Observations on the feedings habits of *Calliactis parasitica* (Couch, 1842), Anthozoa, Cnidaria

Sea anemones
Feeding habits
Associations
Aegean Sea

Anémone de mer
Habitudes nutritionnelles
Peuplements
Mer Égée

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ABSTRACT

Very little was known about the feeding habits of the actinian *Calliactis parasitica*, which almost exclusively lives on gastropod shells inhabited by anomuran crabs. Observations of behaviour in the field and the coelenteron contents of animals coming from two different ecological zones (infralittoral and circalittoral) in Thermaikos Gulf (North Aegean Sea) showed that *C. parasitica* is a non-selective omnivorous species which plays an important role in the benthic food web and its diet reflects the faunal composition in these two zones. Basically, this species is a suspension-feeder, although it can also remove food from the sediment by tactile tentacle motion. Complementary, occasional food sources are the remains of the prey of the associated anomurans.

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RÉSUMÉ

Observations sur les habitudes nutritionnelles de *Calliactis parasitica* (Couch, 1842; Anthozoa, Cnidaria)

Les habitudes nutritionnelles de l'actinie *Calliactis parasitica* étaient jusqu'à présent mal connues. Des observations du comportement *in situ* et du contenu de la cavité intestinale d'animaux provenant de deux zones écologiques différentes (infralittorale et circalittorale) du golfe de Thermaïkos (nord de la Mer Égée) ont démontré que *C. parasitica* est une espèce omnivore non sélective, qui joue un rôle important dans la chaîne alimentaire du benthos, et que son régime alimentaire représente la composition faunistique dans ces deux zones. En principe, cette espèce se nourrit des particules en suspension, bien qu'elle puisse extraire la nourriture du sédiment à l'aide des mouvements de ses tentacules. Pour compléter, elle se nourrit occasionnellement des restes des proies des anomures associées.

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INTRODUCTION

A review of relevant literature shows that comprehensive studies on the feeding habits of the sea anemones started essentially in the mid-seventies. Most of the information collected concerns species of the families Actiniidae and Metridiidae. Schlichter (1975 *a*; 1975 *b*; 1978) reported on the ability of *Anemonia sulcata* to ingest soluble organic substances from its aquatic environment, as part of its energetic needs. Steele and Goreau (1977) and Janssen and Möller (1981) discussed the importance of symbiotic zooxanthellae in the diet of the species *Phyllactis flosculifera* and *A. sulcata*. Ellehauge (1978) described the diet of

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the species *Edwardsia longicornis* and *E. danica* in Danish waters. Möller (1978) described the dietary composition of *A. sulcata*. Van Präet (1978; 1980; 1982; 1983) identified the amount of prey, particulate and dissolved organic matter, in the diet of *Actinia equina* while Zamponi (1980) described the feeding habits of the species *Bunodactis marplatensis* and *Phymactis clematis*. Sebens (1981) studied the allometric and energetic properties of body size in the species *Anthopleura elegantissima*, *A. xanthogrammica* and *Metridium senile*. Finally, Den Hartog (1986) demonstrated the ability of the sea anemone *Urticina eques* to feed on sizeable prey.

Calliactis parasitica is a sea anemone species usually associated with *Anomura decapoda*, having a wide geographical distribution (Schmidt, 1972). In spite of this, little information seems to exist on its feeding habits, other than those given by Ross and Sutton (1961), who observed that "almost all the freshly-trawled *Calliactis* at Plymouth regurgitated large numbers of tiny hermit-crabs in *Turritella* shells". Orton (1922 *a*; 1922 *b*) and Stachowitsch (1980) have observed that this sea anemone "sweeps" the substratum with its tentacles, possibly to adherence microorganisms, and Fedra *et al.* (1976) characterized this species as a suspension feeder.

The purpose of this study was: a) to give information on the feeding habits of the species *C. parasitica*, which is the most characteristic sea anemone among those living symbiotically with anomuran crustaceans; and b) to investigate possible differences in diet composition, among populations living in different depths, given that this species shows a wide vertical distribution (2-650 m, according to Arena and Greci, 1973).

The habitats and communities

Two populations of *C. parasitica* were studied; one from the infralittoral (3-20 m) and the other from the circalittoral zone (45-80 m) of Thermaikos Gulf (North Aegean Sea, Eastern Mediterranean Sea).

In the infralittoral zone, hard substratum and photophilic algae coexisted, as well as soft substratum with *Posidonia* meadows. The bottom sediment was mainly sand (Md = 120-1 800 μm), the organic carbon content of the sediment ranged from 0.7 to 1.2 % and the salinity of the water near the bottom from 30.5 to 33.5 (Chintiroglou, 1987).

In the circalittoral zone, the bottom sediment was silt or sandy silt with a variable amount of shell fragments. The median diameter of the sediment varied from 20 to 80 μm. The organic carbon content of the sediments varied between 0.35 and 2.33 %. The salinity of the water near the bottom was approximately 38.

Information concerning the composition of the fauna in the areas of hard substratum in the infralittoral zone (assemblage of soft photophilic algae) has been given by Koukouras *et al.* (1985) and Chintiroglou (1987). Among the numerous species reported from these complex assemblages, in which the crustaceans are more dominant than polychaetes, the following species are represented: the decapods *Pisidia bluteli*, *P. longimana* and *Sirpus zariquiey*, the polychaete *Polydora caeca*, the gastropod *Bittium reticulatum* and the bivalves *Mytilus galloprovincialis* and *Modiolus barbatus*. In the soft substratum of this area, an assemblage characterized by the presence of the bivalve *Chamelea gallina* was present. The faunal composition of this assemblage in comparable depths in Strymonikos Gulf has been described by Dounas (1986). Among the 159 species of this assemblage, in which the polychaetes prevail (54 %), are the anomurans *Diogenes pugilator* (showing the greatest frequency), and *Anapagurus laevis*, the bivalve *Spisula subtruncata*, the gastropod *Bittium reticulatum* and the polychaete *Polydora caeca*.

In the circalittoral zone, the associated benthic community was that of *Amphiura filiformis*, characterized primarily by the dominance of polychaetes and secondarily by the gastropod *Turritella communis* and the sipunculan *Aspidosiphon muelleri* (usually living inside the empty shells of *Turritella*; unpublished data of the authors). The faunal composition of this community in shallower depths of Thermaikos Gulf has been described by Zarkanellas and Kattoulas (1982). Dounas (1986) has also defined the composition of the same community in the neighbouring area of Strymonikos Gulf in depths of 40-56 m. According to the above authors, the dominant species in these assemblages, besides *A. filiformis* and *T. communis*, are the polychaetes *Sternaspis scutata*, *Terebellides stroemi*, *Nephthys hystricis*, *Tharynx marioni*, *T. heterochaeta*, *T. dorsobranchialis*, *Lubrineris latreilli* and *L. dorsobranchialis*. Of secondary importance in these assemblages, were the bivalves *Parvicardium minimum* and *Corbula gibba* and the decapods *Philoceras bispinosus*, *Galathea intermedia* and *Anapagurus laevis*.

MATERIALS AND METHODS

In this study, 336 sea anemones (*C. parasitica*) from Thermaikos Gulf were examined; 82 of these individuals were collected from substrates of the infralittoral zone by scuba diving, at depths between 3 and 20 m. The remaining 254 individuals were collected with trawls in soft substrates of the circalittoral zone, at depths between 45 and 80 m. During diving, notes were kept on the feeding behaviour of sea anemones as well as on that of the associated anomurans. A number of live individuals were transported to aquaria for further observations. Each sea anemone, from both depths, was detached from its host shell, immediately after its collection and kept in separate plastic bags. Later specimens were fixed in a 10 % formalin solution. All samples were collected in April during daytime.
In the laboratory, the content of each plastic bag was put through a sieve (0.5 mm), in order to collect the food

remains that were possibly regurgitated. Afterwards, the coelenteron of each individual was opened and the food remains were collected under a stereoscopic microscope. Food remains were identified to lowest taxonomic levels depending on their condition.

The results of the analysis of the gastrovascular cavity contents are given separately for each of the two zones, in order to determine possible differences in the composition of the anemone diet, related to the habitat.

To analyze the data of coelenteron contents, the method described by Deniel (1975) was used. According to this method, which has been often used in fish (Deniel, 1975, *etc.*) and cuttlefish studies (Le Mao, 1985), the following parameters were calculated:

Vacuity coefficient (V); $V = Ev.100/N$
Frequency index of prey (f); $f = n/N$
Percentage of prey (Cn); $Cn = n'.100/Np$
where:
Ev = the number of empty gastral cavities
N = the total number of gastral cavities examined
n = the number of gastral cavities containing a certain prey
n' = the total number of individuals of a certain prey
Np = the total number of prey items.

The percentage of various prey items (Cn) can be distinguished as preferential (Cn > 50 %), secondary (10 % < Cn < 50 %) and accidental (Cn < 10 %).

The percentages of the vacuity coefficients and those of the main food items, among the two zones, were compared by a t-test.

RESULTS

Observations made in the field and in aquaria showed that the *C. parasitica* anemones, which were attached to gastropod shells, very often twist their bodies 110-145° (according to their position on the shell), so that their entire, expanded, oral disk becomes almost parallel to the substratum allowing their tentacles to touch the substratum. The anomurans living inside the gastropod shells to which anemones were attached, were moving actively, both in the field and in the laboratory, stirring the sediment with their mouth parts and their claws. When they captured their food and tore it into pieces, very often some food particles came into contact with the tentacles of the anemone and were consumed by it.

Specimens of *C. parasitica* (1 to 6 individuals), were found to be attached to shells of various gastropods and, in one case, to the shell of the bivalve *Ostrea edulis* Linnaeus. In the case of a *Phyllonotus* (= *Murex*) *trunculus* (Linnaeus) shell, which was inhabited by a *Paguristes eremita* (Linnaeus) anomuran, at a depth of 15 m, 12 individuals of equal size were settled. The wet weight (after fixation) of the *P. eremita* anomuran was 27.5 g, that of the shell 69.5 g (length 92 mm) and that of the anemones 196.8 g. In other words, the anomuran carried a total weight of 293.8 g (outside the water), which is about 10 times its own weight. Some of the gastropod shells were empty, while two of them were live gastropods of the species *Bolinus* (= *Murex*) *brandaris* (Linnaeus). In other cases, shells were inhabited by the anomurans *P. eremita* and *Pagurus excavatus* (Herbst). The gastropod species whose shells were used as substrate by *C. parasitica* individuals, as well as the percentages for each case, are given in Table 1. The fact that some individuals (21.8 %) were found to be attached to empty gastropod shells, may be, at least partly, attributed to the abandonment of these shells by the anomurans during trawling. This suggestion is strengthened by the fact that during collections made by scuba diving, no empty shells with *C. parasitica* were found. In summary, 83 % of the specimens collected from the infralittoral zone were settled on shells of the gastropod *P. trunculus* inhabited by the anomuran *P. eremita*, while 96 % of those collected from the circalittoral zone were found on shells of *Cassidaria* (= *Galeodea*) *echinophora*

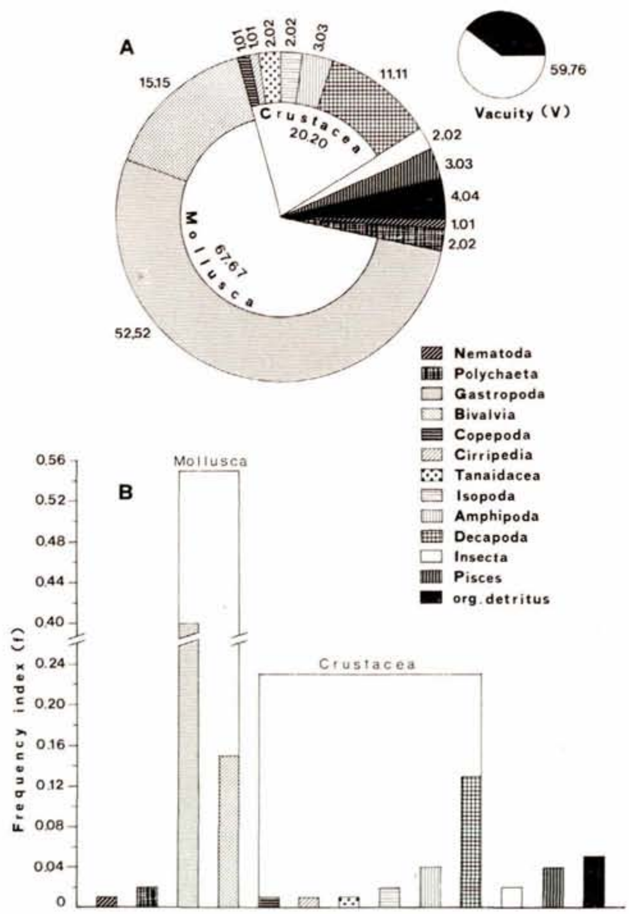

Figure 1

Composition of Calliactis parasitica *diet in the infralittoral zone. A, percentage of different taxa (Cn) and vacuity coefficient (V); B, frequency indices (f).*

Table 1

The various types of substrate (shells) to which one or more individuals of Calliactis parasitica *were found attached. In the last column the percentages for each category are given. I: found at depths 3-20 m (infralittoral zone). C: found at depths 45-80 m (circalittoral zone).*

	Substratum		Species inhabiting the shell	Percentage	
GASTROPOD SHELLS	Empty	*Cassidaria echinopohora* (C) *Bollinus brandaris* (C) *Phyllonotus trunculus* (I)		21.80	
	Inhabited by anomurans	*Gibbula philberti* *Phyllonotus trunculus*	*Paguristes eremita* (I)	27.56	76.3
		Cassidaria echinophora *Bolinus brandaris* *Hadriana craticulata*	*Pagarus excavatus* (C)	48.72	
	Live gastropods		*Bolinus brandaris* (C)	1.28	
BIVALVE SHELLS			*Ostrea edulis* (I)	0.64	

(Linnaeus) inhabited by the anomuran *P. excavatus*.

Of the coelenteron contents of 82 individuals collected from the infralittoral zone, 33 were found to contain food remains (V = 59.76 %). The 99 food remains found correspond to 43 prey organisms given in Table 2. As can be seen from Table 2 and Figure 1, none of these prey organisms can be characterized as prefered, since Cn is lower than 50 %. However, two of them, the gastropod *Apicularia lia* (Monterosato) and the bivalve *Mytilus galloprovincialis* Lamarck, can be characterized as secondary prey (Cn = 11.11 %). All the remaining prey organisms should be characterized as accidental prey (Cn < 10 %). More generally, in the infralittoral zone, dominant prey organisms were the molluscs with approximately 68 % (gastropods 53 %, bivalves 15 %) and the crustaceans with a percentage of 20.20 (decapods 11.11 %). Ten of the species included in Table 2, are among the most common inhabitants of the infralittoral studied in Thermaikos Gulf (*see* text: The communities).

From the circalittoral zone, the coelenteron contents of 254 individuals were examined, 137 of which contained food remains (V = 46.25 %). A large number (563) of food remains were found representing 67 prey organisms (Tab. 3). No prey organism can be characterized as prefered (Tab. 3, Fig. 2). The gastropod *Turritella communis* Risso, and the mysid *Syriella* sp. can be considered as secondary prey (Cn = 30.91 % and 21.51 % respectively). The remaining prey organisms are characterized as accidental. As a result, individuals from the circalittoral zone also use, as a main food source, molluscs which represent 53 % (gastropods 46 %, bivalves 6 %) of their diet and crustaceans which represent approximately 38 % (mysids 22 %, decapods 6 %). Six of the species included in Table 3, are among the most common inhabitants of the infralittoral part investigated in Thermaikos Gulf *(see* text: The communities).

Comparison of the qualitative composition of the anemone diet in the infralittoral zone to that in the circalittoral zone (Tab. 2, 3; Fig. 3), shows great differences. More precisely, out of the 110 prey organisms found in both cases there are only 6 species in common (3 gastropods: *Hinia pygmaea*, *Kleinella* sp., *Cerithiopsis* sp. and 3 decapods: *Anapagurus laevis*, *Liocarcinus depurator*, *L. pusillus*), which, however, are abundant in both zones.

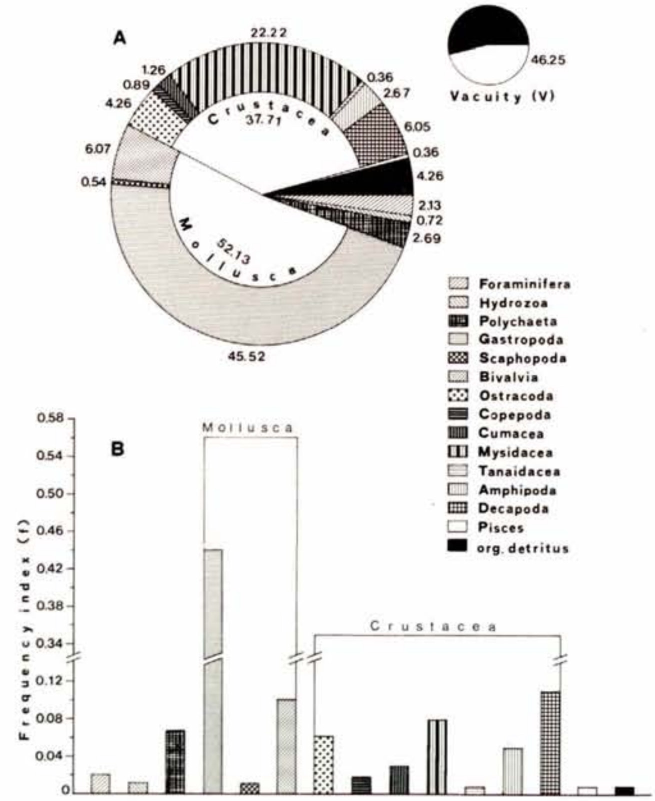

Figure 2

Composition of Calliactis parasitica *diet in the circalittoral zone. A, percentages of different taxa (Cn) and vacuity coefficient (V); B, frequency indicies (f).*

The t-test applied on the vacuity coefficients, and the preya groups molluscs, crustaceans and polychaetes of the two zones showed that: the two vacuity coefficients (infralittoral = 59.76 %, circalittoral = 46.25 %) are significantly different ($t = 2.16$, $n_1 = 82$, $n_2 = 254$). There were also significant differences in the percentages of crustacean ($t = 3.41$, $n_1 = 82$, $n_2 = 254$) and mollusc prey ($t = 2.91$, $n_1 = 82$, $n_2 = 254$) among the two areas. On the contrary, the percentages of polychaete prey were not statistically different ($t = 0.378$, $n_1 = 82$, $n_2 = 254$).

DISCUSSION

The symbiosis of *C. parasitica*, with certain anomurans living inside the gastropod shell on which the former is settled, has been previously reported (Klunzinger, 1877; Andres, 1884; Orton, 1922 *a*; 1922 *b*; Stephenson, 1935; Rabaud, 1937; *etc.*). The number of individuals of this sea anemone that can be attached to a single shell inhabited by an anomuran varies usually between 1 and 6, according to

Table 2

Coelenteron content analysis of 33 Calliactis parasitica *from the infralittoral zone (abbreviations are given in materials and methods).*

			n'	n	f	Cn
NEMATODA			1	1	0.01	1.01
POLYCHAETA		*Polydora caeca*	1	1	0.01	1.01
		Didrupa sp.	1	1	0.01	1.01
MOLLUSCA	Gastropoda	*Gibbula adriatica*	3	1	0.01	3.03
		Putilla sp.	2	1	0.01	2.02
		Turbona cimicoides	1	1	0.01	1.01
		Apicularia lia	11	7	0.09	11.11
		Turboella parva	2	2	0.02	2.02
		Bittium reticulatum	8	5	0.06	8.08
		Bittium sp.	2	1	0.01	2.02
		Cerithiopsis sp.	1	1	0.01	1.01
		Epitonium sp.	1	1	0.01	1.01
		Kleinella sp.	3	2	0.02	3.03
		Turbonilla rufa	1	1	0.01	1.01
		Thaididae	1	1	0.01	1.01
		Cyclope donovani	6	1	0.01	6.06
		Hinia pygmae	2	2	0.02	2.02
		Mangelia sp.	1	1	0.01	1.01
		various, unidentified	7	5	0.06	7.07
	Bivalvia	*Modiolus barbatus*	1	1	0.01	1.01
		Mytilus galloprovincialis	11	8	0.10	11.11
		Spisula subtruncata	1	1	0.01	1.01
		various, unidentified	2	2	0.02	2.02
CRUSTACEA	Copepoda		1	1	0.01	1.01
	Cirripedia	*Balanus* sp.	1	1	0.01	1.01
	Tanaidacea	*Tanais* sp.	2	1	0.01	2.02
	Isopoda	*Cymodoce* sp.	1	1	0.01	1.01
		Dynamene sp.	1	1	0.01	1.01
	Amphipoda	*Synchelidium* sp.	1	1	0.01	1.01
		Caprellidae	1	1	0.01	1.01
		unidentified	1	1	0.01	1.01
	Decapoda	*Diogenes pugilator*	3	3	0.04	3.03
		Anapagurus laevis	1	1	0.01	1.01
		Pisidia bluteli	1	1	0.01	1.01
		Pisidia longimans	1	1	0.01	1.01
		Pirimela denticulata	1	1	0.01	1.01
		Sirpus zariquieyi	1	1	0.01	1.01
		Liocarcinus depurator	1	1	0.01	1.01
		Liocarcinus pusillus	1	1	0.01	1.01
		unidentified	1	1	0.01	1.01
INSECTA			2	2	0.02	2.02
PISCES			3	3	0.04	3.03
Organic detritus			4	4	0.05	4.04

Table 3

Coelenteron content analysis of 137 Calliactis parasitica *individuals from the circalittoral zone (abbreviations are given in material and methods).*

			n'	n	f	Cn
FORAMINIFERA			12	6	0.023	2.13
HYDROZOA		*Eudendrium* sp.	1	1	0.004	0.18
		Plumularia sp.	1	1	0.004	0.18
		Laomedea sp.	1	1	0.004	0.18
		unidentified	1	1	0.004	0.18
POLYCHAETA		*Neoleanira tetragona*	1	1	0.004	0.18
		Ophiodromus sp.	1	1	0.004	0.18
		Syllidae	1	1	0.004	0.18
		Cirriformia sp.	1	1	0.004	0.18
		Cirratulidae	1	1	0.004	0.18
		Sabellides sp.	1	1	0.004	0.18
		Terebellidae	1	1	0.004	0.18
		Hydroides norvegica	1	1	0.004	0.18
		Serpulidae	1	1	0.004	0.18
		Spirorbidae	1	1	0.004	0.18
		various, unidentified	5	5	0.019	0.89
MOLLUSCA	Gastropoda	*Turritella communis*	174	60	0.024	30.91
		Cerithiopsis sp.	1	1	0.004	0.18
		Opalia sp.	1	1	0.004	0.18
		Kleinella sp.	1	1	0.004	0.18
		Odostomia novegradensis	2	2	0.008	0.36
		Odostomia rissoides	1	1	0.004	0.18
		Tornidae	1	1	0.004	0.18
		Naticidae	1	1	0.004	0.18
		Hinia pygmaea	5	5	0.019	0.89
		Hinia sp.	1	1	0.004	0.18
		Mitridae	3	2	0.008	0.53
		Mangelia rugulosa	3	3	0.012	0.53
		Mangelia sp. (2)	1	1	0.004	0.18
		various unidentified	17	11	0.043	3.04
	Bivalvia	*Hyalopecten similis*	2	1	0.004	0.36
		Parvicardium minimum	7	6	0.024	1.24
		Parvicardium sp.	1	1	0.004	0.18
		Tellina fabula	1	1	0.004	0.18
		Abra sp.	1	1	0.004	0.18
		Cultellus adriaticus	1	1	0.004	0.18
		Corbula gibba	16	13	0.051	2.86
		various unidentified	5	3	0.012	0.89
	Scaphopoda	*Dentalium* sp.	2	2	0.008	0.36
		unidentified	1	1	0.004	0.18
CRUSTACEA	Ostracoda		24	16	0.062	4.26
	Copepoda		5	5	0.019	0.89
	Cumacea	*Diastylis* sp.	1	1	0.004	0.18
		Diastylidae	1	1	0.004	0.18
		Cumopsis sp.	2	2	0.008	0.36
		Bodotriidae	1	1	0.004	0.18
		various, unidentified	3	2	0.008	0.36
	Mysidacea	*Syriella* sp.	121	15	0.059	21.51
		various, unidentified	4	4	0.016	0.71
	Tanaidacea		2	2	0.008	0.36
	Amphipoda	*Perrierella* sp.	3	3	0.012	0.53
		Monoculodes sp.	5	4	0.016	0.89
		Eusirus sp.	1	1	0.004	0.18
		Caprella sp.	1	1	0.004	0.18
		various, unidentified	5	9	0.012	0.89
	Decapoda	*Philocheras bispinosus*	7	5	0.019	1.24
		Galathea intermedia	1	1	0.004	0.18
		Pagurus anachoretus	1	1	0.004	0.18
		Anapagurus laevis	9	9	0.035	1.60
		Anapagurus bicormiger	2	2	0.008	0.36
		Liocarcinus depurator	6	3	0.012	1.06
		Liocarcinus pusillus	1	1	0.004	0.18
		larvae	2	2	0.008	0.36
		various, unidentified	5	4	0.016	0.89
PISCES			2	2	0.008	0.36
Organic detritus			24	24	0.094	4.26

the relative literature. In Thermaikos Gulf, in which 12 equal sized individuals of *C. parasitica* were attached to a single shell inhabited by the anomuran *P. eremita*, was exceptional, although Klunzinger (1877) gives a figure showing eight individuals on one shell.

Several anomuran species have been reported living associated with *C. parasitica*, among which the most common are *Paguristes eremita, Dardanus arrosor, Pagurus alatus, P. bernhardus* and *P. cuanensis*. The number of gastropod shell species reported to be inhabited by these anomurans is much larger. The most commonly reported are *Phyllonotus trunculus, Bolinus brandaris* and *Astraea rugosa*. As mentioned above, in the infralittoral zone of Thermaikos Gulf, 83 % of the collected *Calliactis parasitica* were settled on shells of the gastropod *P. trunculus* inhabited by the anomuran *P. eremita*, while 96 % of those collected in the circalittoral zone were settled on shells of the gastropod *C. echinophora* inhabited by the anomuran *P. excavatus*. The difference observed between the two areas should be attributed to the fact that although *C. parasitica* has a wide vertical distribution (Schmidt, 1972, *etc.*), the species pair *P. eremita-P. trunculus* is vertically restricted to the infralittoral zone while the pair *P. excavatus-C. echinophora* to the circalittoral zone. As far as anomurans are concerned, it is known that they usually select suitable (optimal shape and size) gastropod shells among empty ones available in their habitat, on which *C. parasitica* will subsequently settle.

Researchers who studied the symbiosis of *C. parasitica* with certain anomurans (Ross and Sutton, 1961; Ross, 1967; 1974; Stachowitsch, 1979; 1980) have suggested that this anemone is a "suspension" feeder which takes advantage of the anomurans mobility covering up to 20 m per day. This movement stirs up the sediment and induces water movement (Stachowitsch, 1979). Our observations confirm this. Ross and Sutton (1961) have observed that *Calliactis* was not well placed on the shell of gastropods to participate in the crab's food, and that, even in aquaria, such a behaviour was seldom observed. On the contrary, we often observed (both in aquaria and *in situ*) *C. parasitica* individuals living on anomuran shells to capture food particles, while the latter were consuming a large prey (e.g. mussel tissues). On the other hand, Stachowitsch (1980) and others observed that this anemone often turns its oral disk to the sediment with its tentacles "sweeping" the substrate, a fact we also observed during dives. The contact of the tentacles with the sediment particles possibly results in adherence of meiofaunal or even microfaunal organisms. This was confirmed by the observation of Foraminifera, Nematoda, Ostracoda and Copepoda, as well as sediment, in the coelenteron of the examined individuals. Similar observations have been made by Eleftheriou and Basford (1983) for the anemone *Cerianthus lloydi*. It may be suggested that in such as in other sea anemones, soluble organic substances and particulate organic matter play a role in the diet of *C. parasitica*. This has been demonstrated for *Anemonia viridis* (= *A. sulcata*) by Schlichter (1975 *a*; 1975 *b*; 1978), for *C. lloydi* by Tiffon and Daireaux (1974), and for other species by Van Praët (1985).

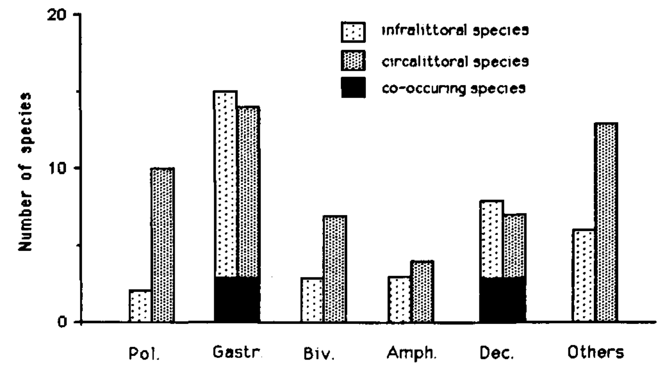

Figure 3

Comparison of the qualitative composition of the diet between individuals of Calliactis parasitica *from the infralittoral and circalittoral zone. The term co-occurring species corresponds to those found in the coelenteron of the anemones from both zone.*

Examination of food consumption shows that *C. parasitica* preys upon a very wide spectrum of organisms in both areas studied (without showing selective preferences; Tab. 2, 3; Fig. 1, 2). Differences in coelenteron contents between individuals from these two zones (Fig. 3) and also the fact that the coelenterons of the individuals from each zone were found to include a significant number (ten species for the infra and six for the circalittoral zone) of food remains belonging to species abundant in these zones (*M. galloprovincialis* and *T. communis*) suggests that the qualitative and quantitative composition of food reflects the composition of the organismic assemblages in which the anemones and anomurans live. Main food sources, in both areas, were molluscs (mostly gastropods) and crustaceans, organisms that are unlikely to be attractive for the hermit crabs. The great number of remains of the mysid *Syriella* sp. found in the coelenteron of sea anemones coming from the circalittoral zone (Tab. 3) may be attributed to the appearence of large concentrations of hyperbenthic mysids in areas with abundant algal detrital deposits (Eleftheriou and Basford, 1983). Möller (1978), in observations of the sea anemone *A. viridis*, found that crustaceans composed 61.9 % of its food and molluscs only 28.4 %. Crustaceans were also the main food source for *C. lloydi* (Eleftheriou and Basford, 1983). Unfortunately, no other information exists on *C. parasitica* for comparison.

Information on predators of *C. parasitica* is also very restricted. Salvini-Plawen (1972) and Ottaway (1977) reported that the starfish *Crossaster papposus* and the pycnogonid *Pycnogonum littorale* are predators of this species. We observed during several dives the starfish *Marthasterias glacialis* feeding on individuals of *C. parasitica*.

Results of this study imply that *C. parasitica*, being a non selective omnivorous species, may play an important role in the benthic food web, but a more complete understanding of its role requires further work. This sea anemone is mainly a suspension feeder, as has been reported by various authors, and also feeds on organisms living in the sediment with the help of its tentacles, which it turns in order to touch the substrate. Stachowitsch (1980) has hypothesized this behaviour as a possible way of receiving its food, but gave no evidence to support this hypothesis. Symbiosis with anomurans may give two advantages to *C. parasitica*: movement, which secures greater quantities of food, and occasional exploitation of the food remains of the anomurans.

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