

Ecological features of the lessepsian migrant *Leonnates persicus* (Polychaeta: Nereididae) from the Levant coast of Turkey

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The seasonal distribution of *Leonnates persicus* was studied along depth transects (10–200 m) of three stations located in the Levant Sea during February–November 2000. *Leonnates persicus* particularly dominated the slightly gravelly sand bottom of stations between 10 and 150 m. Its distributional pattern showed a seasonal trend: it inhabited depths between 40 and 150 m in February and May when surface temperature was below 21 °C, whereas it preferred shallower waters (10–60 m) during the warm season (>29 °C in August). The density of the species in the area varied between 10 and 130 ind m⁻², with a maximum at 25–30 m off Erdemli in August.

Leonnates persicus Wesenberg-Lund, 1949 is a nereidid originally described from the Persian Gulf. Its occurrence in the Mediterranean Sea was first reported off Haifa (Israel) at depths between 13 and 153 m by Ben-Eliahu (1991). Most recently, Çınar et al. (2002) reported four specimens of *L. persicus* with reproductive products at 26–46 m in Izmir Bay, the north Aegean Sea.

This paper examines the recent establishment of *Leonnates persicus* populations off the Levant coast of Turkey and its spatio-temporal distribution in the investigated area (off Erdemli-Mersin), with regard to environmental characteristics such as temperature, sediment structure, and total carbonate and organic carbon content of the sediment.

Benthic samples were collected by RV 'Erdemli' along depth transects (10–200 m) off three stations (Erdemli, Kumkuyu and Limonlu) in February, May, August and November 2000 (Figure 1). Each transect comprised seven stations (10, 25, 50, 75, 100, 150, and 200 m depths), where two–three replicates were taken by using a van Veen grab (~0.10 m² surface area). Water temperature, salinity and density were measured by means of a conductivity, temperature and depth probe. Characterizations of sediments such as grain size, CaCO₃ content, and total organic and inorganic carbon contents were determined. The collected benthic material was sieved through a set of sieves with 0.5, 1 and 2 mm mesh size. Residues on each sieve were fixed with 3% formalin and then preserved in 70% alcohol. Non-parametric Spearman rank correlation coefficients and non-parametric Kruskal–Wallis analysis of variance was used for evaluating biotic and abiotic data collected.

Leonnates persicus was present in all seasons at depths ranging from 10 to 150 metres and occurred at all transects of the stations Erdemli and Limonlu (Figure 1). Its density ranged from 10 to 130 ind m⁻² off Erdemli, from 10 to 30 ind m⁻² off Limonlu, and from 10 to 20 ind m⁻² off Kumkuyu (Figure 1). The difference in the density of the species within stations was not statistically significant ($P > 0.05$), while a statistically significant difference was found in the density of the species within the depths and seasons ($P < 0.05$).

The frequency and abundance of *Leonnates persicus* in the study area were associated with the environmental factors such as water temperature, salinity and density, grain size of bottom sediment, total organic carbon and total carbonate content of the sediment

(Figure 2). Although there was no significant correlation between the species density and the above-mentioned factors in February and May, a significant correlation was found between the species density and seven factors in August, only three factors in November, and six factors with disregard to season (i.e. annual base) at level of $P < 0.05$ (Figure 2).

Abundance of the species was negatively correlated with water depth in August when the abundance was relatively high in shallow waters of the study area (Figure 2). Furthermore, abundance of the species increased significantly with increasing bottom temperature and salinity and decreased with increasing bottom density of the water. Moreover, significant correlations were found between the density of the species and the percentage of sand, total carbonate and total inorganic carbon contents of the sediment. Densities of the species at the depths (20–30 m) off Erdemli, Limonlu and Kumkuyu in August were 130, 30 and 0 ind m⁻² with total organic carbon contents of 0.75%, 0.41% and 0.24%, respectively. Sediment of the depth (20–30 m) of Kumkuyu was silt, while sediments of the other two sites were slightly gravelly sand.

In November, the distribution of the species was positively correlated with the percentage of gravel and total organic carbon content of the sediment, whereas it was negatively correlated with the bottom salinity of the water. As all data from the one-year survey are pooled, it can be seen that the quantity of *L. persicus* was significantly correlated with the environmental parameters such as bottom temperature, surface salinity, bottom density, total carbonate, total organic carbon and total inorganic carbon (Figure 2).

Leonnates persicus seemed to prefer the sediment composed mainly of less than 35% total carbonate, less than 12% gravel, more than 65% sand, less than 55% silt and less than 21% clay. The density of *L. persicus* peaked in shallow water sediments characterized by less than 28% total carbonate, less than 2% gravel, more than 90% sand, less than 5% silt and less than 3% clay. As a result of partial correlation analysis, six variables that were significantly correlated with density of the species at $P < 0.05$ were found with respect to annual base. Of the variables, near bottom salinity and water depth were negatively correlated with the density, whereas near bottom density, gravel, sand and silt content of the sediment were positively correlated with the density of the species.

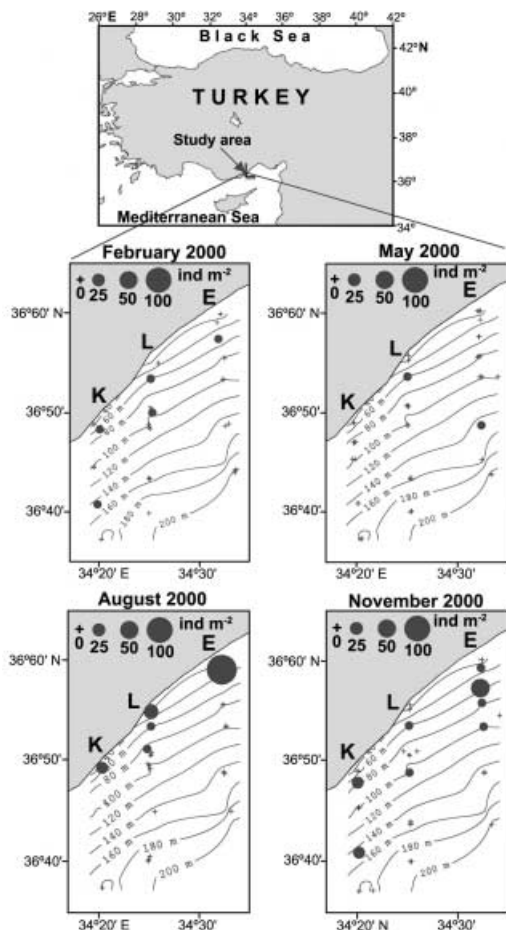


Figure 1. Map of the study area with location of sampling sites (E, Erdemli; L, Limonlu; K, Kumkuyu), and spatio-temporal densities (ind m^{-2}) of *Leonnates persicus* in the area.

It was very apparent in summer that this species only inhabited depths between 20 and 60 m, whereas it occurred between 30 and 100 m in November when the surface temperature was about 22°C. *Leonnates persicus* was found at relatively deep water (50–146 m) in February and May when the temperature was less than 22°C. The species inhabited slightly gravelly sandy mud or slightly gravelly muddy sand bottoms whose total organic carbon content was higher than 0.50% during the cold-water months. *Leonnates persicus* was abundantly found on slightly gravelly sand in August at depths of 20–30 m where total organic carbon was about 0.75% and near bottom temperature was greater than 28°C. The species seemed to move to gravelly sand bottom of deep water with total organic carbon higher than 0.55% in November, when the surface temperature decreased to 22°C. Furthermore, no individual was observed on sediments with total carbonate content higher than 35% (mainly shell fragments) between 60 and 100 m depths. The species was previously reported on clay with a little sand (Wesenberg-Lund, 1949) in the Persian Gulf and silt (Qiu & Qian, 2000) at depths of 5–58 m off Hong Kong. However, Çinar et al. (2002) found it on muddy bottom in Izmir Bay (Aegean Sea).

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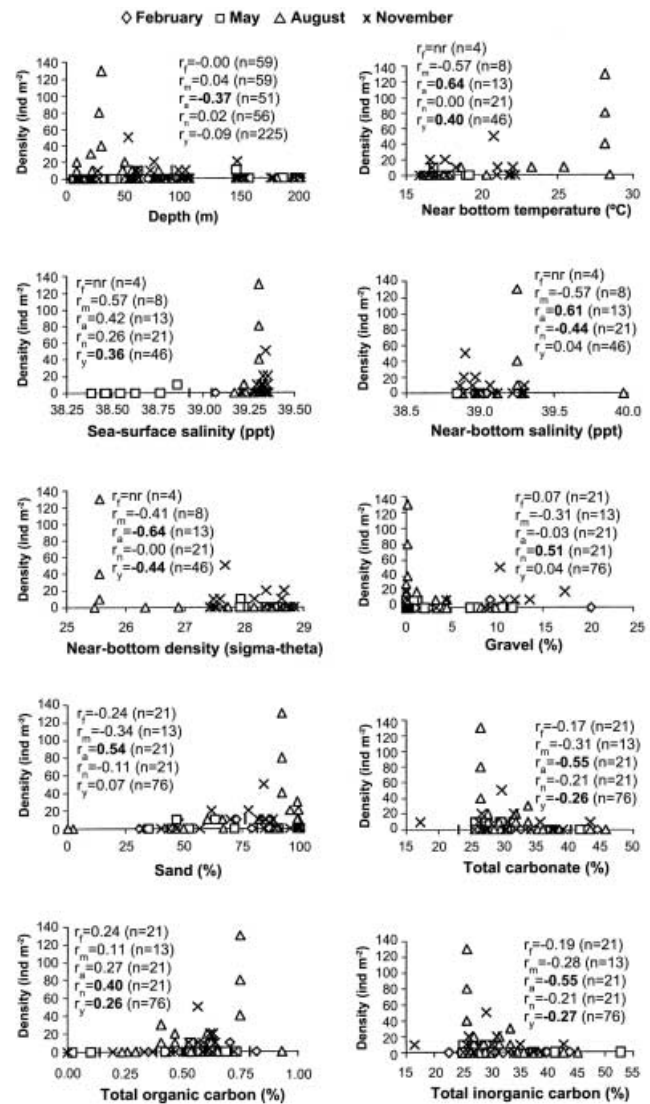


Figure 2. Relations of square-root transformed density (ind m^{-2}) of *Leonnates persicus* to the environmental parameters (rf, Spearman rank correlation coefficient in February; rm, correlation coefficient in May; ra, correlation coefficient in August; rn, correlation coefficient in November; ry, correlation coefficient in year 2000).

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