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SHORT NOTE

Seasonal variation in abundance of *Corophium orientale* (Crustacea : Amphipoda) in Monolimni lagoon (Evros Delta, North Aegean Sea)

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Amphipods of the genus *Corophium* are frequently important components of inshore ecosystems. *Corophium orientale Schellenberg*, 1928 is a common and frequently abundant inhabitant of Mediterranean lagoons and coastal brackish environments; nevertheless, its population dynamics have not yet been studied. The present study describes the monthly variation in population density of the amphipod *C. orientale* in the two parts of Monolimni lagoon, Evros Delta, N. Aegean Sea. This variation is discussed in relation to the life cycle of the species and to some abiotic and biotic factors.

Monolimni (or Paloukia) lagoon, occupying an area of about 115 ha, communicates with the sea mainly through an opening 15m wide. Between February 1998 and February 1999 macroalgae were occasionally observed in both parts of the lagoon (the southern and northern ones), while a meadow of *Ruppia maritima* occurred in the innermost northern one. During the aforementioned period monthly samples of benthic macrofauna were collected at the stations I_1 and B_2 located in the southern and northern part of Monolimni lagoon, respectively (1). For this study all *Corophium orientale* specimens were separated from the remaining macrofauna and counted.

Further examination of *C. orientale* specimens was used for the description of the life cycle of this species (2). The structure of the macrobenthic assemblages in these stations throughout the period February 1998 to February 1999, as well as the monthly variation in several water and sediment parameters were also described (1). Table I shows the fluctuations of all these environmental parameters over the sampling period.

In station I_1, population density of *Corophium orientale* was low in February – April, increased in May – July and peaked in August (Fig. 1). It decreased in September – October ; after October, density gradually decreased until the last sampling (Fig. 1). In station B_2, the abundance of *C. orientale* was low in February – March 1998, increased from April onwards and peaked in June (Fig. 1). It decreased in July – August. Density increased again in September, while after September it varied at relatively lower levels (Fig. 1). Density of *C. orientale* showed a significant seasonal variation in both stations (Kruskal – Wallis one – way analysis of variance : H=22.398, DF=3, P<0.001 in station I_1 ; H=9.152, DF=3, P<0.05 in station B_2) being lowest in spring in both stations and highest in summer in station I_1 and in autumn in station B_2. During spring density of the two populations did not differ significantly (Mann – Whitney U – test) ; however, density in station I_1 was significantly higher than that in station B_2 mainly in summer (P<0.001), but also in autumn and winter (P<0.01).

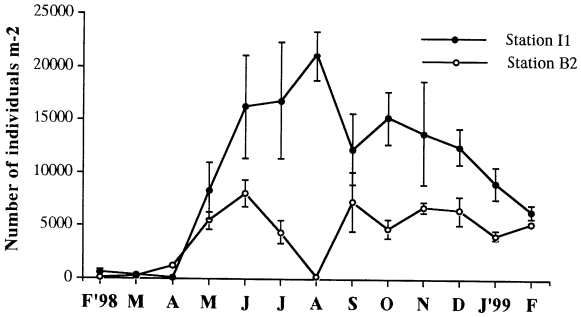

Fig. 1. – Monthly variation in population density (mean ± standard error) of *Corophium orientale* in station I_1 and station B_2 in Monolimni lagoon, Evros Delta.

We tested for significant correlations (Spearman's Rank correlation coefficient ρ) between the monthly variation in population density of *C. orientale* and that in (a) several physicochemical parameters of the water and sediment, and (b) the abundance of the constant co-occurring macrofaunal taxa [*Ventrosia maritima* (Milaschewitch, 1916), *Streblospio shrubsolii* (Buchanan, 1890), *Hediste diversicolor* (Muller, 1776), *Gammarus aequicauda* (Martynov, 1931), *Abra ovata* (Philippi, 1836) in both stations, as well as Cumacea in station I_1 and *Cerastoderma glaucum* (Poiret, 1789), Chironomidae larvae and Tubificidae in station B_2]. In station I_1, there was a signif-

icant positive correlation between density of *C. orientale* and salinity (Table 1) ; salinity had a value of about 0.3 psu in spring, 1.2 – 5.6 psu in summer, 3 – 4 psu in autumn and 0.5 – 1.5 psu in winter. A significant negative correlation was found between *C. orientale* abundance and dissolved O_2 and also O_2 saturation (Table 1), since these parameters had higher values during the colder period of the year, when the amphipod abundance was more or less low. The correlations of *C. orientale* density with those of the constant macrobenthic taxa were not significant. In station B_2, no significant correlation was found between *C. orientale* abundance and any one of the abiotic parameters (Table 1) ; there was a positive correlation with the abundance of the bivalve *A. ovata* (ρ=0.736, P<0.01) and the amphipod *G. aequicauda* (ρ=0.648, P<0.05), which showed similar trends in seasonal variation.

TABLE 1

The range of several physicochemical parameters of water and sediment and Spearman's rank correlation coefficient (ρ) values between density of *Corophium orientale* and these physicochemical parameters throughout the sampling period in stations I_1 and B_2 in Monolimni Lagoon, Evros Delta (*: P<0.05; **: P<0.01; ns: not significant; n=13; a: n=12; b: n=11).

		Station I_1		Station B_2	
	Variable	**Variable Range**	ρ	**Variable Range**	ρ
Water	Depth (cm)	50 - 85	-0.048 ns	30 – 55	0.599 ns b
	Salinity (psu)	0.3 – 5.6	0.810 **	0.3 – 5.7	0.377 ns
	Dissolved O_2 (mg l^{-1})	6.05 – 14.7	-0.706 * b	9.78 – 18.0	-0.400 ns b
	O_2 saturation (%)	74 – 122	-0.645 * b	101 – 220	-0.064 ns b
	pH	7.4 – 9.1	-0.349 ns	7.45 – 9.32	0.069 ns
	Transparency (cm)	35 – 65	0.019 ns	15 – 55	0.046 ns a
	Temperature (°C)	1.8 – 26.7	0.516 ns	4.2 – 28.5	0.126 ns
Sediment	Temperature 1cm (°C)	2.1 – 26.6	0.512 ns	3.7 – 27.0	0.190 ns
	Temperature 5cm (°C)	1.9 – 26.5	0.512 ns	3.5 – 28.6	0.176 ns
	Median diameter (μm)	143 – 176	-0.108 ns	94 – 129	-0.033 ns
	Organic matter (%)	0.15 – 1.73	0.525 ns	0.48 – 2.20	0.538 ns

Salinity was the only examined parameter that essentially showed an association with the density of *C. orientale*. Extremely low salinities coincided with decreases in abundance in winter and with low abundances in spring. Nevertheless, the increase in population density during late spring at salinities of 0.3 – 0.4 psu indicates that this amphipod is highly tolerant to extremely low salinities ; particularly, it appears to be more tolerant than other brackish water *Corophium* species, such as *C. volutator* and *C. insidiosum* (3, 4).

In station I_1 breeding of *C. orientale* peaked in March, June and September, and a spring, a summer and an overwintering cohort were produced showing a life span of about 4, 5 and 8 – 9 months, respectively (2). Therefore, population density increased during late spring and summer following the recruitment of the spring and summer cohorts, while it decreased after summer mainly or partly due to the die – off initially of the spring cohort and afterwards of the summer one. A similar increase in density during the main reproductive period has been also reported for other *Corophium* populations (e.g. 5, 6). Breeding of various *Corophium* species occurs mainly from mid or late spring to autumn in northern brackish habitats, while in more southerly ones the breeding period is usually wider (e.g. 7, 8). Comparison of the monthly variation in abundance of *C. orientale* in the two parts of Monolimni lagoon revealed a striking difference during summer. In station B_2 breeding of *C. orientale* peaked in April and then, in September ; a lack of large individuals observed in summer possibly contributed to that hiatus in reproduction (2). That lack should be attributed to a size – selective predation probably by shorebirds (*Tringa totanus, Calidris* spp.), which gather especially in that part of the lagoon during summer. As a consequence, recruitment occurred only during late spring and early autumn, two discrete generations, a spring and an overwintering one, were produced (2) and population density decreased in July. Predation by migratory shorebirds (*Callidris pusilla*) has been considered itself responsible for a similar decline in densities of *Corophium volutator* during summer in intertidal mudflats of the Bay of Fundy, Canada (9, 10). In addition, the major part of the *C. orientale* population may have temporarily emigrated from station B_2 during August, when dense vegetation of *Ruppia maritima* and high temperatures occurred, in order to avoid some unfavorable conditions such as low oxygen concentrations at night. Under experimental conditions an emigration of *Corophium volutator* from sediments associated with low oxygen saturation has been observed (11).

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