

Population dynamics of the krill *Meganyctiphanes norvegica* (M. Sars, 1857) (Crustacea: Euphausiacea) in the Ligurian Sea (NW Mediterranean Sea). Size structure, growth and mortality modelling

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Abstract. The seasonal abundance, population structure and dynamics of the euphausiid *Meganyctiphanes norvegica* were studied from samples taken year round in the NW Mediterranean Sea. Length–frequency distributions were generally bimodal: the first mode was interpreted as the born-in-the-year cohort (0+) and the second as a combination of the older age classes (1+). To describe growth, a bilinear function provides the best fit. A growth rate of 0.052 mm day⁻¹ (1.56 mm month⁻¹) was calculated for the first part of the growth function and 0.0034 mm day⁻¹ for the second part. A negative exponential mortality function was fitted, giving a mortality rate of 0.0034 day⁻¹ (1.25 year⁻¹). A numerical simulation of the size structure of the Ligurian population was performed and the validity of the model was checked using a multifactorial analysis. The demographic characteristics of the Ligurian population were compared to those of other areas and were interpreted as a functional adaptation of *M.norvegica* to the southern part of the geographical distribution of the species.

Introduction

Euphausiids are important members of the pelagic community in most seas of the world. The northern krill, *Meganyctiphanes norvegica* (M. Sars, 1857), is the largest euphausiid species in the northern hemisphere. The species is present in the North Atlantic and adjacent seas (Mauchline and Fisher, 1969) and in the north-western part of the Mediterranean (Ruud, 1936; Franqueville, 1970; Boucher and Thiriot, 1972; Wiebe and D'Abramo, 1972). Northern krill are an important element of the pelagic food web as a trophic resource for fish, birds and whales (Pearcy *et al.*, 1979). In the north-western Mediterranean Sea, the species is frequently found in the stomach of high trophic level organisms: squid *Illex coindetti* by Sanchez (1982); red tunna, *Thunnus thynnus*, by Quynh (1978); and fin whales, *Balaenoptera physalus*, by several authors (Viale, 1985; Orsi Relini, 1992; Orsi Relini and Relini, 1993).

The population dynamics and production of *M.norvegica* have been studied in the North Atlantic and the adjacent seas (Einarsson, 1945; Mauchline, 1960; Matthews, 1973; Hollingshead and Corey, 1974; Jörgensen and Matthews, 1975; Berkes, 1976; Falk-Petersen and Hopkins, 1981; Lindley, 1982; Boysen and Bucholz, 1984; Mauchline, 1985; Astthorsson, 1990), but not in the Mediterranean, since the study of Ruud (1936).

Population dynamics of *M.norvegica* are affected directly and indirectly by multiple factors. For example, swarming behaviour, diel vertical migrations, seasonal reproduction and recruitment are all influenced by environmental factors acting at different scales (e.g. primary production, biotic parameters, fronts and gyres). The Ligurian front is a zone of enhanced productivity characterized by an

