NEW RECORDS OF ELLOBIOPSIDAE (PROTISTA (*INCERTAE SEDIS*)) FROM THE NORTH PACIFIC WITH A DESCRIPTION OF *THALASSOMYCES ALBATROSSI* N.SP., A PARASITE OF THE MYSID *STILOMYSIS MAJOR*

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ABSTRACT

Ten species of ellobiopsids are currently known to occur in the North Pacific Ocean—three on mysids and seven on other crustaceans. *Thalassomyces boschmai* parasitizes mysids of genera *Acanthomysis, Neomysis,* and *Meterythrops* from the coastal waters of Alaska, British Columbia, and Washington. *Thalassomyces albatrossi* n.sp. is described as a parasite of *Stilomysis major* from Korea. *Thalassomyces fasciatus* parasitizes the pelagic mysids *Gnathophausia ingens* and *G. gracilis* from Baja California and southern California. *Thalassomyces marsupii* parasitizes the hyperiid amphipods *Parathemisto pacifica* and *P. libellula* and the lysianassid amphipod *Cyphocaris challengeri* in the northeastern Pacific. *Thalassomyces fagei* parasitizes euphausiids of the genera *Euphausia* and *Thysanoessa* in the northeastern Pacific from the southern Chukchi Sea to southern California, and occurs off the coast of Japan in the western Pacific. *Thalassomyces capillosus* parasitizes the decapod shrimp *Pasiphaea pacifica* in the northeastern Pacific from Alaska to Oregon, while *Thalassomyces californiensis* parasitizes *Pasiphaea emarginata* from central California. An eighth species of *Thalassomyces* parasitizing pasiphaeid shrimp from Baja California remains undescribed. *Ellobiopsis chattoni* parasitizes the calanoid copepods *Metridia longa* and *Pseudocalanus minutus* in the coastal waters of southeastern Alaska. *Ellobiocystis caridarum* is found frequently on the mouth parts of *Pasiphaea pacifica* from southeastern Alaska. An epibiont closely resembling *Ellobiocystis caridarum* has been found on the benthic gammarid amphipod *Rhachotropis helleri* from Auke Bay, Alaska. Where sufficient data are available, notes on variability, seasonal occurrence, and effects on the hosts are presented for each species of ellobiopsid.

The family Ellobiopsidae (Protista (*incertae sedis*)) is a heterogeneous group of parasites and epibionts found on various crustaceans (mostly planktonic) and on the benthic polychaete worm *Nephthys ciliata* Müller. The Ellobiopsidae have been classified at various times as protistans, colorless algae, fungi, or protozoans. The recent work of Galt and Whisler (1970) suggests including the parasitic ellobiopsids among the dinoflagellates.

The parasitic ellobiopsids are multinucleate protistans with reproductive structures outside the host and absorptive portions inside. The reproductive structures often resemble a large mold; consequently, much of the descriptive terminology of ellobiopsids is mycological. The reproductive parts of an ellobiopsid (Figure 1) consist of a short primary stalk passing from the organ of fixation through the cuticle of the host and one or more trophomeres which branch from the primary stalk. The trophomeres in turn bear one or more gonomeres at their distal end.

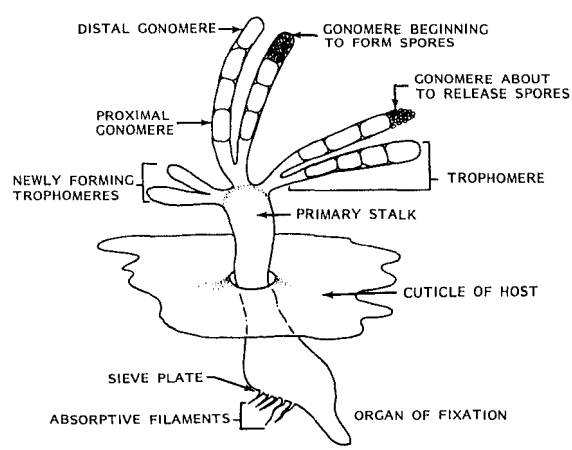

FIGURE 1.—Schematic of an ellobiopsid (*Thalassomyces* sp.)

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The mature distal gonomeres further subdivide to produce motile biflagellate spores (Galt and Whisler 1970).

The internal portion of a parasitic ellobiopsid, the organ of fixation, may be compact (like a bulb or taproot—Figure 1) or may be branching (rhizomorphous). The compact forms bear ridged sieve plates from which extend fine protoplasmic filaments. These filaments are believed to absorb nutrients from the host. The internal portions are difficult to observe without staining and sectioning techniques and have not been used much for taxonomic purposes.

The nonparasitic epibionts of the genus *Ellobiocystis* Coutiere do not have an internal organ of fixation but attach directly to the host's cuticle. These epibionts superficially resemble single trophomeres of the parasitic ellobiopsids but usually have a single gonomere. They are small and attached singly or in clusters to the mouth parts of various shrimps, mysids, and amphipods. Only the morphology of the *Ellobiocystis* spp. has been described. The inclusion of *Ellobiocystis* spp. in the Ellobiopsidae is very questionable.

Other than their morphology, little is known about the ellobiopsids of the genus *Thalassomyces* or their effects on hosts. The development of reproductive spores has been described (Galt and Whisler 1970); however, the mode of infection, time required to mature, and true incidence of infection remain subjects of speculation. Some of the parasitic ellobiopsids sterilize the hosts and probably exert some control on the molting cycle of crustacean hosts. Undoubtedly, the parasites draw heavily on the metabolic resources of the hosts, which conceivably would increase mortality and decrease reproduction in the host populations.

Ellobiopsids were first recognized as a component of the northeastern Pacific fauna when McCauley (1962) recorded *Thalassomyces capillosus* (Fage) as a parasite of the shrimp *Pasiphaea pacifica* Rathbun. Since then eight additional ellobiopsids have been recognized in zooplankton collections from the eastern North Pacific. Only two species of ellobiopsids have been reported from the western North Pacific. In the following discussions for each species, I summarize observations, some new and some from the literature, on the occurrence and hosts of the North Pacific ellobiopsids. I list synonymies only for references to material from the North Pacific. For convenience only, I have treated those ellobiopsids found on mysids first and those found on amphipods, euphausiids, shrimp, and copepods second.

ARTIFICIAL KEY TO ELLOBIOPSIDS FOUND ON MYSIDS

The published keys to the ellobiopsids (Kane 1964; Collard 1966) do not give complete coverage to the ellobiopsids found on mysids. Kane's key is restricted to genera of ellobiopsids, and Collard's key covers only 9 of the 11 known species of *Thalassomyces*. Identification of the known species of *Ellobiocystis,* and *Ellobiopsis* and most *Thalassomyces* is possible by reference to the summaries by Boschma (1949, 1957, 1959). The following key supplements Collard's but treats only the ellobiopsids found on mysids. Two of the species, *T. nouveli* (Hoenigman 1954) and *T. niezabitowskii* (Hoenigman 1960), are known only from the Mediterranean Sea; and *Ellobiocystis caridarum* (Coutiere) while not known from North Pacific mysids is found on Antarctic mysids (Boschma 1949, 1959) and has been found on the North Pacific decapod shrimp *Pasiphaea pacifica.*

1. No root system of attachment to host; attached to oral appendages. Mature parasite consists of single trophomere with one or more gonomeres . . . . . *Ellobiocystis caridarum* (Coutiere)
   Root system of attachment to host; not attached to oral appendages. Mature parasite with many trophomeres branching from stalk(s) . . *Thalassomyces* (2)
2. Parasite attached to ventral surface of first abdominal segment. Long pendulous umbellate trophomeres; usually only one gonomere per trophomere (length of mature gonomere 1.5 to over 2 times the diameter) . . . *T. fasciatus* (Fage)
   Site of attachment usually dorsal thoracic, but variable. Trophomeres not pendulous; usually more than one gonomere per trophomere (2-4) . . . . . (3)
3. Mature gonomeres flattened spheres. Mean length-diameter ratio less than 1 . . . . . *T. nouveli* (Hoenigman)
   Mature gonomeres globular to oval. Mean length-diameter ratio greater than 1 . . . . (4)

4. Primary stalks widely spaced when more than one per host. Mature gonomere length-diameter ratio 0.7-1.9 (mean about 1.2) .....(5)
   Primary stalks closely spaced when more than one per host. Mature gonomere length-diameter ratio 1.5-2.4 (mean about 2) .....*T. albatrossi* n.sp.
5. Mature terminal gonomere shape ellipsoid, with the distal end the same size as the proximal end, to spherical ....*T. boschmai* (Nouvel)
   Mature terminal gonomere shape ovoid, with the distal end smaller than the proximal end, to spherical ....*T. niezabitowskii* (Hoenigman)

ELLOBIOPSIDS OF NORTH PACIFIC MYSIDS

Thalassomyces boschmai (Nouvel 1954)

Thalassomyces sp.—Wing (1965), Hoffman and Yancey (1966), Thorne (1968).
Thalassomyces boschmai—Galt and Whisler (1970), Vader (1973b).

Ellobiopsids of the genus *Thalassomyces* have been observed on Mysidae from Alaska (Wing 1965; Hoffman and Yancey 1966); from Puget Sound (Thorne 1968); and from southern British Columbia (J. Galt, Friday Harbor Laboratory, University of Washington, Friday Harbor, WA 98250, pers. commun.). New collections of Alaska mysids (Table 1) plus supplementary material from Puget Sound enabled me to identify these ellobiopsids as *T. boschmai.*

Characteristics of *T. boschmai*

The identification of *Thalassomyces* spp. parasitizing mysids is based on external portions so variable that for definitive identifications, several characters must be examined. The external characters used to identify a species are the total size or height of the parasite, length of trophomeres, number of trophomeres per primary stalk, number of gonomeres per trophomere, and size and shape of gonomeres. The number of primary stalks and the site of attachment are also useful characteristics. Differences between specimens from different localities may be associated with local races and may to some extent be phenotypically associated with the host species.

TABLE 1.—Records of *Thalassomyces boschmai* found on mysids in Alaska, 1963-67.

Area, collection number, and species of host	Number of mysids with *T. boschmai*	Number of *T. boschmai*
Little Port Walter[1]		
AB66-243		
Acanthomysis pseudomacropsis	4	4
Neomysis kadiakensis	70+	80+
AB66-244		
Acanthomysis pseudomacropsis	2	2
Neomysis kadiakensis	9+	23+
Auke Bay[2]		
AB65-108		
Acanthomysis pseudomacropsis	8	8
Neomysis kadiakensis	8	10+
Katlian Bay[3]		
AB67-45		
Acanthomysis pseudomacropsis	1	1
AB67-46		
Meterythrops robusta	2	2
Kachemak Bay[4]		
Acanthomysis pseudomacropsis	3	6

[1]Taken in light-baited trap; lat. 56°23'N, long. 134°39'W; 7-8 September 1966.
[2]Taken in light-baited trap; lat. 58°21'N, long. 134°40'W; 24 June 1964.
[3]Taken in Isaacs-Kidd mid-water trawl; lat. 57°10'N, long. 135°21'W; 21 April 1967.
[4]Collection of Hoffman and Yancey (1966); lat. 59°27'N, long. 151° 33'W; October, December 1963 and February 1964. No collection number because material was lost.

The height of the North Pacific *T. boschmai* ranges from 0.75 to 1.70 mm; most of the specimens are between 1.30 and 1.50 mm. The maximum height is larger than the 1.25 mm given by Hoenigman (1954) for *T. boschmai* found on *Leptomysis gracilis* G. O. Sars, but in the Pacific, host mysids are much longer than the Mediterranean *Leptomysis* (13 mm). *Neomysis kadiakensis* Ortman are often over 20 mm long. Boschma (1959) noted a positive relationship between the size of the host and the size of the parasite *T. fagei* (Boschma) on euphausiids.

Mature trophomeres constitute most of the external mass of an ellobiopsid parasite. Within a parasite, the lengths of the trophomeres appear uniform, but they vary greatly between parasites. Lengths of trophomeres from 18 parasites found on *Acanthomysis pseudomacropsis* (Tattersall) and *N. kadiakensis* were from 0.72 to 1.32 mm. Because gonomeres are lost during sporulation, old trophomeres are generally 0.3 to 0.7 mm shorter than those that still have three or four gonomeres.

The number of trophomeres per primary stalk depends on the state of development and the condition of preservation. Dichotomous branching close to the point where the trophomeres

join the primary stalk makes it difficult to determine the number of trophomeres in a dense tuft, or the number that may be developing, or those that may have been lost. Counts of trophomeres on 21 *T. boschmai* from southeastern Alaska ranged from 13 to 46 (mean 28.6). Hoffman and Yancey (1966) examined six parasites which had 7 to 20 trophomeres each. Nouvel and Hoenigman (1955) found a maximum of 32 (mode 16) trophomeres for 21 Mediterranean *T. boschmai* from Cabo do Palos, Spain.

The number of gonomeres on a mature trophomere of *T. boschmai* is usually three, rarely four. Trophomeres having no gonomeres or up to two are immature, damaged, or are degenerating after sporulation. Degenerating trophomeres may be recognized by the small rudiments of protoplasm left after sporulation (Nouvel and Hoenigman 1955).

The size and shape of the gonomeres, especially the distal gonomere (Figure 1), are used as taxonomic characters, but most descriptions give little information on the variability of gonomere characters. I measured gonomere lengths and diameters and computed length-diameter ratios for 10 *T. boschmai* from each of two sites in southeastern Alaska and one in Puget Sound for comparison with data from central Alaska (Hoffman and Yancey 1966) and the western Mediterranean (Nouvel and Hoenigman 1955) (Table 2). The ranges of lengths and diameters were greater in specimens from southeastern Alaska and Puget Sound than in those from central Alaska or the Mediterranean, although the mean sizes were similar. A weighted *t*-test (Ostle 1963) confirmed (95% level) that ellobiopsids from different host species of mysids but within the same collection belong to the same statistical population; that is, all the ellobiopsids within each collection may be considered as one species. Tests for significant differences between means indicated that *T. boschmai* from the three collections were from different populations, but the broad overlap of gonomere size ranges, especially the length-diameter ratios (Figure 2), makes specific distinction unwarranted.

Occasionally an ellobiopsid will form more than one primary stalk by internal budding. This produces two or more stalks which separately penetrate the host's cuticle. The stalks are usually less than 1 mm apart. Budding described for *T. boschmai* and *T. nouveli* in the Mediterranean (Hoenigman 1954) is rare in the North Pacific *T. boschmai*. I examined 130 ellobiopsids from the North Pacific and found only one instance of apparent budding—a *T. boschmai* on an *A. pseudomacropsis* from Katlian Bay, Alaska.

On mysids, *T. boschmai* usually occur either on the dorsal surface of the host's carapace or on the last thoracic segment, although some are found on the dorsal, lateral, or ventral surface of the abdomen. In contrast, the most frequent sites of attachment on *L. gracilis* are the frontal plaque and rostral areas (Hoenigman 1954; Nouvel 1954; Nouvel and Hoenigman 1955).

Less than 10% of the parasitized mysids I examined had more than one *T. boschmai*. In one case a mysid had four ellobiopsids, and another mysid bore scars from four ellobiopsids. Hoenigman (1954) observed one *L. gracilis* with seven *T. boschmai*. When two or more ellobiopsids occur on a mysid, they usually are widely separated; one ellobiopsid may be on the thorax and the other(s) may be on various parts of the abdomen or rostrum. Two of the three hosts described by Hoffman and Yancey (1966) had both ellobiopsids on the carapace; in the third, the second ellobiopsid was on the abdomen.

Observations of Living *T. boschmai*

Collard (1966), Vader and Kane (1968), and Galt and Whisler (1970) have described living *Thalassomyces* spp. I briefly observed three living *T. boschmai* on *A. pseudomacropsis* from the first Auke Bay collection (AB65-108). In the live *T. boschmai*, the external portions were transparent and colorless except for a slight yellow tint at the base of the primary stalk. Perhaps the tinting is caused by the same melanic pigment deposited by the host at the margin of the pore through the host's cuticle. Deposition of pigments at the site of injury or parasitism is a frequent occurrence among crustaceans. The parasites stand out from the host's carapace, which gives the appearance of a flexible cluster of grapes that twist and turn slightly as the host swims. The live ellobiopsids I observed had about 40 trophomeres each with one to four gonomeres per trophomere. Many distal gonomeres were pebbled as described by Collard (1966) and Galt and Whisler (1970). I observed that some gonomeres had the amorphous drop of protoplasm described by Collard, but I did not find the

TABLE 2.—Ranges, means, and 0.95 confidence intervals (CI) of means for lengths, diameters, and length-diameter ratios of terminal gonomeres of *Thalassomyces boschmai* parasitizing mysids in collections from the western Mediterranean, Washington, southeastern Alaska, and central Alaska.

Host mysid and number of gonomeres measured		Length (mm)			Diameter (mm)			Ratio length to diameter		
		Range	Mean	0.95CI	Range	Mean	0.95CI	Range	Mean	0.95CI
					Western Mediterranean (Cabo do Palos, Spain)					
Leptomysis gracilis[1]										
8		0.240-0.300	0.258		0.205-0.240	0.228		1.00-1.46	1.14	
7		0.155-0.185	0.172		0.150-0.170	0.158		1.00-1.17	1.09	
Total	—	0.155-0.300	—	—	0.135-0.250	—	—	—	—	—
					Washington (Puget Sound)					
Neomysis kadiakensis										
1		—	0.208		—	0.250		—	0.83	
5		0.24-0.27	0.251		0.19-0.24	0.223		0.96-1.44	1.14	
7		0.21-0.26	0.232		0.16-0.22	0.180		1.04-1.44	1.31	
4		0.30-0.36	0.319		0.26-0.28	0.269		1.12-1.35	1.19	
5		0.32-0.36	0.339		0.27-0.30	0.282		1.09-1.33	1.21	
4		0.24-0.28	0.251		0.18-0.24	0.200		1.20-1.33	1.26	
3		0.23-0.26	0.239		0.22-0.24	0.231		0.96-1.10	1.03	
4		0.30-0.33	0.305		0.24-0.29	0.260		0.98-1.22	1.14	
3		0.25-0.28	0.262		0.18-0.20	0.193		1.32-1.40	1.36	
1		—	0.305		—	0.190		—	1.61	
Total	37	0.21-0.36	0.273	±0.014	0.18-0.30	0.228	±0.014	0.96-1.61	1.22	±0.06
					Southeastern Alaska (Little Port Walter)					
Acanthomysis pseudomacropsis										
10		0.19-0.22	0.198		0.17-0.22	0.198		0.94-1.00	1.00	
Neomysis kadiakensis										
10		0.24-0.29	0.263		0.20-0.26	0.223		1.00-1.41	1.18	
10		0.22-0.25	0.235		0.19-0.24	0.224		0.90-1.25	1.05	
10		0.22-0.29	0.259		0.22-0.26	0.236		0.90-1.25	1.10	
10		0.29-0.34	0.314		0.26-0.31	0.295		1.00-1.17	1.06	
10		0.24-0.38	0.298		0.24-0.34	0.287		0.71-1.17	1.04	
10		0.22-0.26	0.242		0.19-0.23	0.210		1.00-1.25	1.15	
10		0.31-0.41	0.350		0.24-0.29	0.275		1.08-1.42	1.28	
10		0.26-0.36	0.278		0.24-0.31	0.241		1.00-1.44	1.15	
10		0.19-0.24	0.214		0.19-0.24	0.206		0.90-1.12	1.03	
10		0.19-0.26	0.226		0.19-0.24	0.204		1.00-1.25	1.11	
10		0.22-0.29	0.247		0.17-0.22	0.197		1.00-1.67	1.26	
Total	120	0.19-0.41	0.260	±0.012	0.17-0.34	0.233	±0.009	0.71-1.67	1.10	±0.04
					Southeastern Alaska (Auke Bay)					
Acanthomysis pseudomacropsis										
11		0.15-0.31	0.205		0.13-0.23	0.168		0.79-1.71	1.23	
11		0.17-0.28	0.228		0.14-0.18	0.156		1.21-1.87	1.46	
13		0.24-0.32	0.291		0.18-0.28	0.230		1.08-1.39	1.27	
10		0.13-0.17	0.157		0.14-0.16	0.150		0.86-1.14	1.04	
10		0.24-0.38	0.319		0.22-0.31	0.261		0.84-1.73	1.24	
10		0.27-0.29	0.282		0.18-0.24	0.212		1.21-1.56	1.34	
5		0.27-0.30	0.280		0.17-0.29	0.202		0.96-1.70	1.44	
Neomysis kadiakensis										
10		0.20-0.25	0.231		0.15-0.23	0.173		1.08-1.39	1.25	
Total	80	0.13-0.38	0.230	±0.019	0.13-0.31	0.181	±0.014	0.79-1.87	1.28	±0.05
					Central Alaska (Kasitsna Bay)					
Acanthomysis pseudomacropsis[2]										
—		—	—	—	0.14-0.21	0.17	—	—	—	—

[1]Data from Nouvel and Hoenigman (1955). The authors gave the total length and diameter ranges shown but did not give the total number of gonomeres used to figure these ranges.
[2]Data from Hoffman and Yancey (1966).

gonomeres of *T. boschmai* to be adherent as Collard found for *T. californiensis* Collard.

Effect of Host

Adult and juvenile mysids are parasitized by *T. boschmai*. I made no histological studies of sterilization, but in the 130 parasitized mysids examined, no brooding females occurred and reduced oostegites were common. Sterilization may not always result, for Nouvel and Hoenigman (1955) found a brooding female *L. gracilis* parasitized by *T. boschmai*. Because the length of time for development of the parasite or the eggs of the mysids is not known, the specimen observed by Nouvel and Hoenigman may have deposited her eggs before being parasitized. The parasite must also affect the host's molting and growth because

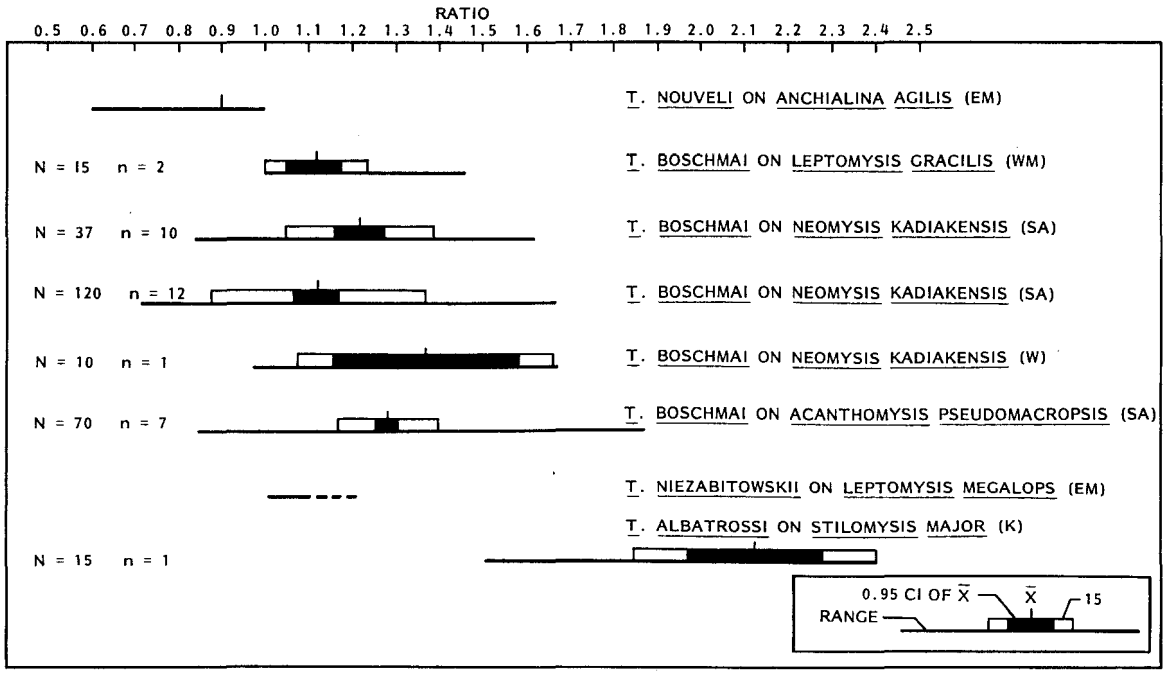

FIGURE 2.—Length-diameter ratios of *Thalassomyces* found on Mysidae from the eastern Mediterranean (EM), western Mediterranean (WM), Washington (W), southeastern Alaska (SA), and Korea (K). The horizontal line represents the sample range, the vertical line the sample mean; the black rectangle represents the 0.95 confidence limits of the mean, and the distance from the mean line to the edge of the white rectangle represents 1 standard deviation; N = number of gonomeres measured and n = number of parasites (the numbers are unknown for *T. nouveli* and *T. niezabitowskii*).

the external portions of the parasite could hardly be retained during a molt. The control over molting could be by starvation as postulated by Wickstead (1963) or by disturbance of the host's neuroendocrine system as postulated by Hoffman and Yancey (1966). The close association of other *Thalassomyces* with the nervous system (Boschma 1959; Kane 1964; Collard 1966) or the gonadal areas (Einarsson 1945; Boschma 1959) suggests some hormonal control over growth, molting, and maturation of the host.

The behavior of the parasitized mysids is not noticeably affected. The swimming speed and maneuverability of parasitized and nonparasitized mysids appear to be the same; flexing and twisting of the ellobiopsids as they are dragged through the water apparently do not affect the host.

Hosts of *T. boschmai*

This species has been recorded as a parasite of *L. gracilis* and *Gastrosaccus lobatus* (Nouvel) in the Mediterranean Sea (Nouvel 1954; Hoenigman 1954, 1960, 1963; Nouvel and Hoenigman 1955). Five mysids are known as hosts of *T. boschmai* in the eastern North Pacific. In Puget Sound, *Acanthomysis macropsis* (Tattersall), *A. nephrophthalma* Banner, and *N. kadiakensis* are hosts (Thorne 1968). In Alaska, *A. pseudomacropsis* (Wing 1965, Hoffman and Yancey 1966), *N. kadiakensis* (Wing 1965), and *Meterythrops robusta* S. I. Smith have been observed parasitized by *T. boschmai*. *Meterythrops robusta* is a new host record.

Seasonal Occurrence

Thorne (1968) reported a seasonal pattern of incidence of infection by mysids (the percentage of *N. kadiakensis* with ellobiopsids) by *T. boschmai* at Port Orchard, Puget Sound, Wash. The incidence of infection at Port Orchard was low in the winter and spring (1 to 8% of adults, 1 to 21.5% of immatures) and rose in the late summer to a maximum in October (17% of adults, 35% of immatures). A seasonal pattern of infestation is not clear in the Alaska material. Although the

number of infected hosts and the proportion of hosts with more than one parasite were greatest in the late summer, this may be an artifact of sampling methods. Long-term sampling with plankton nets at Auke Bay and Little Port Walter has not captured parasitized mysids and generally has not taken large numbers of mysids. The light-baited trap is exceptionally effective in capturing mysids but has been used only in summer. Although no quantitative data are available for the Auke Bay sample (AB65-108—Table 1), it contained several thousand mysids. The two Little Port Walter collections contained about 9,000 and 7,000 mysids respectively (Table 3).

Thalassomyces albatrossi n.sp.

?*Amallocystis fasciatus*—Tattersall (1951), Boschma (1959).
Thalassomyces fasciatus—Collard (1966).
Thalassomyces n.sp.—Vader (1973b).

Type location:[2] *Albatross* stn. 4867, lat. 36° 31'N, long. 129°46'E; depth 150 fathoms; 1 August 1906. USNM 82439.

Holotype: One slide with several gonomeres and trophomeres separated and mounted whole. Remainder left on the host. Host: *Stilomysis major* Tattersall, female, 26 mm long; carapace length, 7.9 mm.

Paratype: Immature, bearing two tufts or stalks of trophomeres, intact on host. Host: *S. major*, female, from USNM 81268.

Location: *Albatross* stn. 4862, lat. 36°20'N, long. 129°50'E; depth 184 fathoms; 31 July 1906.

Disposition of types: Holotype and paratype deposited in Division of Crustacea, Smithsonian Institution, U.S. National Museum, Washington, D.C., as Type USNM 24366 and USNM 24367.

[2]The locale on the original collection labels is Cape Clonard, Japan. Political changes since 1906 have resulted in name changes, the area now being referable to near Yonghae, South Korea.

Specific Diagnosis

The external portion of the parasite is visible as one to four tufts of trophomeres located mid-dorsally on the host's thorax. In the mature parasite, each tuft contains up to 50 trophomeres, which arise by close dichotomous branching from the primary stalk. Trophomeres are 0.80 to 1.70 mm long. Each trophomere bears one to four gonomeres, usually three. Mature distal gonomeres are oval to elongate in shape—0.4 to 0.7 mm long and 0.25 to 0.35 mm in diameter. The length of the distal gonomere is 1.5 to 2.4 times the diameter. The penultimate and proximal gonomeres are usually shorter than the distal gonomere but have about the same diameter.

[Diagnosis Propria: Pars parasiti externa apparet unus ad quattuor racemi trophomerorum medio dorso in animalis thorace positi. In maturo parasito, unusquisque racemorum fert ad quinquaginta trophomera, quae in duas partes proximas ex stirpe principali dividuntur. Trophomera sunt 0.80 ad 1.70 mm longa. Unumquidque trophomerorum fert unum ad quattuor gonomera, plerumque tria. Matura gonomera distalia sunt conformatione ovata ad praelonga—0.4 ad 0.7 mm longa et 0.25 ad 0.35 mm per medium. Longitudo gonomeri distalis est 1.5 ad 2.4 eius gonomeri dimetientes. Gonomera paenultima et proximalia sunt plerumque breviora quam gonomera distali, sed sunt per medium fere eadem.]

This species differs most clearly from other closely related *Thalassomyces* (*T. boschmai*, *T. niezabitowskii*, and *T. nouveli*) found on mysids by having much longer terminal gonomeres (which exceed 0.4 mm), a more elongate shape of the gonomeres, and three or four tufts of

TABLE 3.—Species and number of mysids and incidence of *Thalassomyces boschmai* in two light-baited trap samples at Little Port Walter, 7-8 September 1966.

Species	AB66-243 (2-h set)		AB66-244 (7-h set)	
	Number of mysids caught	Number of mysids parasitized by *T. boschmai*	Number of mysids caught	Number of mysids parasitized by *T. boschmai*
Acanthomysis pseudomacropsis	1,680	4	4,960	2
Acanthomysis sp.	1,600	0	290	0
Neomysis kadiakensis	5,630	70+	1,160	9+
Mysis litoralis	<20	0	740	0
Total	8,930	74+	7,150	11+

trophomeres rather than one or two per parasite. It differs from *T. fasciatus* by being attached to the dorsum of the host's thorax rather than the ventral abdomen, by bearing multiple gonomeres on each trophomere rather than one or rarely two, and by having much shorter lengths of the trophomeres (not including the gonomeres —about half that of *T. fasciatus*).

Description of Holotype

Externally, the holotype consists of three tufts of trophomeres attached to the dorsal carapace (Figure 3). The prior existence of a fourth tuft is indicated by a scar on the host's carapace. Dense packing of the trophomeres and the apparent loss of some by breakage during preservation and handling made it impossible to determine the exact number of trophomeres in each tuft. Examination at 40× magnification indicated the following approximate numbers: 45 in the left anterior tuft, 20 in the left posterior tuft, and 35 in the right posterior tuft. The trophomeres branch dichotomously close to the primary stalk, which gives an appearance of many trophomeres arising directly from the primary stalk. The trophomeres are of various lengths—0.8 to 1.7 mm. Each trophomere (Figure 4a, b) is composed of a short basal portion and one to three gonomeres, usually three. A few trophomeres appear to have lost a fourth gonomere.

The gonomeres (Figure 4) vary in shape from oval to elongate; a few distal gonomeres are small and cone shaped. The penultimate and proximal gonomeres vary considerably in length but are of similar diameter to the normal distal gonomeres (0.25 to 0.32 mm). The dimensions of 15 distal gonomeres (measured in situ) are summarized in Table 4.

The host specimen, which was preserved in ethyl alcohol, was partially dehydrated, brittle, and broken at the third and fourth thoracic

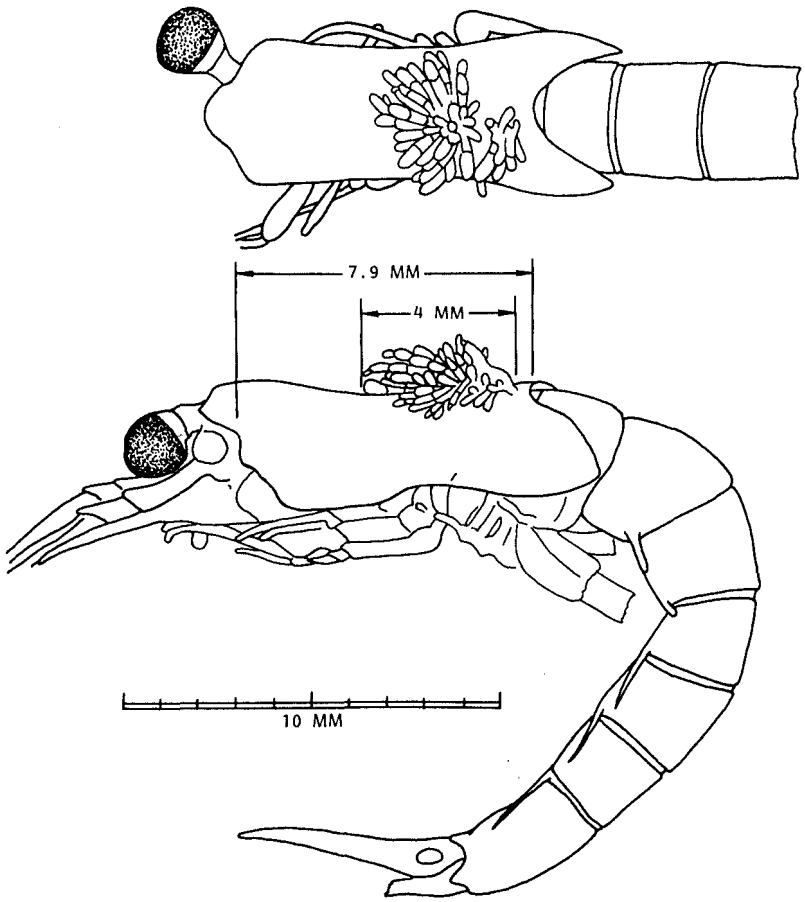

FIGURE 3.—Holotype of *Thalassomyces albatrossi* n.sp. on *Stilomysis major*. A. Lateral view. B. Dorsal view.

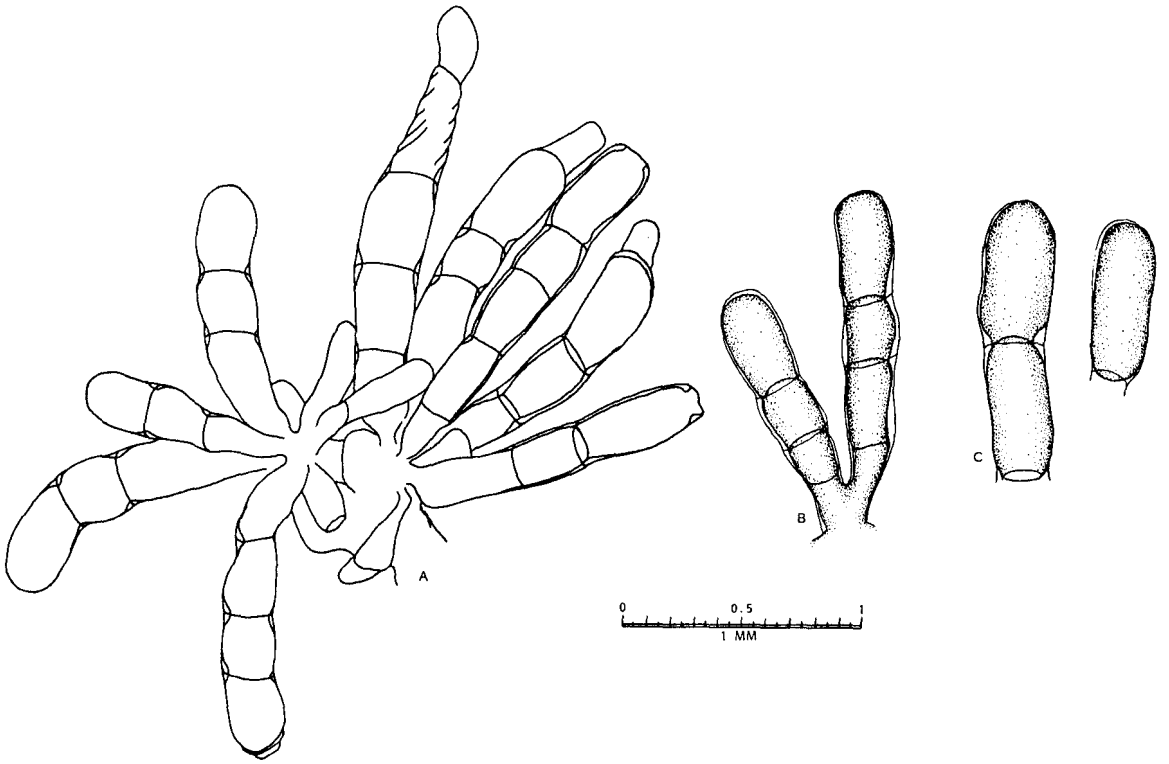

FIGURE 4.—Holotype of *Thalassomyces albatrossi* n.sp. A. Cluster of trophomeres. B. Pair of trophomeres, each bearing three gonomeres. C. Separate gonomeres.

TABLE 4.—Dimensions of 15 distal gonomeres from holotype of *Thalassomyces albatrossi* n.sp.

Dimension	Range (mm)	Mean (mm)	SD	0.95 CI of mean
Length	0.41-0.68	0.57	0.07	0.04
Diameter	0.25-0.32	0.27	0.03	0.01
Length-diameter ratio	1.5-2.4	2.1	0.3	0.15

segments—the site of attachment to the ellobiopsid. Histological studies were not done because of this damage. Each of the three primary stalks passes through the carapace of the host. Just inside the carapace there is a connection between the left pair of stalks. A similar connection between the right stalk and the left anterior stalk is indicated by a torn piece of an ellobiopsid projecting from the right stalk toward the left anterior stalk. Below the connection between the left pair of stalks is a small (about 1.5 mm long) elongate conical organ of absorption (fixation), which appears to have passed through or between the ovaries of the host. The organ is similar to that figured for *T. nouveli* by Hoenigman (1954).

Description of Paratype

The paratype is an immature ellobiopsid consisting of two primary stalks which pass through the carapace of the host. None of the trophomeres bear more than two gonomeres; several of them have no gonomeres and appear to have been damaged in handling or by drying after preservation. Because of the withered state of the specimen, no accurate measurements of either the trophomeres or the gonomeres can be made. The gonomeres on one of the stalks are, however, thinner than those on the other. No sporulating gonomeres are present.

Specimens Examined

In the discussion that followed his description of *S. major*, Tattersall (1951) states that two specimens were parasitized by an ellobiopsid resembling *T. fasciatus* (Fage). Subsequent authors accepted this tentative identification by Tattersall, but my examination of the ellobiopsids from his material revealed only *T.*

albatrossi. I have examined 15 *S. major* from three of Tattersall's collections. Two of the collections (USNM 82439—2 *S. major*, and USNM 81268—10 *S. major*) contained the holotype and paratype respectively of *T. albatrossi*. In the third collection (USNM 82440—three *S. major; Albatross* stn. 4861; lat. 36°19'N, long. 129°47'E; 163 fathoms; 31 July 1906) I found a female *S. major* bearing four scars from an ellobiopsid.

Effect on the Host

The mysid specimens bearing the type and paratype ellobiopsids were females of mature size but with reduced oostegites. This apparent sterilization agrees with observations of Fage (1941), Einarsson (1945), and Nouvel (1941), who noted that ellobiopsids sterilize their hosts. A scarred mature female *S. major* in USNM 82440 was brooding young but appeared to have been parasitized earlier by an ellobiopsid. The scars consisted of holes in the carapace, probably caused by the primary stalks of the parasite. Each of the four holes had a heavy deposit of pigment at the margin that was surrounded by a clear area. Thus, it appears that the sterilization by ellobiopsids may be temporary, as suggested by Wickstead (1963), or it may be influenced by the age of the host at the time of infection.

Distribution

The new species has been reported only from the eastern coast of Korea, the type locality of the parasite and its host.

Derivation of Name

The specific name *albatrossi* is selected to honor the U.S. steamer *Albatross*, the vessel from which the parasitized mysids were collected. The many biological collections made from the *Albatross* during 39 yr of service to the U.S. Fisheries Commission and later to the U.S. Bureau of Fisheries have been of immeasurable value in the investigation of life in the oceans.

Thalassomyces fasciatus (Fage 1936)

Amallocystis fasciatus—Pequegnat (1965).
Thalassomyces fasciatus—Vader (1973b).

Thalassomyces fasciatus is a large species known to parasitize only lophogastrid mysids of the genus *Gnathophausia*. Pequegnat (1965) found it on *G. ingens* (Dohrn) and *G. gracilis* Willemoes-Suhm off central Baja California. It has also been collected in the Santa Cruz Basin off California (S.B. Collard, Marine Environmental Sciences Consortium, Dauphin Island, AL 36528, pers. commun.). Boschma (1959) recorded this ellobiopsid on *G. gigas* Willemoes-Suhm from Spain; on *G. ingens* from Morocco, the Lesser Antilles, and the Maldive Islands; and on *G. zoea* Willemoes-Suhm from Portugal, Guiana, the Fiji Islands, and New Zealand.

Thalassomyces fasciatus attaches to the ventral surface of the first abdominal somite of the host. The gonomeres are oval and about twice as long as wide (0.4 by 0.2 mm), and normally, there is only one gonomere per trophomere (Boschma 1959). The trophomeres are long (1.5 mm total length) and joined in groups of five or six to the primary stalk (Fage 1941). In these aspects *T. fasciatus* differs from the *T. albatrossi* n.sp. found on *S. major* by Tattersall (1951), which were erroneously believed to be *T. fasciatus* by Boschma (1959) and Collard (1966). The size of the gonomeres and total length of trophomeres (including the gonomeres) in the two species are similar, although my specimens of *T. albatrossi* have a greater number of gonomeres per trophomere than *T. fasciatus* and therefore do not appear to be as long and pendulate.

ADDITIONAL RECORDS OF NORTH PACIFIC ELLOBIOPSIDS

Besides the three species of *Thalassomyces* found on mysids, seven other ellobiopsids have been found on crustaceans in the North Pacific. The following sections summarize current knowledge about the hosts and distribution of these seven ellobiopsids.

Thalassomyces marsupii Kane 1964

Thalassomyces marsupii—Galt and Whisler (1970), Vader (1973b).

Thalassomyces marsupii is found inside the marsupium of host amphipods. The mature parasites resemble compact egg masses. Usually the whitish spherical gonomeres are smaller than the

eggs of the host species. An infected amphipod carries one, rarely two, parasites. The mature parasites may completely fill the marsupium of small amphipods and occasionally protrude beyond the marsupium of an immature host. In large or heavily pigmented amphipods, *T. marsupii* is easily overlooked unless specifically searched for. On male amphipods, *T. marsupii* are more easily noticed although they are often obscured by the thoracic legs and coxal plates of the host.

Thalassomyces marsupii parasitizes both pelagic and benthic amphipods and appears to have a worldwide distribution. The recorded pelagic hosts are hyperiids of the genus *Parathemisto: P. gaudichaudii* (Guerin) in the North Atlantic, Benguela Current, and Southern Ocean (Kane 1964); *P. abyssorum* Boeck in the North Atlantic (Vader and Kane 1968) and Arctic (Tencati and Geiger 1968); *P. gracilipes* Norman in the North Sea (R. A. McHardy, Department of Oceanography, The University, Southampton, England, pers. commun.); and *P. pacifica* Stebbing in Puget Sound (Galt and Whisler 1970). A similar parasite has been observed on *Cystisoma* sp., a hyperiid, in the North Pacific (T. H. Bowman, Division of Crustacea, Smithsonian Institution, U.S. National Museum, Washington, DC 20560, pers. commun.). The recorded epibenthic gammarid hosts of *T. marsupii* are: *Eusirus leptocarpus* G. O. Sars, *E. longipes* Boeck, *Rhachotropis aculeata* (Lepechin), *R. macropus* G. O. Sars, and *R. helleri* Boeck, all family Eusiridae, from several North Atlantic locales (Vader and Kane 1968).

I have observed *T. marsupii* on three species of amphipods in southeastern Alaska: the hyperiids *Parathemisto pacifica* and *P. libellula* (Lichtenstein) and the pelagic gammarid *Cyphocaris challengeri* Stebbing (family Lysianissidae). *Parathemisto libellula* and *C. challengeri* are new host records as well as geographic range extensions for *T. marsupii*. The parasitized amphipods were collected with a 1.8-m Isaacs-Kidd mid-water trawl by the Bureau of Commercial Fisheries (now the National Marine Fisheries Service) in Lynn Canal and Chatham Strait. The sampling program continued from March 1964 to February 1967; each year eight stations (Figure 5) were sampled quarterly at depths of 15 and 100 m. Beginning with the August 1965 samples, I kept records of the occurrence of *T. marsupii* on

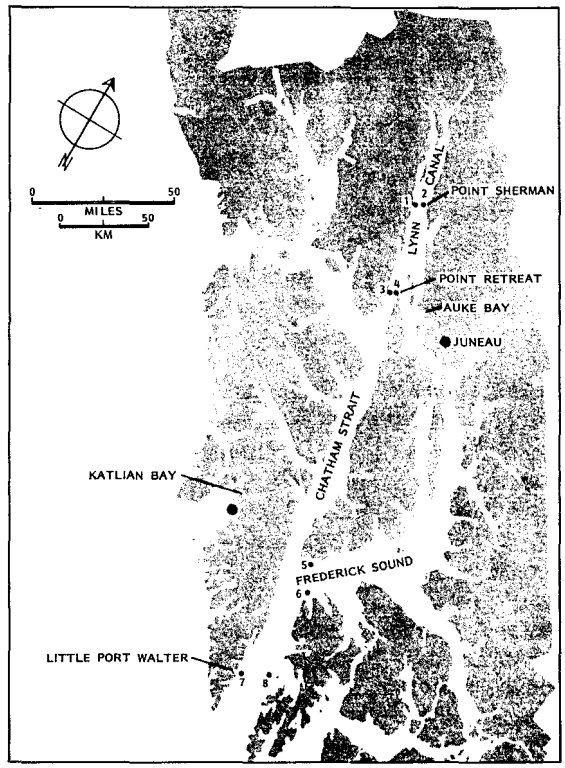

FIGURE 5.—Locations in southeastern Alaska where ellobiopsids were collected.

Alaska amphipods. The parasitized amphipods were found mostly in the 15-m samples. *Cyphocaris challengeri* was the most frequent host, and the highest incidence of parasitism occurred in the August samples (Table 5).

The internal portions of the parasite were not examined, but the external morphology, size, and site of attachment correspond closely to Kane's original description. Most of the specimens I examined were forming gonomeres. A few gonomeres had begun cleavage to form spores. The sporulating gonomeres were not as deeply sculptured nor as dark as those described by Kane (1964).

Thalassomyces fagei (Boschma 1948)

Thalassomyces fagei—Hoffman and Yancey (1966), Komaki (1970), Vader (1973b).

The euphausiid *Thysanoessa raschii* (M. Sars) is the most common host of *Thalassomyces fagei* in Alaska waters. I have examined parasitized

TABLE 5.—Occurrence of *Thalassomyces marsupii* on three species of amphipods taken in quarterly sampling with a 1.8-m Isaacs-Kidd mid-water trawl (August 1965 to February 1967) in southeastern Alaska.

Cruise date and station number	*Cyphocaris challengeri*		*Parathemisto libellula*		*Parathemisto pacifica*	
	Number collected	Number parasitized	Number collected	Number parasitized	Number collected	Number parasitized
August 1965						
1	107	3	80	0	4	0
2	176	5	89	0	3	0
3	10	1	4,144	0	9	0
4	228	3	494	0	40	0
5	62	3	3	0	4	0
6	43	2	0	—	4	0
7	20	3	6	0	3	0
8	44	3	13	0	2	0
November 1965						
8	19	1	1	0	2	0
February 1966						
8	124	1	0	—	0	—
September 1966						
1	2	0	465	1	0	—
2	0	—	1,350	10	0	—
3	0	—	60	3	15	0
4	<50	1	130	5	18	1
5	272	0	43	0	12	1
6	1,346	12	382	0	159	0
February 1967						
6	21	1	6	0	0	—

specimens collected in sampling by the National Marine Fisheries Service (NMFS) in southeastern Alaska, south-central Alaska, the eastern Bering Sea, and the southeastern Chukchi Sea. Hoffman and Yancey (1966), who reported that *T. fagei* parasitized *Thysanoessa raschii* in Kachemak Bay, south-central Alaska, followed the development of external portions of the ellobiopsids from April through June. Examination of euphausiids collected during 4 yr (1962-66) of plankton sampling by NMFS in southeastern Alaska indicates that the ellobiopsids are most evident during May. Maturing ellobiopsids are seen on *T. raschii* as early as April and occasionally as late as December. A similar pattern of occurrence was described by Mauchline (1966) for *Thalassomyces fagei* on euphausiids in the North Atlantic.

Euphausia pacifica Hansen is abundant in lower Chatham Strait, southeastern Alaska, but is rarely parasitized by *T. fagei*. *Euphausia pacifica* bears this ellobiopsid off southern California (S. B. Collard, Marine Environmental Sciences Consortium, Dauphin Island, AL 36528, pers. commun.). An unidentified *Thalassomyces* was found on *E. pacifica* and *Thysanoessa longipes* Brandt in British Columbia (T. H. Butler, Biological Laboratory, Fisheries Research Board of Canada, Nanaimo, B.C., pers. commun.). In view of the wide distribution (Jones 1964) and known occurrence on at least 19 species of euphausiids (Vader 1973b), the British Columbia *Thalassomyces* is probably *fagei*. Komaki (1970) records *T. fagei* parasitizing *E. similis* G. O. Sars from Suruga Bay, Japan and *Thysanoessa inermis* (Krøyer) from the Bering Sea.

Thalassomyces capillosus (Fage 1938)

Amallocystis capillosus—McCauley (1962).
Thalassomyces capillosus—Collard (1966), Hoffman and Yancey (1966), Vader (1973a, b).

Thalassomyces capillosus is a parasite of the pelagic shrimp *Pasiphaea pacifica* from Coos Bay, Oreg., (McCauley 1962) to Prince William Sound, Alaska (Hoffman and Yancey 1966). I found nearly 700 *T. capillosus* in varying stages of development the year-round on *Pasiphaea* collected with a 1.8-m Isaacs-Kidd trawl in Chatham Strait and Lynn Canal. They were most abundant during the late spring and early summer, when it was not unusual to find 5 to 10% of the *Pasiphaea* in a sample parasitized; in one sample (May 1965 at the southern end of Chatham Strait) 47 of 115 *Pasiphaea* were parasitized by *T. capillosus*. *Thalassomyces capillosus* is also common in British Columbia (T. H. Butler, Biological Laboratory, Fisheries Research Board of Canada, Nanaimo, B.C., pers. commun.). Although *T. capillosus* are common in the northeastern Pacific, Vader (1973a) records only about

100 specimens in literature published on Atlantic *Pasiphaea* spp.

This parasite apparently has both physiological and morphological effects on the host shrimp. As noted by Bergan (1953), male and female shrimp were both parasitized; none of the parasitized females were carrying eggs, which indicates that the parasite must have sterilized the host. Although Bergan (1953) found no evidence that the root system of the parasite penetrates the host's gonads, it is possible that the parasite controls the sexual development and molting processes of the host either by influencing hormone production (Hoffman and Yancey 1966) or by a starvation effect (Wickstead 1963). In addition to the effect on growth and reproduction, *T. capillosus* causes a characteristic upward deflection of the host's rostrum (Boschma 1959; McCauley 1962; Hoffman and Yancey 1966). It is not known whether the deformation of the rostrum occurs before or after the primary stalks break through the cuticle of the host. The ellobiopsid is frequently lost or degenerates, but the upturned rostrum remains as evidence of parasitism. It was primarily on the basis of the upturned rostrum that *Pasiphaea principalis* Sund was erroneously distinguished from *P. tarda* Krøyer (Boschma 1959).

Thalassomyces californiensis Collard 1966

Thalassomyces californiensis n.sp.—Collard (1966).

Thalassomyces californiensis—Vader (1973a, b).

Thalassomyces californiensis is a parasite of the shrimp *Pasiphaea emarginata* Rathbun off the coast of central California (Collard 1966). *Thalassomyces californiensis* superficially resembles *T. capillosus*, but the primary stalks penetrate the eye stalks of the host rather than the base of the rostrum. Five to 20 primary stalks may be associated with each organ of fixation (Collard 1966) rather than the one to four primary stalks found in *T. capillosus*. Collard did not find any major morphological or histological changes caused by this parasite.

Thalassomyces species (not identified)

Thalassomyces sp.—Collard (1966).

A third species of *Thalassomyces* infects *Pasiphaea chacei* Yaldwyn in southern Baja California but is unidentified. This parasite is found on the anterior part of the abdomen (R. Lavenberg, Los Angeles County Museum of Natural History, Los Angeles, CA 90007, pers. commun.).

Ellobiopsis chattoni Caullery 1910

Ellobiopsis chattoni—Hoffman and Yancey (1966).

Hoffman and Yancey (1966) reported *E. chattoni* as a parasite of the calanoid copepod *Metridia longa* (Lubbock) in Auke Bay, southeastern Alaska. During monthly sampling of the Auke Bay vicinity by the NMFS from August 1962 to January 1964, copepods parasitized by *E. chattoni* were found from late July through December; 5 to 25% of the *M. longa* were parasitized and peak infestation was in late October and early November. Hoffman and Yancey (1966) found only *M. longa* infected by *E. chattoni* despite the availability of other potential calanoid hosts—*Calanus finmarchicus* (Gunnerus), *Pseudocalanus minutus* (Krøyer), and *Acartia clausii* Giesbrecht. Wickstead (1963) noted a similar 100% host specificity of *E. chattoni* on *Undinula vulgaris* var. *major* Sewell in the Zanzibar Channel.

There may be a large seasonal and yearly variation in the rate of infection by ellobiopsids and perhaps even in the species of copepod infected. I sampled zooplankton monthly in Auke Bay and near Point Retreat (Figure 5) from September 1969 through October 1970. During this time, *E. chattoni* did not infect *M. longa* but did infect *P. minutus*; the level of infection was very low, however: one to six *P. minutus* were taken each month from the thousands of potential hosts examined, but no distinct seasonal trend of infection was evident.

Ellobiocystis caridarum (Coutiere 1911)

Sampling with the 1.8-m Isaacs-Kidd mid-water trawl in southeastern Alaska yielded many *Pasiphaea pacifica* (a pelagic shrimp) with the epibiont *E. caridarum* on their mouth parts. Boschma (1959) discussed the difficulties in identifying the various species of *Ellobiocystis*

described by Coutiere. Boschma also examined the question of including the genus *Ellobiocystis* within the family Ellobiopsidae and of including various epibionts described by With (1915), Monod (1926), and Sewell (1951) within the genus. I follow Boschma (1959) in considering the *Ellobiocystis* found on *P. pacifica* to belong to the collective species *E. caridarum* s.l. This constitutes the first record of *E. caridarum* s.l. outside of the Atlantic and Antarctic oceans.

Ellobiocystis caridarum attach as single trophomeres directly to the mouth parts of the host. There is no branching of the trophomeres, and no organs of adsorption penetrate the cuticle of the host. The trophomeres may occur singly or in small groups attached to the labia, mandibles, maxillae, or maxillipeds. Single trophomeres on the oral appendages are usually attached near the base of a seta, sometimes directly to a seta. When on the mandibles, the trophomeres are located between the teeth. Groups of trophomeres, each trophomere separately attached to the host's cuticle, may contain 12 or more individuals when on the labia but usually contain less than 8 when attached to the maxilla or maxillipeds. I have seen nearly 50 *E. caridarum* on a single *Pasiphaea*.

The size and form of *E. caridarum* s.l. found on *P. pacifica* in southeastern Alaska are as variable as the size and form figured by Boschma (1959) for the *E. caridarum* found on *P. semispinosa* Holthuis. The maximum observed length of trophomeres of Alaska specimens was 1.17 mm and of gonomeres was 0.54 mm; the maximum diameter of trophomeres was 0.56 mm and of gonomeres was 0.42 mm. The shapes of the gonomeres varied from ovals, slightly longer than wide, to rods eight times longer than wide. Each maturing trophomere carried one gonomere; less than 1% of the trophomeres had two or three gonomeres.

The incidence of *E. caridarum* s.l. on *P. pacifica* is not known, primarily because the epibiont is not readily noticeable in either the living or preserved state. When searched for, *E. caridarum* have been found on *P. pacifica* of a wide size range (30 to 80 mm total length) and during all months of the year. The proportion of the *P. pacifica* having *E. caridarum* varies but is usually less than 10%. In one exceptional sample (AB65-15, southern Chatham Strait, May 1965), 84% (263 of 314) were infested.

Ellobiocystis species?

Monod (1926) figured an epibiont found on the mouth parts of the Antarctic amphipod *Podocerus septemcarinatus* Shellenberg (= *Platophium hystricoides* Monod). This epibiont has been provisionally classified as *Ellobiocystis caridarum* by Boschma (1959). Vader and Kane (1968) reported a similar epibiont on the mouth parts of *Rhachotropis macropus* from western Norway. The taxonomic status of these epibionts still is uncertain (W. Vader, Zoologisk Avdeling, Tromsø Museum, Tromsø, Norway, pers. commun.).

I found small epibionts like those figured by Monod (1926) on the amphipod *R. helleri* from Auke Bay, Alaska. The small bean-shaped organisms (Figure 6) are attached to the labia, mandibles, and maxillipeds of the host by a short stalk. Lengths range from 0.10 to 0.13 mm. The separation of body and stalk is more distinct than in the *E. caridarum* figured by Boschma (1959) or than in material from *Pasiphaea pacifica* that I have seen. None of the epibionts on *R. helleri* are divided into gonomeres or spores. Although these epibionts superficially resemble early stages of developing *E. caridarum*, their proper identification remains in doubt.

SUMMARY

1. *Thalassomyces boschmai* is found on the mysids of the genera *Acanthomysis, Neomysis*, and *Meterythrops* in the northeastern Pacific.

2. *Thalassomyces albatrossi* n.sp. is described as a parasite of *Stilomysis major* from the western Pacific off Korea.

3. *Thalassomyces fasciatus* is found on *Gnathophausia ingens* and *G. gracilis* from Baja California and southern California.

4. *Thalassomyces marsupii* is found on the amphipods *Parathemisto pacifica, P. libellula*, and *Cyphocaris challengeri* from the inside coastal waters of southeastern Alaska and *P. pacifica* from Puget Sound.

5. *Thalassomyces fagei* has been found on the euphausiid *Thysanoessa raschii* from southeastern Alaska, the Bering Sea, and the Chukchi Sea and on *Euphausia pacifica* from California and southeastern Alaska.

6. *Thalassomyces capillosus* is common on the shrimp *Pasiphaea pacifica* in the coastal waters

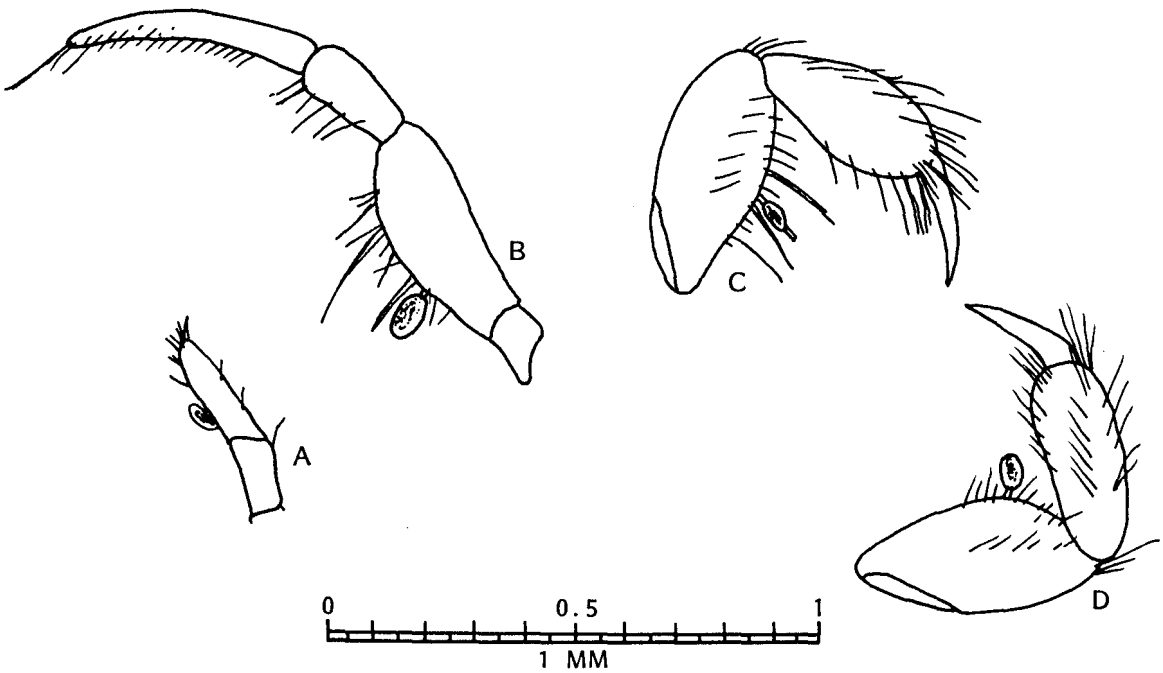

FIGURE 6.—*Ellobiocystis* sp.? on mouth parts of the amphipod *Rhachotropis helleri*. A. Palp of first maxilla. B. Mandibular palp. C. and D. Maxilliped palps.

of the northeastern Pacific during all seasons of the year.

7. *Thalassomyces californiensis* is found on *P. emarginata* from southern California.

8. *Ellobiopsis chattoni* is found on the copepod *Metridia longa* from Auke Bay, Alaska, from July through December; peak abundance is in late October and early November. *Pseudocalanus minutus* is also a host of *E. chattoni*.

9. *Ellobiocystis caridarum* is found in a wide variety of growth forms on *Pasiphaea pacifica* from southeastern Alaska during all seasons of the year. Incidence of infestation by *E. caridarum* may be as high as 84% of the *Pasiphaea*. This is the first report of *E. caridarum* from the North Pacific.

10. A small epibiont resembling *E. caridarum* has been found on the mouth parts of the amphipod *Rhachotropis helleri* from Auke Bay, Alaska.

11. Known North Pacific ellobiopsids, their hosts, and the geographical range of the ellobiopsids are summarized in Table 6.

ACKNOWLEDGMENTS

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LITERATURE CITED

BERGAN, P.
1953. A note on the ellobiopsid genus *Amallocystis* Fage. Univ. Bergen Arbok 1952, Naturvitensk Rekke 14, 19 p.

BOSCHMA, H.
1949. Ellobiopsidae. Discovery Rep. 25:281-314.
1957. Ellobiopsidae. Fich. Ident. Zooplankton 65, 4 p. Cons. Perm. Int. Explor. Mer.
1959. Ellobiopsidae from tropical West Africa. Atl. Rep. 5:145-175.

TABLE 6.—North Pacific ellobiopsids, known North Pacific range, and known North Pacific hosts.

Ellobiopsid	Known North Pacific range of ellobiopsid	Known North Pacific hosts
Thalassomyces albatrossi n.sp.	Eastern Korea	*Stilomysis major*
Thalassomyces boschmai	Puget Sound, Wash., to Kachemak Bay, Alaska	*Acanthomysis macropsis* *Acanthomysis pseudomacropsis* *Acanthomysis nephrophthalma* *Neomysis kadiakensis* *Meterythrops robusta*
Thalassomyces fasciatus	Southern Baja California to Santa Cruz Basin, Calif.	*Gnathophausia gracilis* *Gnathophausia ingens*
Thalassomyces capillosus	Southern Oregon to Prince William Sound, Alaska	*Pasiphaea pacifica*
Thalassomyces californiensis	Central California	*Pasiphaea emarginata*
Thalassomyces sp.	Baja California	*Pasiphaea chacei*
Thalassomyces fagei	Southern California to southeastern Chukchi Sea; Suruga Bay, Japan	*Euphausia pacifica* *Euphausia similis* *Thysanoessa inermis* *Thysanoessa longipes* *Thysanoessa raschii*
Thalassomyces marsupii	Puget Sound, Wash., to southeastern Alaska	*Parathemisto pacifica* *Parathemisto libellula* *Cyphocaris challengeri*
Ellobiopsis chattoni	Southeastern Alaska	*Metridia longa* *Pseudocalanus minutus*
Ellobiocystis caridarum	Southeastern Alaska	*Pasiphaea pacifica*
Ellobiocystis sp.	Southeastern Alaska	*Rhachotropis helleri*

COLLARD, S. B.
1966. *Thalassomyces californiensis* sp. n., a parasite of the nervous system of a shrimp, *Pasiphaea emarginata* Rathbun. K. Ned. Akad. Wet., Proc. Ser. C., Biol. Med. Sci. 69(1): 37-49.

EINARSSON, H.
1945. Euphausiacea. I. Northern Atlantic species. Dana Rep., Carlsberg Found. 27, 185 p.

FAGE, L.
1941. Mysidacea. Lophogastrida — I. Dana Rep., Carlsberg Found. 19, 52 p.

GALT, J. H., AND H. C. WHISLER.
1970. Differentiation of flagellated spores in *Thalassomyces* ellobiopsid parasite of marine Crustaceae. Arch. Mikrobiol. 71:295-303.

HOENIGMAN, J.
1954. Novosti s Področja Jadranskega Zooplanktona. (O najdbi elobiopsidov). [Fr. summ.] Biol. Vestn. 3:106-116.
1960. Faits nouveaux concernant les Mysidaces (*Crustacea*) et leurs epibiontes dans l'Adriatique. Rapp. P.-V. Réun. Comm. Int. Explor. Sci. Mer Mediterr. 15:339-343.
1963. *Mysidacea* de l'expédition "Hvar" (1948-1949) dans l'Adriatique. Rapp. P.-V. Réun. Comm. Int. Explor. Sci. Mer Mediterr. 17:603-616.

HOFFMAN, E. G., AND R. M. YANCEY.
1966. Ellobiopsidae of Alaskan coastal waters. Pac. Sci. 20:70-78.

JONES, L. T.
1964. A new host and location for the euphausiid parasite *Thalassomyces fagei* (Boschma) (Protozoa, Ellobiopsidae). Crustaceana 7:148-150.

KANE, J. E.
1964. *Thalassomyces marsupii*, a new species of ellobiopsid parasite on the hyperiid amphipod *Parathemisto gaudichaudii* (Guer.). N.Z. J. Sci. 7:289-303.

KOMAKI, Y.
1970. On the parasitic organisms in a krill, *Euphausia similis*, from Suruga Bay. J. Oceanogr. Soc. Jap. 26:283-295.

MAUCHLINE, J.
1966. *Thalassomyces fagei*, an ellobiopsid parasite of the euphausiid crustacean, *Thysanoessa raschi*. J. Mar. Biol. Assoc. U.K. 46:531-539.

MCCAULEY, J. E.
1962. Ellobiopsidae from the Pacific. Science (Wash., D.C.) 137:867-868.

MONOD, T.
1926. Tanaidacés, isopodes et amphipodes. Expedition Antarctique Belge, Resultats du Voyage de la Belgica en 1897-99, Rapports Scientifiques. Zoologie, Part 6, No. 36, p. 1-67.

NOUVEL, H.
1941. Sur les ellobiopsides des mysidacés provenant des Campagnes du Prince de Monaco. Bull. Inst. Oceanogr. (Monaco) 809, 8 p.
1953. Un Ellobiopsidae nouveau (*Amallocystis boschmai* n. sp.) parasite d'un Mysidacé en Méditerranée. Vie Milieu 4:57-58.

NOUVEL, H., AND J. HOENIGMAN.
1955. *Amallocystis boschmai* Nouvel 1954 ellobiopsidé parasite du mysidacé *Leptomysis gracilis* G. O. Sars. Res. Camp. Pr. Lacaze-Duthiers, vol. 2. Vie Milieu, Suppl. 6, p. 7-19.

OSTLE, B.
1963. Statistics in research. 2nd ed. Iowa State Univ. Press, Ames, 585 p.

PEQUEGNAT, L. H.
1965. The bathypelagic mysid *Gnathophausia* (Crustacea) and its distribution in the eastern Pacific Ocean. Pac. Sci. 19:399-421.

SEWELL, R. B. S.
1951. The epibionts and parasites of the planktonic Copepoda of the Arabian Sea. John Murray Expedition, 1933-34, Sci. Rep., Zool. Bot. 9:255-394.

TATTERSALL, W. M.
1951. A review of the Mysidacea of the United States National Museum. U.S. Natl. Mus., Bull. 201, 292 p.

TENCATI, J. R., AND S. R. GEIGER.
1968. Pelagic amphipods of the slope waters of northeast Greenland. J. Fish. Res. Board Can. 25:1637-1650.

THORNE, R. E.
1968. Diel variations in distributions and feeding behavior of Mysidacea in Puget Sound. M.S. Thesis, Univ. Washington, Seattle, 49 p.

VADER, W.
1973a. The oldest published record of a *Thalassomyces* species (Ellobiopsidae). Sarsia 52:171-174.
1973b. A bibliography of the Ellobiopsidae, 1959-1971, with a list of *Thalassomyces* species and their hosts. Sarsia 52:175-180.

VADER, W., AND J. E. KANE.
1968. New hosts and distribution records of *Thalassomyces marsupii* Kane, an ellobiopsid parasite on amphipods. Sarsia 33:13-20.

WICKSTEAD, J. H.
1963. A new record of *Ellobiopsis chattoni* (Flagellata incertae sedis) and its incidence in a population of *Undinula vulgaris* var. *major* (Crustacea Copepoda). Parasitology 53:293-296.

WING, B. L.
1965. A *Thalassomyces* sp. (Ellobiopsidae) infesting *Ancanthomysis pseudomacropsis* and *Neomysis kadiakensis* (Mysidacea) in southern Alaska. (Abstr.) *In* Ocean science and ocean engineering 1965. 1:295. Trans. Joint Conf. Exhib., Mar. Technol. Soc. and Am. Soc. Limnol. Oceanogr.

WITH, C.
1915. Copepoda. I. Calanoida Amphascandria. The Danish Ingolf Expedition 3(4):1-260.