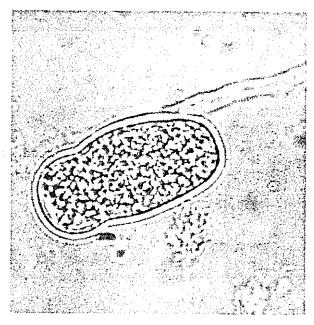


Figure 6. <u>Nematopsis peneai</u> Sprague from the intestine of <u>P. aztecus</u> (600x).

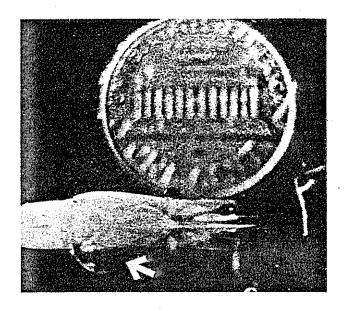
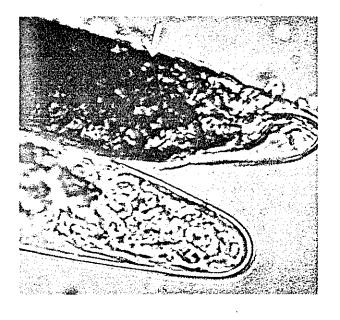


Figure 7. Probopyrus pandalicola (Packard) in the gill chamber of Palemonetes pugio.

Figure 8. Brownishblack discoloration of the gills of P. vannamei (600x).



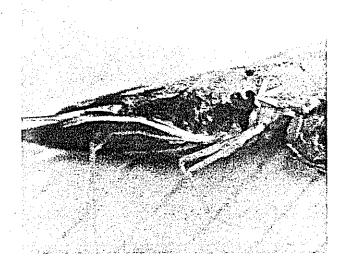


Figure 9. Advanced discoloration on the gills of P. vannamei.

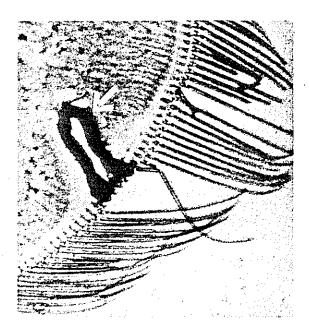


Figure 10. Apparent action of chitinoclastic bacteria on a uropod of P. vannamei