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THE GROWTH AND LONGEVITY OF *CHAMELEA GALLINA* (MOLLUSCA, VENERIDAE) IN THE BLACK SEA

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The Growth and Longevity of *Chamelea gallina* (Mollusca, Veneridae) in the Black Sea. Boltacheva N. A., Mazlumyan S. A. — Annual growth rings were found in the study of shell sections of *Chamelea gallina* (Linnaeus, 1758), from which the age and the longevity of *Chamelea gallina* were determined. Based on standard individuals, maximum age of molluscs was assessed as 9 years. Results obtained are compared with those known for Mediterranean population of the same species. It was also found that *Chamelea gallina* collected from different localities of the same area have comparable maximum shell length but considerably differ in the growth rate.

Key words: Mollusca, Veneridae, *Chamelea gallina*, Black Sea, growth, longevity, maximum age.

Рост и продолжительность жизни *Chamelea gallina* (Mollusca, Veneridae) в Черном море. Болтачева Н. А., Мазлумян С. А. — При исследовании радиальных срезов раковин *Chamelea gallina* (Linnaeus, 1758) выявлены годичные слои роста, что позволило определить возраст моллюсков и продолжительность их жизни. Максимальный возраст моллюсков, определенный по эталонным экземплярам — 9 лет. Полученные данные сопоставлены с известными для популяции этого вида из Средиземного моря. Показано, что при значительно различающихся темпах роста моллюсков из разных частей ареала, предельные размеры раковины близки.

Ключевые слова: Mollusca, Veneridae, *Chamelea gallina*, Черное море, рост, продолжительность жизни, максимальный возраст.

Introduction

The bivalve *Chamelea gallina* (Linnaeus, 1758) is mass species commonly found at sandy shoals, it is also the major component of Venus * sand biocenosis of the Black Sea. Many aspects of the biology of *C. gallina* have been thoroughly studied (Kisseleva, 1981; Scarlato, Starobogatov, 1972; Chukhchin, 1965), however there is deficiency of the knowledge about longevity, age and growth rate of the mollusc. In addition to the Black Sea, this species also inhabits the Mediterranean Sea and the Atlantic Ocean. Therefore, comparison between the longevity and growth rate of molluscs collected from different sites of the distribution area was the aim of the reported study.

Material and methods

Molluscs for the study were collected during February-March 1992 after they had been dislodged and washed ashore due to storm events in Omega Bay (Black Sea) with the greatest depth about 19 m. The anterior-posterior length (L) of the shells was measured with vernier calliper to the nearest 0.1 mm. Shell valves were cut from the umbo to the ventral margin along the axis of maximum growth (radial section). The surface of the sections was polished and examined under a light microscope. Sections got from 144 molluscs were studied.

Results

The examination of the radial sections has shown that dark and light growth zones distinctly alternate. The dark bands cross medium and external layers of the shell, gradually sloping in underlying parts of the valve and emerging on the surface in the groo-

* From *Venus gallina*, the former generic name of *C. gallina*.

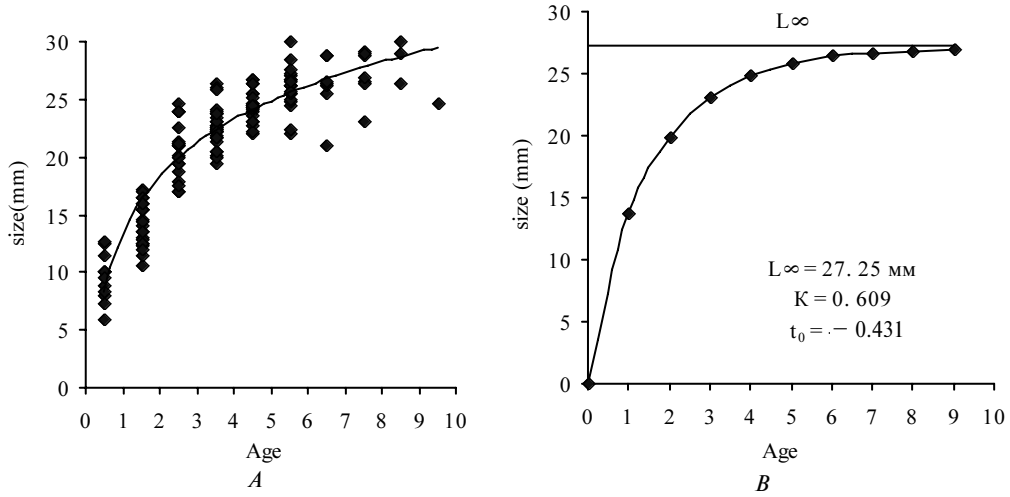

Fig. 1. *C. gallina*. Growth curve: *A* — determined from internal growth rings; *B* — Von Bertalanffy growth equation.

Рис. 1. *C. gallina*. Кривые роста: *A* — эмпирическая кривая, построенная на основании полученных данных о внутренних слоях роста; *B* — кривая роста Берталанфи.

ves between concentric ribs. Such alternation is usually associated with a delay of a shell growth and has been reported for a number of species (Zolotarev, 1989). However, growth delay periodicity is usually species-specific. *A. hypothesis* has been advanced (Mazlumyan, Valovaya, 1994) that this structure of the shell forms in the molluscs depending on season. For *C. gallina* from the western Mediterranean the periodicity of the inhibited growth has been acknowledged as annual (Ramon, Richardson, 1992). Therefore, the alternation of dark and light growth zones found in this species can be used in determining age of the clam. In the Black Sea *C. gallina* have breading season in July–August (Chukhchin, 1965). For our study molluscs were collected during February–March; therefore individuals described as fry, should probably be of age about 6–8 months, yearling — 1.5 yr. old and two-year old — 2.5 yr. old, etc.

Collective linear growth is described by two growth curves: an empirical curve, derived from the obtained data (fig. 1, *A*) and Von Bertalanffy growth curve (fig. 1, *B*), based on Hohendorf method (Hohendorf, 1966). It is Von Bertalanffy growth curve that describes the growth of *C. gallina* most reliably, with the difference between empirical and computed estimates (L_t), deviating ± 2.99 % (fig. 1, B):

$$L_t = 27.25\ (1 - e^{-0.609\ (t + 0.143)})$$

The equation consists of an independent variable (individual age, yr, t), a dependent variable — (shell length, mm, Lt) and three parameters — $L\infty$; K; t_0. K equal 0.609 describes annual decrease of the shell's growth rate (Walford, 1946). Given K = 0.609, annual increment of the shell's length is 55% last year's increment (Hohendorf, 1966). In *C. gallina*, annual shell length increase declines with time: deceleration of the growth manifests itself on both the empirical and computation-based curves (fig. 1).

On the Von Bertalanffy growth curve it can be seen as beginning from the dot which corresponds to age of five years (fig. 1, *B*). Comparison with the empirical curve (fig. 1, *A*) evinces correspondence between values of the length (L_t), closely approximating maximum physiological length possible, $L\infty = 27.25$ mm, — an asymptote of a Von Bertalanffy growth curve, and the age of 5 years.

The assessment of the longevity *C. gallina* inhabiting in the Black Sea has produced interesting results. Maximum age of clams in the examined sample was 9 years

(1 individual). At the same time, the greatest shell length measured in molluscs under the present study was 31 mm, vs. 43 mm formerly reported (Scarlato, Starobogatov, 1972). It is known that maximum age determined from standard individuals may vary depending on the scope of the sample. Then, it is possible to evaluate the longevity using statistics obtained based on Von Bertalanffy equation (Zolotarev, 1989):

$$T = -[\ln (1-L_m/L\infty)] / K,$$

where T is the age of the largest individual L_m — its length, K and $L\infty$ are equation parameters; the value 27.10 mm, the average maximum length computed, for example, through measuring 7 molluscs can also be used as L_m. Maximum age resulted from this computation equals 9 years, i. e. the maximum age of clams included in the sample. This phenomenon can be explained by similarity between the empirical and the computation-based curve.

It is noteworthy that for Mediterranean *C. gallina* maximum age was estimated 4 years. Shell length measured in this age group averages 27 mm (Ramon, Richardson, 1992). *C. gallina* from the Black Sea reached this length at the age of 8 years (fig. 1). The difference between growth rate of *C. gallina* from the two seas may be due to dif-ference in the environmental temperature, which is 7–28°C in the Mediterranean near the coast of Spain, and 4–21°C in the Black sea (Omega Bay) (Ramon, Richardson, 1992; Pavlova, Ovsianiy, 1999). The marked difference between the longevity maximums in *C. gallina* of the same length from the two populations evaluated through measuring standard individuals may probably be due to that maximum longevity of molluscs of this species is predertermined by the length, not by the age. This phenomenon has been documented for molluscs and other hydrobionts (Valovaya, 1982; Vigman, 1979; Nikolsky, 1965).

The obtained data add to the knowledge having been accumulated about the biology of *C. gallina*. In particular, in the Black Sea the clams grow sex mature having reached the length 8–14 mm (Chukhchin, 1965) that corresponds to dimensions characteristic of the first but not of the second year of life, as it was formerly believed.

Conclusions

On radial sections of the shells of Black Sea *C. gallina* annual growth rings are visible. The curve of *C. gallina* collective linear growth is well described by Von Bertalanffy equation; where it is K = 0.609; $L\infty$ = 27.25 mm; t_0 = −0.143. Maximum longevity assessed using standard individuals and Von Bertalanffy equation is 9 years for the Black Sea. Molluscs taken from different points of the same area have similar maximum shell length, though their growth rates differ considerably. In the Black Sea *C. gallina* may breed during the first year of life.

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