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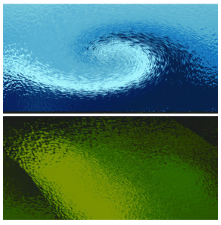

RESEARCH ARTICLE

Population structure and spatial distribution of Loripes lacteus (Linnaeus, 1758) in Varano lagoon, SE Italy

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Abstract

1 - In Varano lagoon (Puglia, Italy) the bivalve *Loripes lacteus* (Linnaeus, 1758) constitutes the most abundant species among the organisms of the benthic macrofauna. This work presents the results of five years (from 2001 at 2006) of observations on the abundance, size/age population structure and spatial distribution of this species within the basin (6500 ha). *L. lacteus* is one of the most common and frequent bivalve species in Mediterranean lagoons. It typically occurs in reduced sediments where it is able to live at low oxygen concentration due to a particular respiratory pigment haemoglobin. Lucinid bivalves house symbiotic, sulphur-oxydizing chemoautotrophic bacterias in their gills, which contribute substantially to their nutrition.

2 - The design was to perform two sampling campaignes on yearly basis during the intermediate seasons (Spring and Autumn), when possible. Each sampling was realized collecting 53 sampling units taken from 53 stations distributed regularly over the lagoon surface. Each sampling unit consisted in all the individuals contained in a solid 15 x 15 x 20 cm of sediment and held on 1 mm mesh.

3 - Growth patterns were determined with the Bhattacharya method which uses modal progression analysis from size frequency distribution.

4 - The results showed a spatial distribution of *L. lacteus* which occurred in patches and changed among samples. The population analysis showed two modal classes for each sampling time.

5 - *L. lacteus* is an "r" strategy species with small size, brief life cycle, with great capacity of recovery after environmental crises.

Keywords: *Loripes lacteus*, Varano lagoon (Puglia, Italy), spatial distribution, population structure, r strategy.

Introduction

Key role of bivalves in the macrofaunal assemblages of the soft bottom has been widely investigated (Peterson, 1977; Dame, 1996).

Loripes lacteus (Linnaeus, 1758) is one of the most common and widespread species of the benthic macrofauna in Mediterranean lagoons (Bedulli and Sabelli, 1990).

In Varano lagoon, previous studies (Scirocco *et al.*, 2002; 2006) highlighted the dominant presence of bivalves compared to the other taxa, *L. lacteus* being the most abundant.

This bivalve typically occurs in reduced sediments where it is able to live at low oxygen concentrations, due to the respiratory pigment hemoglobin (FAO, 1998). Lucinid bivalves house symbiotic, sulphur-oxydizing chemo-autotrophic bacteria in their gills, which contribute substantially to their

nutrition (Johnson, *et al.*, 1996).
Knowledge of the population distribution and relative abundance of *L. lacteus* is important as this organism is a food source for fish and a more general indicator of environmental conditions.
This work presents an analysis of the length/age structure and abundance of the population of *L. lacteus* in Varano lagoon (6500 ha), showing spatial distribution from 2001 to 2006. Few studies have been conducted on *L. lacteus*, so that the present work provides some basic information on the biology of the species by describing the size/age distribution of the population, its spatial distribution and a quantitative assessment of the stock in Varano lagoon.

Materials and Methods

Area of investigation

Varano Lagoon is located along the Southern Adriatic coast (Italy) near the Gargano promontory (Figure 1).
It is one of the greatest lagoons of Italy with its 6500 ha of surface; the average depth is 4 m, with a maximum of 5 m in the central zone. Communication with the sea occurs through two artificial channels, Capoiale and Varano, located respectively at the western and eastern end of the coastal barrier.

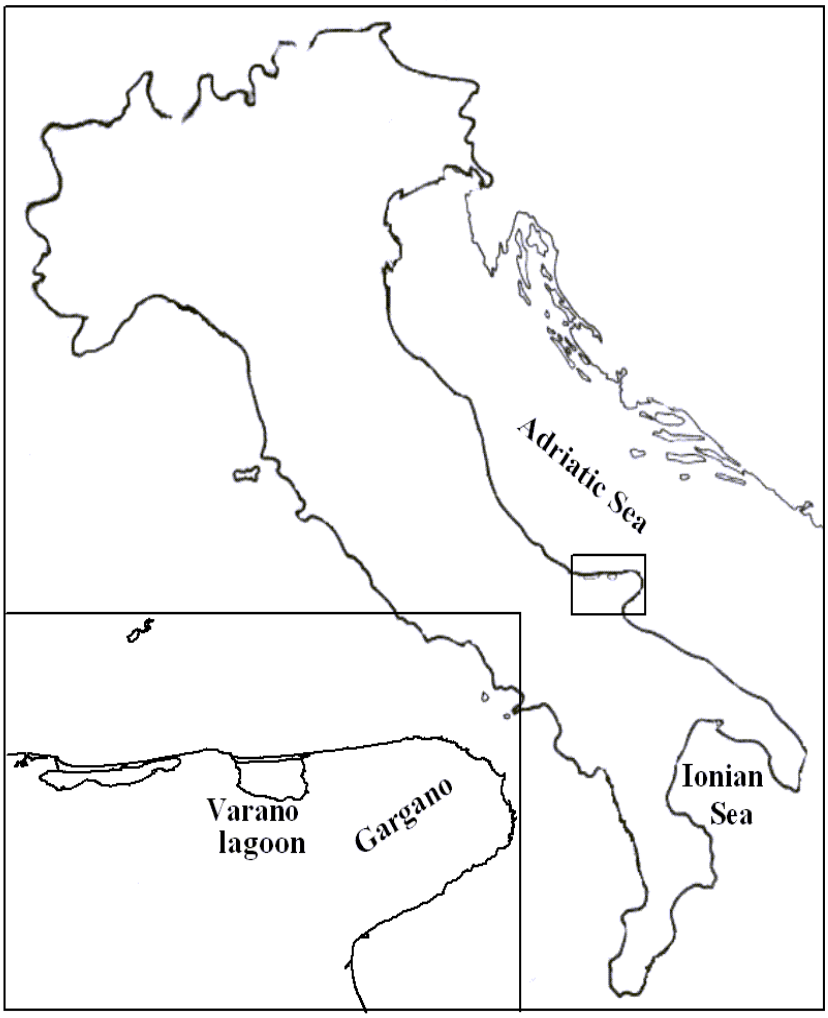

Figure 1. Investigation area Italy- Gargano

The tidal excursion is about 30 cm (Caroppo, 2000). In the course of the year water salinity values range from 20 psu to 30 psu and temperature values between 6 and 30°C. In this brackish system dinoflagellate blooms occur quite frequently during the summer, creating critical conditions for the rest of the living organisms.

Sampling and laboratory methods

Dynamics and distribution of lacteus was studied in Varano lagoon from October 2001 to November 2006. Each sampling campaign was composed of 53 sampling units taken from 53 stations distributed regularly over the lagoon surface (Figure 2). Each sampling unit consisted in all the individuals of *L. lacteus* contained in a solid 15 x 15 x 20 cm of sediment and held on 1 mm mesh.

Samples were stored in labelled plastic bags and then transported to the laboratory, where they were sorted and washed to remove all adhering organisms and other debris. Living individuals were separated, identified and counted. *L. lacteus* specimens were measured for shell length (L, mm), with a digital caliper to the nearest 0.01 mm, and weighed for total weight (TW, g) on a top-loading digital balance (precision of 0.001 g). Spatial distribution of population was mapped on obtained abundances, using package Surfer 8.

Growth patterns were determined following the Bhattacharya method (1967) which uses Modal Progression Analysis from size/ frequency distribution (software package FISAT; Gayanilo & Pauli, 1997). The ANOSIM test statistic *R* (two-way) was run on data, considering "time" and "space" as factors, to verify significant differences in *L.*

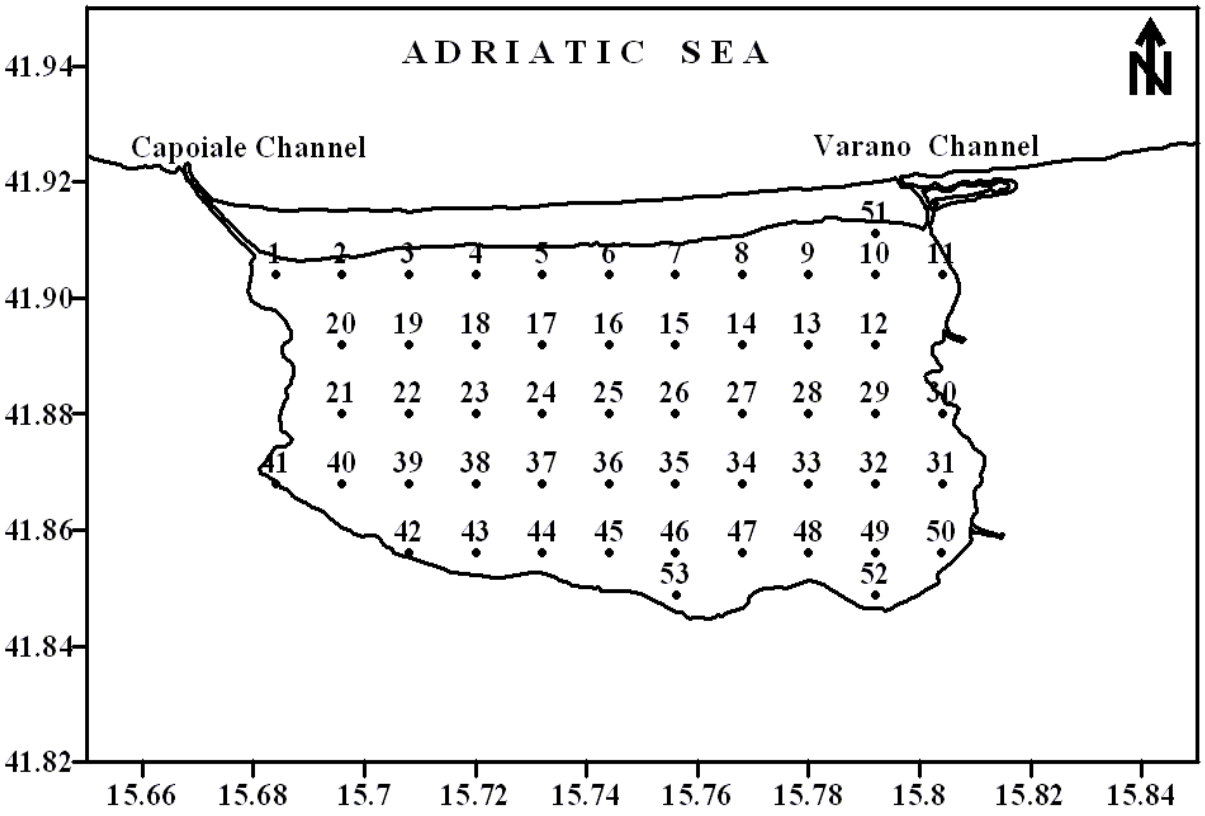

Figure 2. Location of sampling sites in Varano lagoon

lacteus distribution (Clarke 1993). Statistical analyses were performed by StatSoft 5.0 and Primer v6.

Results and Discussion

Spatial distribution of *L. lacteus* occurred in patches, the distribution of which changed between samples (Figure 3).

The species was more consistently present along the borders of the lagoon, rarely colonizing the deeper central zone (Figure 3). On October 2001 most of the population was located on the northern side of the lagoon with 21 ind/m^2. On August 2002 a mean density of 18 ind/m^2 were recorded on the southern side. In June 2003, the highest

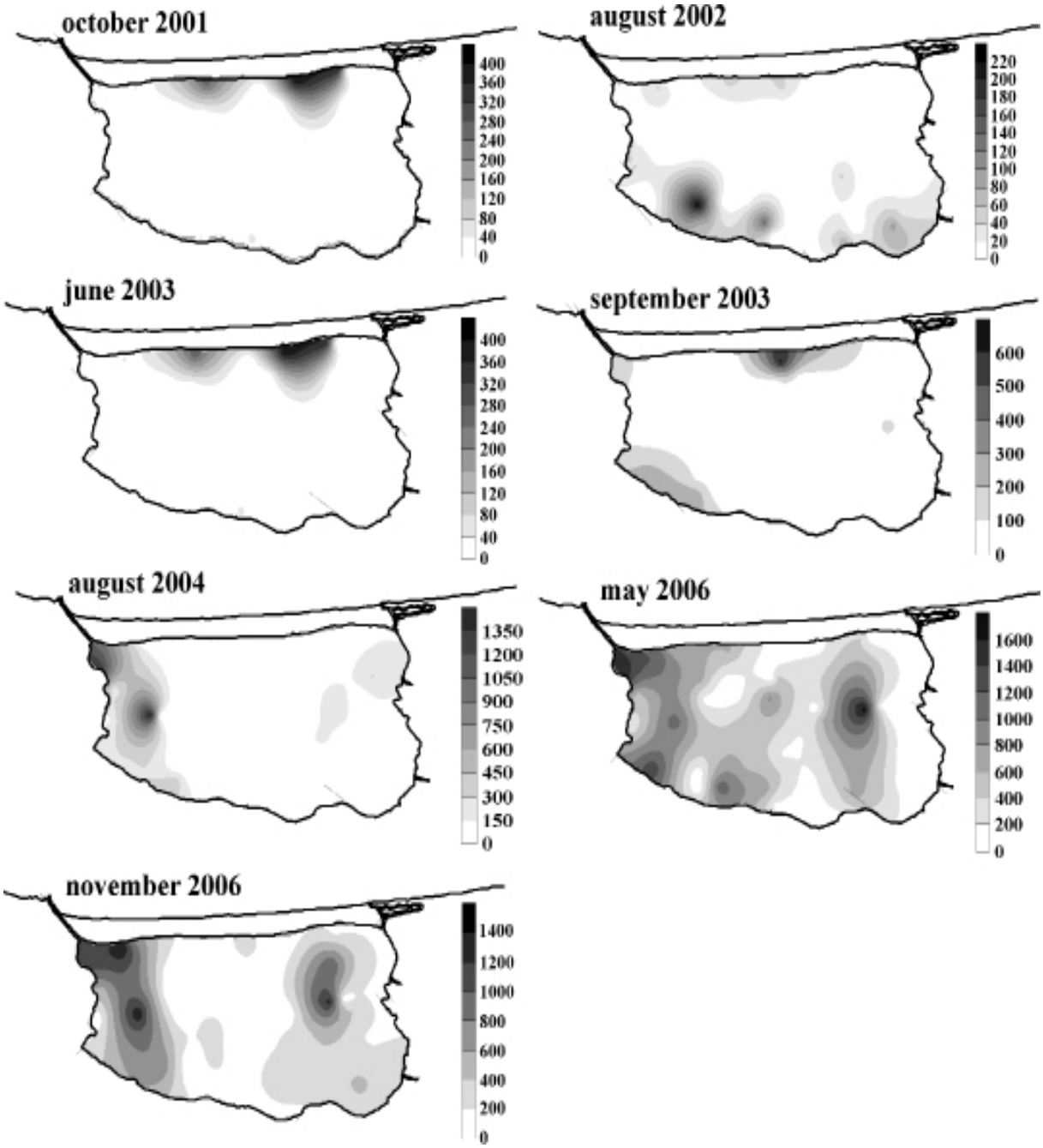

Figure 3. Spatial distribution of lacteus abundances (ind.m-2) in Varano lagoon from 2001 to 2006.

number of individuals, 38 ind/m^2, were again found on the northern side of the lagoon; in September 2003 *L. lacteus* was present along the entire perimeter with 58 ind/m^2. During 2004, the highest mean density (191 ind/m^2) was recorded in August close to the Capoiale channel. Data obtained during May 2006 showed that almost the entire bottom of the lagoon was inhabited, presenting a mean density of 463 ind/m^2; in November of the same year the sample revealed that the density had diminished (308 ind/m^2) with less animals in the central zone.

At this step, the One Way ANOVA elaboration was calculated to verify the equality between the average lengths over the sampling periods. The analysis highlighted a not-significant difference (P>0,05) of varying sizes to time. In order to verify significant differences in *L. lacteus* abundances, considering both factors "space" and "time", the ANOSIM test was used. Although the results obtained confirmed a variability related to both space and time (seasonal factor R = 0206, p = 0.01%; station factor R = 0.066, p = 0.01%) of *L. lacteus*, the analysis of both tests showed how the seasonal factor was pre-dominant than the other one.

Population analysis showed two modal classes, or cohorts, for each sample (Figure 4), that is two generations which closely succeed each other especially during the

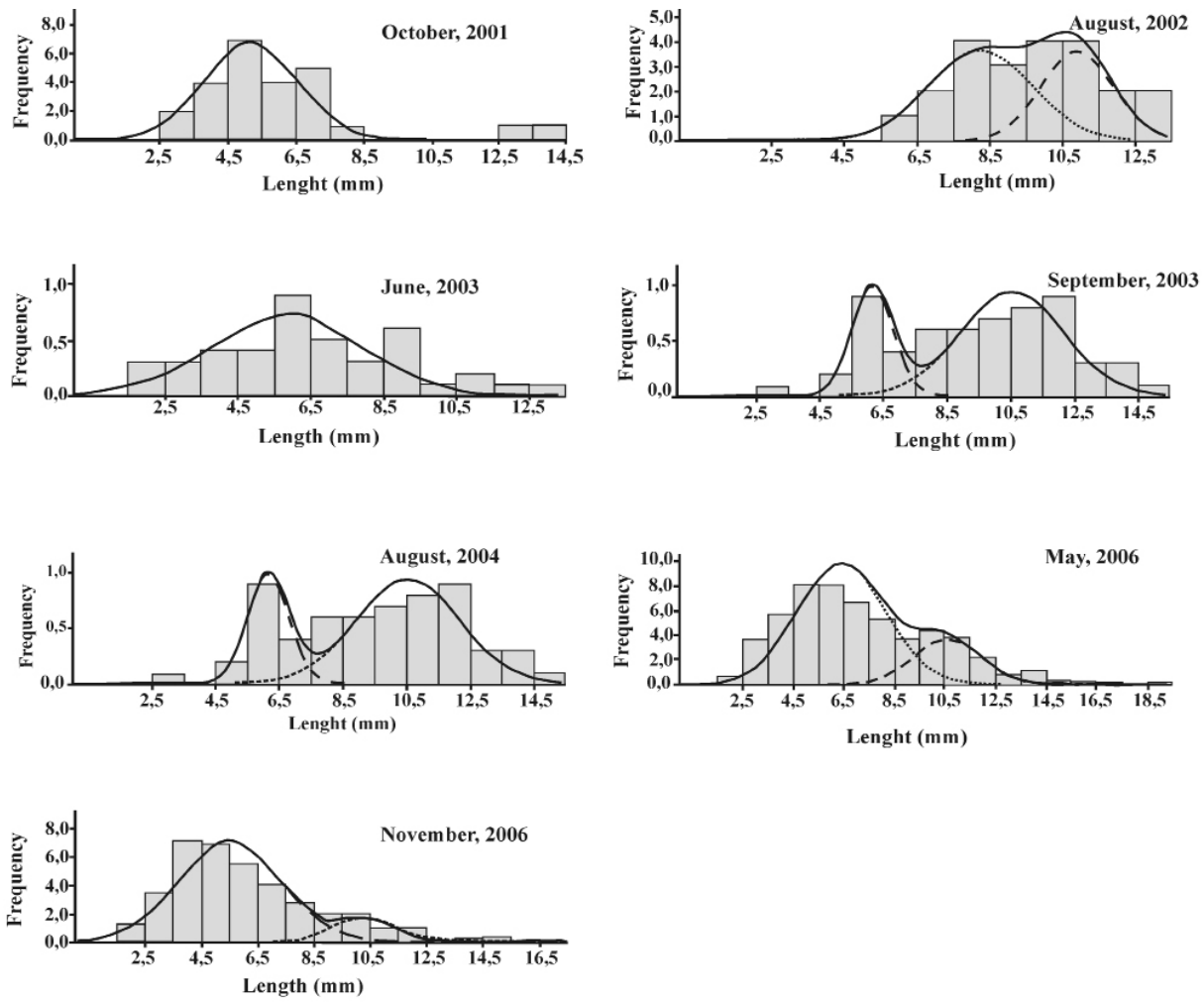

Figure 4. Length-frequency distributions of specimens collected in Varano lagoon from 2001 to 2006

warmer months.

The highest biomass and abundance were observed in May 2006 with 58 ± 43 g/m^2 and 463 ± 416 ind/m2 respectively; while the lowest value was in August 2002 with 6 ± 3 g/m^2 of mean biomass and 18 ± 41 ind/m2 of mean abundance (Figure 5).

The smallest shell length measured was 2 mm while the largest was 19 mm (Table 1).

Growth patterns were determined with the Bhattacharya method which uses modal progression analysis from size frequency distribution.

Frequency distributions showed that the

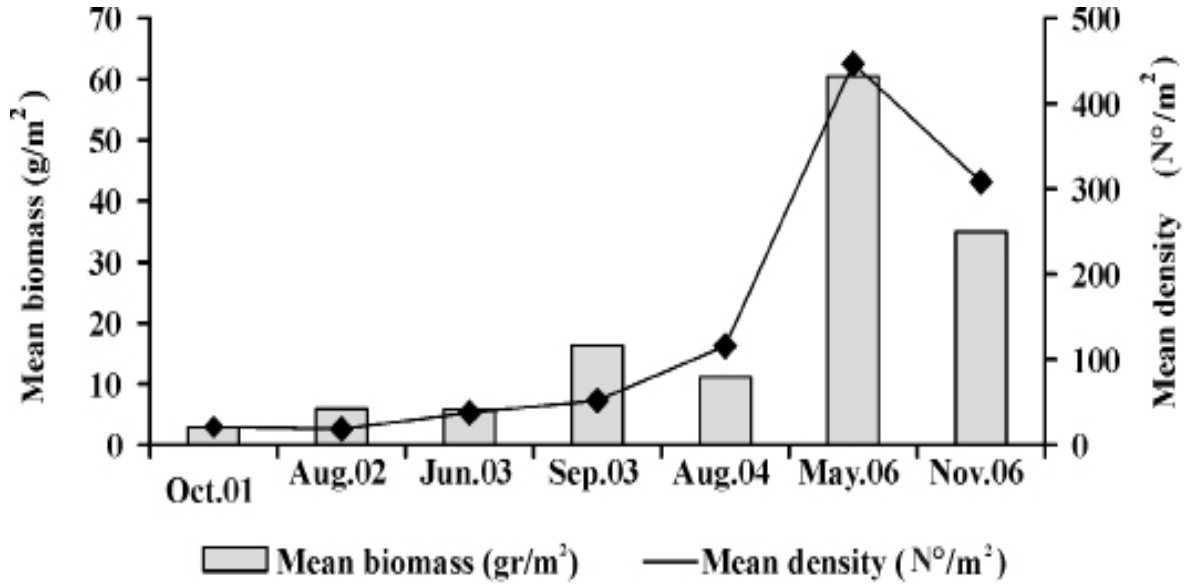

Figure 5. Temporal distribution of abundance (ind.m-2) and biomass (g. m-2)

Table 1 - The total number of individuals, minimum, maximum and mean length of L. lacteus and the percentage of stations covered by this bivalve during the study period.

Sampling	Total n° of ind.	Length (mm)			Occurrence of *L. lacteus* (%)
		Min	Max	Mean	
October 01	25	4	15	7.05	9
August 02	22	4	14	9.05	24
June 03	44	3	14	7.05	30
September 03	61	4	16	9.42	45
August 04	127	2	15	7.05	36
May 06	550	1	19	9.56	98
November 06	368	3	18	8.87	68

highest size is 19 mm. The life expectancy is one year; this is particularly obvious when there are at least two samples per year (as during 2003 and 2006). From the data, it can be observed that population size was not constant, but changed over time. During the year 2002 only 22 individuals were collected, while in May 2006 the sample included 553 specimens. These results show that *L. lacteus* is an "r" strategy species as defined by Pianka (1970, 2000), with small size, brief life cycle and great capacity of recovery after environmental crises (e.g. the dystrophic crisis) (Table 2).

Tab. 2 – Strategy (r and k) adopted by species according to Pianka (1970) based on ecological characteristics

Characteristic	Strategy" r"	Strategy " K"
environment	unpredictable	predictable
size of population	change over time	costant over time
competition	low	great
selection criterion	quick development	slow development
	precocious reproduction	slow reproduction
	small size	large size
	numerous individuals	few individuals
expectancy of life	short (<1 year)	long (>1 year)
step of succession	precocious	last
carry out	productivity	efficiency

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