# PRELIMINARY OBSERVATIONS ON AMPHIPOD ASSEMBLAGES ASSOCIATED WITH *MYTILUS GALLOPROVINCIALIS* LAMARCK BEDS FROM THERMAIKOS GULF (AEGEAN SEA)

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**Abstract**

Quantitave sampling on mussel beds attached on artificial substrates at three sites of Thermaikos Gulf, in summers and winters of two successive years, revealed the presence of 6600 amphipod individuals belonging to 17 species. The most dominant species were: *Elasmopus rapax, Maera inaequipes* and *Corophium acutum.* Significant differences in the abundances of amphipods and in diversity indices between the two seasons were found, the former increasing as the latter decreases in summer.

*Key-words: Crustacea, Population dynamics, Rocky shores, Zoobenthos, Aegean Sea*

## Introduction

The assemblage of mussel beds as a facies of the photophilic algae biocoenosis (1) has been investigated in the Western Mediterranean and the European Atlantic coast (2, 3, 4, 5), while in the Eastern Mediterranean only two works include information on its structure; those by Topaloglou and Kihara (6) who studied the mussel community in Bosphorus Strait and Kocatas (7) who gave some qualitative and quantitave information on its structure in a broader study of hard substrate populations in the Gulf of Izmir. On the other hand, although amphipods play an important role in the benthic ecosystem, their ecology has not been sufficiently studied especially in the eastern part of the Mediterranean. All the relative literature has been reviewed by Stephanidou & Voultsiadou (8) in a faunistic study of amphipods of the North Aegean.

This study is a part of a broader research aiming to study the structure of *Mytilus galloprovincialis* beds in the Bay of Thessaloniki; as proved by Koukouras & Russo (9) and Nicolaidis (10), Thermaikos Gulf in general, and more specifically the area of the sampling stations, is subjected to the effects of pollution which is mainly organic. Under these circumstances, the structure of the populations associated with *M. galloprovincialis* beds in this areamay change in time due to pollution. In the present paper some preliminary results concerning the amphipod populations associated with mussel beds are presented.

## Materials and methods

Sampling was carried out in three sites located on the east coast of the Bay of Thessaloniki (Fig. 1): Perea (site 1), Nei Epivates (site 2) and Agia Triada (site 3). On the artificial hard substrate of the piers built in the above sites, dense populations of *Mytilus galloprovincialis* exist. The sampling areas can be characterized as "polluted" although pollution is not as heavy as on the western coast of the Bay, where the industrial area is located (9). Scuba diving was employed for sampling with a special hard substrate sampler designed by Chintiroglou and Koukouras (11), in summer and winter of two successive years, 1994 and 1995. Samples were preserved in a 10 % formaline solution. Totally 36 samples were taken (3 samples per site, per season), each covering an area of 400 $cm^2$. In order to quantify the contribution of the various species, mean abundance and partial mean dominance were calculated (3). The Shannon-Wiener information function (H') was used as a diversity index (12). For the comparison of amphipod abundance between seasons and ammong different sites, Kruskal-Wallis test (13) was employed. Ward's method was used to construct hierarchical classification of amphipod faunal similarities between stations using Euclidean distances (14).

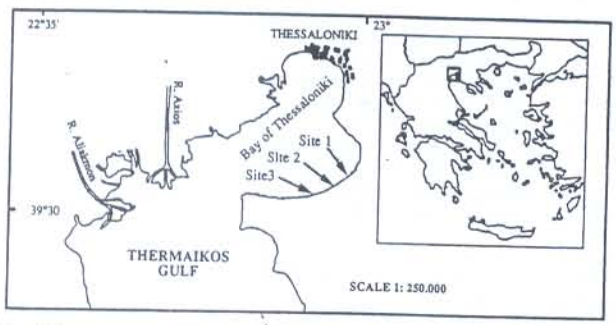


Fig. 1: Map of sampling sites. Site 1= Perea; Site 2= Nei Epivates; Site 3= Agia Triada.

## Results

6600 amphipods, belonging to 14 genera and 17 species (16 Gammaridea and 1 Caprellidea) were found associated with *Mytilys galloprovincialis* beds in the three sampling sites (Table 1). Mean abundances and partial mean dominances for the aamphipod species found, as well as total numbers of species, individuals and Shannon-Wiener index are presented in Table 1. In Figure 2, the number of amphipod individuals per site and season is compared with the corresponding numbers of species and Shannon-Wiener indices, the former increasing as the other two decrease, in the summer season.

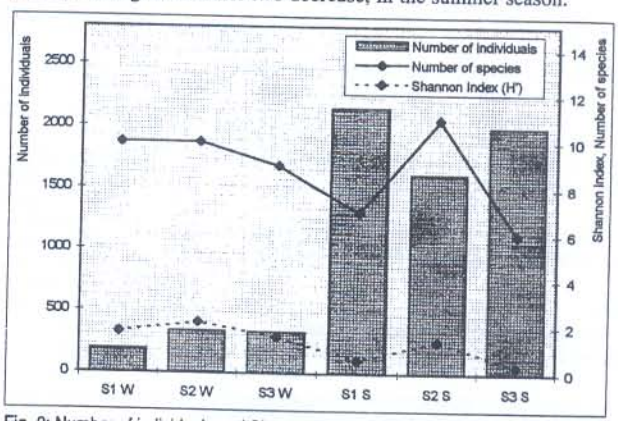


Fig. 2: Number of individuals and Shannon-Wiener Index for each season and site S1= site 1; S2= site 2; S3= site 3; W= winter; S= summer.

The most dominant amphipod species, by far, is *Elasmopus rapax* (mA=151.6, pmD=82.7); second is the species *Maera inaequipes* (mA=14.8, pmD=8.1) and third *Corophium acutum* (mA=7.8, pmD=4.2). Four more species, namely *Erichthonius brasiliensis, Jassa marmorata, C. sextonae* and *Microdeutopus stationis* had high abundances in some of the samples.

Shannon index calculated separately for each site had similar values in sites 1 and 3 (0.74 and 0.61 respectively), but higher in site 2 (1.63). Comparison of the three sites on the basis of their amphipod abundance by the Kruskal-Wallis test, showed no significant differences among them either in summer (H=1.064, p=0.5873) or in winter (H=4.999, p=0.082). Samples were grouped according to their similarity as in the dendrogram of Figure 3. As we can see, they are divided into two groups corresponding to the two seasons (summer and winter). In each season, the samples of the three sites had high affinities reaching 62% in the summer and 89% in the winter. Shannon index differed between seasons: winter values for the three sites were 1.76, 2.18 and 0.57 while summer values were 0.58, 1.39 and 0.33 respectively (Fig. 2). Significant differrences in the abundances of the three sites examined as a total between the two seasons were found by Kruskal-Wallis test (site 1: H=9.791, p=0.0204; site 2: H=9.513, p=0.0232; site 3: H=7.615, p=0.04). From Figure 2, it is also obvious that the number of individuals was greater in summer than in winter samples.

## Discussion

Mussel beds form one of the facies of the photophilic soft algae biocoenosis, usually appearing on hard substrates of the harbours (1). Other facies of the same biocoenosis have been recently examined in the Aegean Sea, such as that of *Anemonia viridis* (11). The composition of the assemblages associated with sponges (15, 16) and the scle-

ractinian coral *Cladocora caespitosa* (17) has been also studied in this area. Compared with the above, the examined *M. galloprovincialis* beds are poorer in species number only than the assemblage associated with sponges.

The amphipod genera found during the present study are almost the same that usually appear in the corresponding mussel beds from other Mediterranean areas (3, 5) but the total number of species is higher; Bellan-Santini (3) has found the maximum number of 15 amphipod species in a polluted area.

The most dominant species in the studied area were *Elasmopus rapax, Maera inaequipes* and *Corophium acutum.* The species of the genus *Elasmopus* are almost always present, with relatively high abundances, compared with other amphipods, also in other Mediterranean areas (2, 3, 7). *Maera inaequipes,* on the other hand, is a very common species in the other photophilic assemblages from the Aegean, being the most dominant species in the assemblage of *Cladocora caespitosa* (17); however, the latter has not been always found in *M. galloprovincialis* beds elsewhere. The third dominant species, *Corophium acutum,* is reported for the first time from mussel beds, while other species of the genus *Corophium* have rarely been found by other authors and only in low abundances (*e.g. C. aherusicum* by Kocatas (7) and Bellan Santini (3) or *C. volutator* by Topaloglou (6)).

The observed lower diversity in summer should be attributed to the increase of the abundance of the dominant species and basically of *Elasmopus rapax,* presumably due to reproduction; this made some species, such as *Hyale camptonyx, Jassa marmorata* and *Phtisica marina* to appear almost exclusively in winter samples. It should be mentioned that species of *Hyale* have been found in great abundances in the corresponding assemblages from other Mediterranean areas (3, 5, 7, 6).

Finally, diversity values were found to be similar with those reported for amphipod populations from *M. galloprovincialis* beds in other polluted areas (3).

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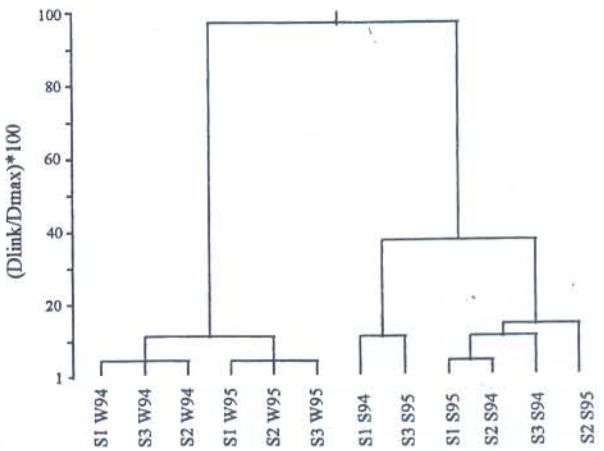


Fig. 3: Dendrogram from cluster analysis (Ward's method, euclidean distances). S1= site 1; S2= site 2; S3= site 3; W= winter; S= summer

Table 1: Distribution of Amphipod species associated with the assemblage of Mytilus galloprovincialis in the three sites. Am= mean abundance; Dmp= partial mean dominance; W= winter; S= summer

| | SITE 1 | | | | | | SITE 2 | | | | | | SITE 3 | | | | | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ampipod species | W | | S | | total | | W | | S | | total | | W | | S | | total | | | |
| | Am | Dmp | Am | Dmp | Am | Dm | Am | Dmp | Am | Dmp | Am | Dm | Am | Dmp | Am | Dmp | Am | Dm | Am | Dmp |
| *Amphilochus neapolitanus* Della Valle | | | | | | | 0.2 | 0.3 | | | 0.1 | 0.06 | | | | | | | 0.0 | 0.02 |
| *Amphithoe ramondi* Audouin | | | | | | | | | 0.3 | 0.1 | 0.2 | 0.10 | 0.2 | 0.3 | | | 0.1 | 0.04 | 0.1 | 0.06 |
| *Corophium acherusicum* A.Costa | 0.2 | 0.5 | | | 0.1 | 0.04 | | | 0.2 | 0.1 | 0.1 | 0.06 | | | 0.2 | 0.1 | 0.1 | 0.04 | 0.1 | 0.06 |
| *Corophium acutum* Chevreux | 0.7 | 2.1 | 13.5 | 3.8 | 7.1 | 3.66 | 4.0 | 7.2 | 26.0 | 9.7 | 16.0 | 9.24 | 1.0 | 1.8 | 1.5 | 0.5 | 1.3 | 0.66 | 7.9 | 4.24 |
| *Corophium sextonae* Crawford | 1.2 | 3.7 | 6.2 | 1.7 | 3.7 | 1.69 | 1.8 | 3.3 | 10.0 | 3.7 | 5.9 | 3.66 | 0.5 | 0.9 | | | 0.3 | 0.13 | 3.3 | 1.79 |
| *Elasmopus rapax* A.Costa | 20.8 | 86.5 | 325.8 | 91.2 | 173.3 | 89.23 | 25.3 | 45.4 | 187.5 | 69.8 | 106.4 | 65.89 | 33.5 | 80.7 | 316.5 | 95.4 | 175.0 | 90.44 | 151.6 | 82.68 |
| *Erichthonius brasiliensis* (Dana) | 0.2 | 0.5 | 1.2 | 0.3 | 0.7 | 0.34 | | | 1.0 | 0.4 | 0.5 | 0.31 | 0.8 | 1.5 | 3.5 | 1.1 | 2.2 | 1.12 | 1.1 | 0.61 |
| *Hyale camptonyx* (Heller) | 0.3 | 1.1 | | | 0.2 | 0.09 | | | | | | | | | | | | | 0.1 | 0.09 |
| *Jassa marmorata* Holmes | 3.8 | 12.2 | 0.2 | 0.0 | 2.0 | 1.03 | 1.2 | 2.1 | | | 0.6 | 0.36 | 4.0 | 7.3 | | | 2.0 | 1.03 | 1.6 | 0.85 |
| *Maera inaequipes* (A.Costa) | 2.2 | 6.9 | 10.0 | 2.8 | 6.1 | 3.19 | 9.7 | 17.3 | 42.2 | 15.7 | 26.0 | 16.07 | 14.7 | 28.6 | 10.0 | 3.0 | 12.3 | 6.37 | 14.8 | 8.06 |
| *Melita hergenis* Reid | | | | | | | 0.3 | 0.6 | | | 0.2 | 0.10 | | | | | | | 0.1 | 0.03 |
| *Microdeutopus anomalus* Rathke | | | | | | | | | 0.2 | 0.1 | 0.1 | 0.06 | | | | | | | 0.0 | 0.02 |
| *Microdeutopus stationis* Della Valle | 1.7 | 6.3 | 0.3 | 0.1 | 1.0 | 0.61 | 12.2 | 21.8 | 1.0 | 0.4 | 6.6 | 4.06 | 0.3 | 0.6 | 0.2 | 0.1 | 0.3 | 0.13 | 2.6 | 1.43 |
| *Orchomene humilis* (A.Costa) | | | | | | | | | 0.3 | 0.1 | 0.2 | 0.10 | | | | | | | 0.1 | 0.03 |
| *Perioculodes aequimanus* (Kossmann) | | | | | | | 1.0 | 1.8 | | | 0.5 | 0.31 | | | | | | | 0.2 | 0.09 |
| *Phtisica marina* Slabber | 0.3 | 1.1 | | | 0.2 | 0.09 | 0.2 | 0.3 | | | 0.1 | 0.06 | | | | | | | 0.1 | 0.06 |
| *Stenothoe cavimana* Chevreux | | | | | | | | | | | | | 0.2 | 0.3 | | | 0.1 | 0.04 | 0.0 | 0.02 |
| Number of species | 10 | | 7 | | 10 | | 10 | | 11 | | 15 | | 9 | | 6 | | 10 | | 17 | |
| Number of individuals | 188 | | 2143 | | 2331 | | 335 | | 1614 | | 1947 | | 331 | | 1991 | | 2322 | | 6600 | |
| Shannon Wiener Index (H') | 1.76 | | 0.58 | | 0.74 | | 2.18 | | 1.39 | | 1.63 | | 0.57 | | 0.33 | | 0.81 | | | |

**References**

1. Pérès J. M., 1982. Major benthic assemblages. In: Marine Ecology Vol.5 part I, Otto Kinne ed., John Wiley & Sons Ltd: 373-522
2. Bellan-Santini D., 1967. Contribution à l'étude des peuplements infralittoraux sur substrat rocheux (étude qualitative et quantitative de la frange superieure). *Rec. Trav. Sta. mar. Endoume,* 63 (47): 5-294
3. Bellan-Santini D., 1981. Influence des pollutions sur le peuplement des amphipodes dans la biocénose des algues photophiles. *Tethys* 10(2): 185:194
4. Saldanha L., 1974. Estudo do povoamento dos horizontes superiores da rocha litoral da Costa da Arrabida (Portugal). *Publ. Mus. Lab. Zool. Anthr. Fac. Cien.,* Lisboa, 5: 1-382
5. Tsuchiya M., Bellan-Santini D., 1989. Vertical distribution of shallow rocky organisms and community structure of mussel beds *(Mytilus galloprovincialis)* along the coast of Marseille, France. *Mesogée,* 49: 91-110
6. Topaloglu B., Kihara K., 1993. Community of Mediterranean mussel *Mytilus galloprovincialis* LAMARCK, 1819 in the Bosphorus straight. *J. Tokyo Univ.* Fish. 80: 113-120
7. Kocatas A., 1978. Contribution à l'étude des peuplements des horizons supérieurs de substrat rocheux du golfe d'Izmir (Turquie) (in Turkish). *Ege Univ. Fen. Fak. Mon. Ser.,* 12: 1-93
8. Stefanidou D. & Voultsiadou-Koukoura E., 1995. An account of our knowledge of the amphipod fauna of the Aegean sea. *Crustaceana* 68(5): 597-615
9. Koukouras A. & Russo A., 1991. Midlittoral soft substratum macrofaunal assemblages in the North Aegean Sea. *Marine Ecology,* 12(4): 293-316
10. Nikolaidis G., 1987. Der Einfluss Häeuslicher und industrieller Abwässer auf die Biomasse und die Zusammensetzung der epilithischen Algengesellschaften der Makrophyten des Eulitorals und des oberen Sublitorals im Golf von Thessaloniki, Griechenland. *Nova Hedwigia* 45(1-2): 147-168
11. Chintiroglou Ch., Koukouras Ath., 1992. A population of the sea anemone *Anemonia viridis* (Forskal, 1775) and its associated flora and fauna, in the north Aegean sea. *Int. Revue ges. Hydrobiol.,* 77: 483-495
12. Daget J. 1979. Les modèles mathématiques en écologie. Collection d'écologie, Masson, Paris: 1-172
13. Siegel S., 1956. Nonparametric Statistics for the Behavioral sciences. International Student Edition McGraw-Hill Kogakusha, LTD: 1-131
14. Aldenderfer M. S. and Blashfield R. K., 1984. Cluster analysis. Sage University papers 07-044: 1-88
15. Koukouras A., Voultsiadou-Koukoura E., Chintiroglou Ch., Dounas C., 1985. Benthic bionomy of the North Aegean sea III. A comparison of the Macrobenthic animal assemblages associated with seven sponge species. *Cah. Biol. Mar.,* 26: 301-309.
16. Koukouras A., Russo A., Voultsiadou-Koukoura E., Arvanitidis C. & Stefanidou D., 1996. Macrofauna Associated with sponge species of different morphology. *Marine Ecology,* 17(4): 569-582.
17. Koukouras A., Kuehlmann D., Voultiadou-Koukoura E., Vafidis D., Dounas C., Chintiroglou Ch., Koutsoubas D., in preparation. Macrofaunal assemblage associated with the scleractinian coral *Cladoccora caespitosa* (Linnaeus) in the Aegean sea.