

RECENT BIVALVE ECOLOGY APPLIED TO THE RECONSTRUCTION OF PALEOCOMMUNITIES

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ABSTRACT. Eleven genera of Paleogene Bivalvia were found on various sites in the region of the Northern Rhodope slopes and taxonomically identified. The fossil representatives' peculiarities and their quantitative representation in the separate sites have been studied. An effort has been made at interpreting and reconstructing the environment in three separate regions of the Paleogene sea basin, using the data about the ecology of the recent bivalves. Some differences have been found in the structure of the paleotaxocenosis, to a large extent due to the type of the bottom sediments, hydrodynamics and the depth of the sublittoral.

KEY WORDS. Upper Eocene, Bivalvia, Ecology and Paleoecology, Bulgaria

INTRODUCTION

The palaeoecological approach in studying fossil fauna reveals their dependence on the habitat, their adaptation to the environment, as well as the influence which these organisms had on that habitat. This allows the fossils to be studied not only as examples of specific systematic groups, but also as participants in the formation of their living environment where various sediment deposits had been forming.

Geologic and partly paleontologic studies in the region of the Northern Rhodope slopes have been carried out by a number of authors (Bonchev, 1960; Belmustakov, 1968; Cholakov, 1972 etc.). According to them, the age of all sediment rocks between Assenovgrad and Peshtera is Upper Eocene. The monography "Bulgaria's Fossils" (Karagyuleva, 1964) contains an overview of the Paleogene bivalves. It lists all found and identified Paleogene bivalves up to that time. Later, Dragomanov (1980) reports Paleogene bivalves from the Plovdiv region, and the latest data are from Cholakov & Lyutskanov (1991) and Temelkov & Cholakov, (1996).

It seems necessary to point out, that most paleontologic researches to date are of the descriptive type, purely morphological and systematical.

The aim of the present paper is to show how the variety and abundance of Upper Eocene Bivalves in a given region can serve for analysis and reconstruction of the environment.

MATERIAL AND METHODS

63 relatively well-preserved fossil Paleogene bivalves have been researched. They were collected from 3 sites in the region of the Northern Rhodope slopes: Assenovgrad satellite suburbs of Upper and Lower Voden (UTM:LG25); between the villages of Kozarsko and Zhrebichko (UTM:KG85); south of the town of Perushtiza (UTM: KG95). The sites are natural surface rocks, road-digs and small building-material quarries (Fig.1).

After cleaning, the fossils were taxonomically identified down to Genus level.

Ecology and Paleoecology have a common theoretical basis, but the methods of research are different, as ecology studies processes, whereas paleoecology studies the results from the processes of the geological past. The following methods were used: taphonomic, morphofunctional, uniformitarian and quantitative (Yanin., 1983).

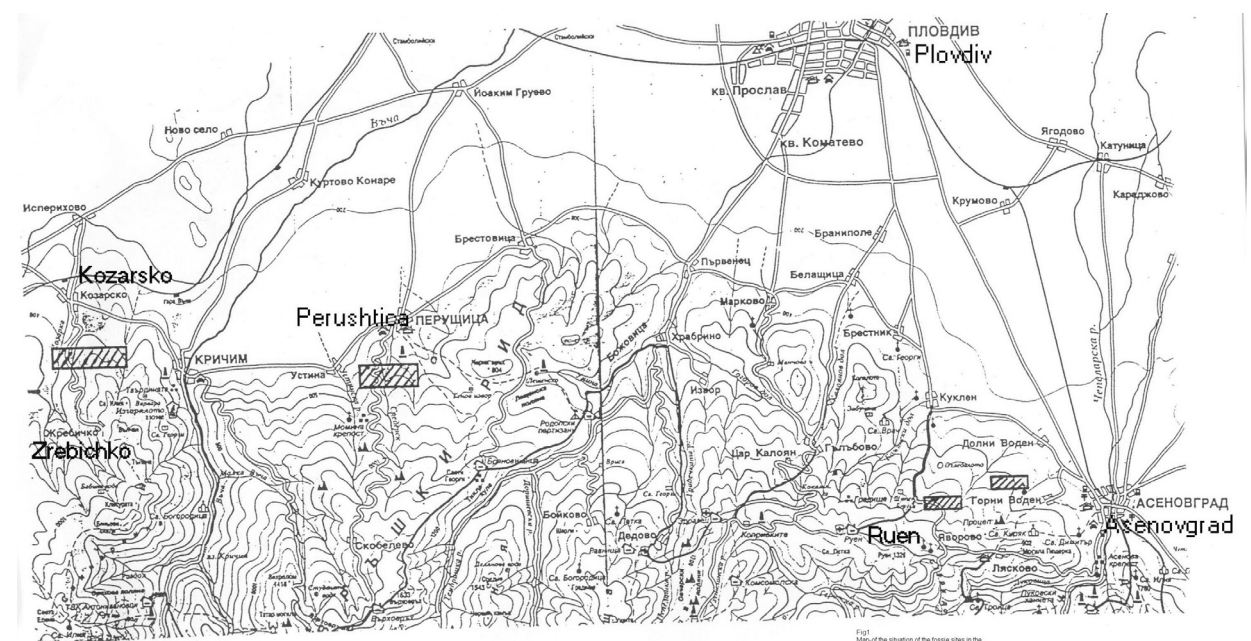


Fig1

Map of the situation of the fossil sites in the Plovdiv region

RESULTS AND DISCUSSION

The taxonomically identified fossils of class Bivalvia are represented by the following Genera: *Tellina* Linnaeus, 1758 (fig 2); *Lima* Bruguiere, 1792 (fig.3); *Ostrea* Linnaeus, 1758 (fig 4); *Chlamys* Bolten in Röding, 1798 (fig 5); *Pecten* Müller, 1853 (fig. 6); *Spondylus* Linnaeus, 1758 (fig.7); *Macrosolen* Mayer-Eymar, 1833 (fig.8); *Cardium* Linnaeus, 1758 (fig.9); *Crassatella* Lamarck, 1799 (fig.10); *Venericardia* Lamarck, 1801 (fig.11); *Venus* Linnaeus, 1758 (fig.12). We used the systematics for the Paleogene bivalves of "Bulgaria's Fossils," (Karagyuleva, 1964), „A Handbook on the ecology of marine bivalves“ (Davitashvili & Merklin, 1966) and "Paleontological descriptions," (Korobkov, 1978).

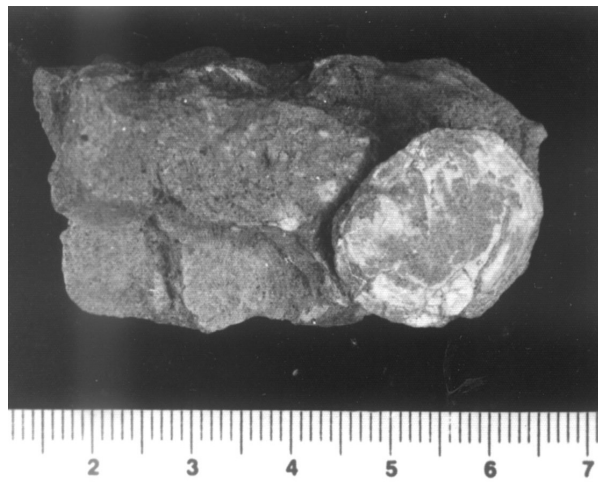


Fig. 2. *Tellina* sp.

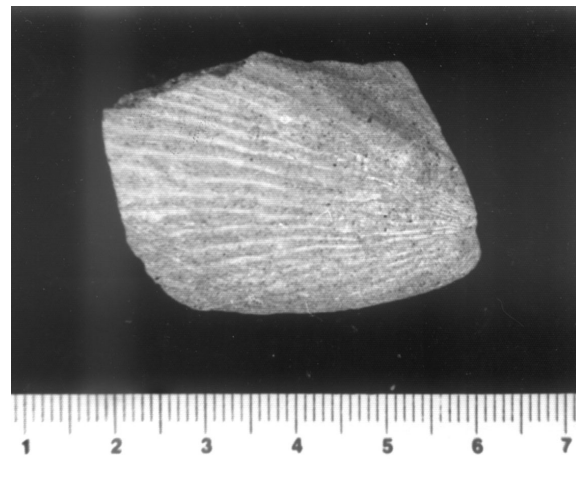


Fig. 3. *Lima* sp.

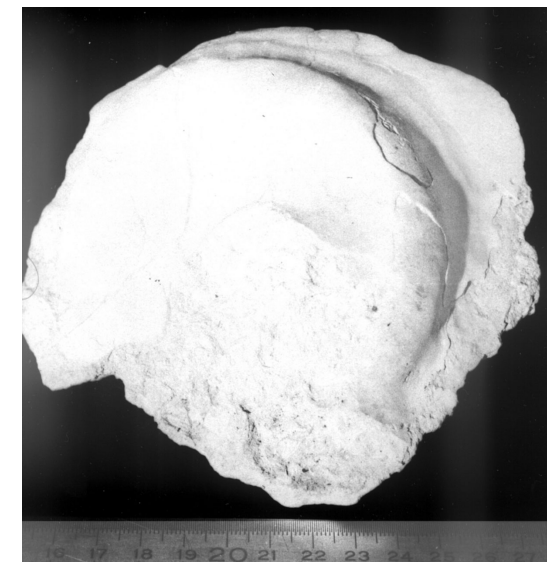


Fig. 4. *Ostrea* sp.



Fig. 5. *Chlamys* sp.



Fig. 6. *Pecten* sp.



Fig. 7. *Spondylus* sp.

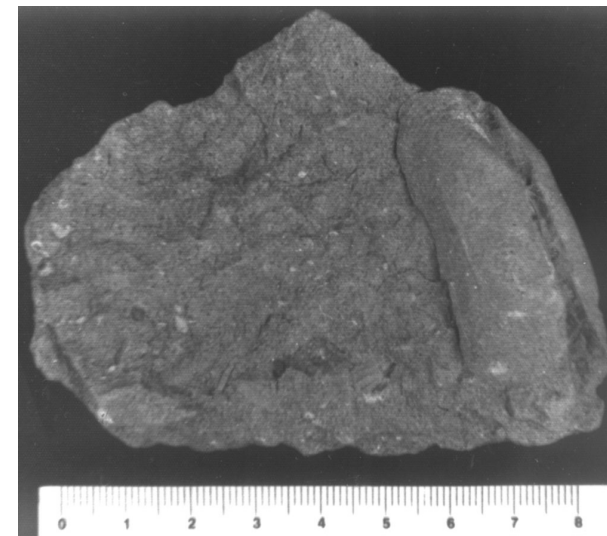


Fig. 8. *Macrosolen* sp.

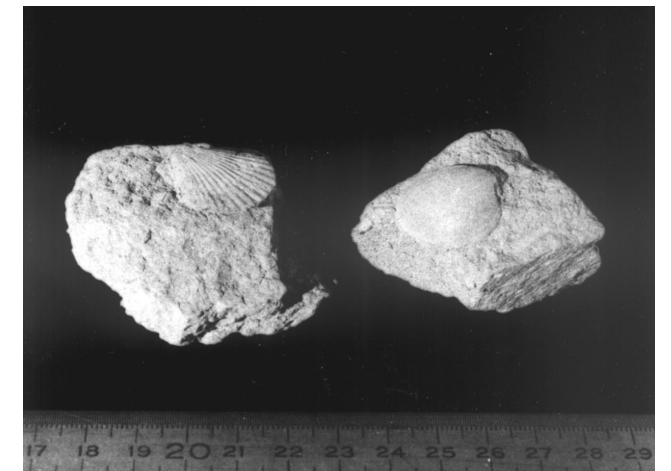


Fig. 9. *Cardium* sp.



Fig. 10. *Crassatella* sp.

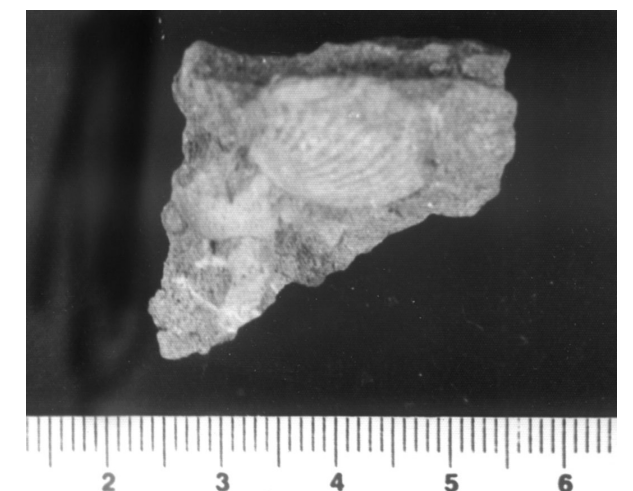


Fig. 11. *Venericardia*

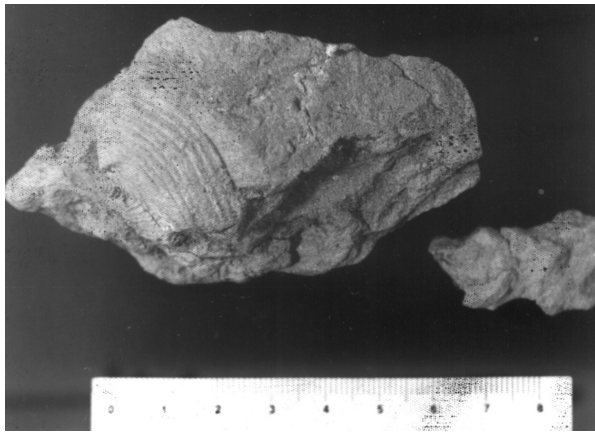


Fig. 12. *Venus sp.*

The ecologic classification of marine organisms reflects their way of life and their habitat. A comparative analysis of the paleocommunities was carried out on the basis of the substratum, which is a major factor for determining the type of benthos organisms in the basin. The substratum is very important as regards the bivalves' manner of attachment, movement and their mechanism of feeding. The analysis covers organisms that had existed contemporarily, but had lived in relatively different conditions in the three sites.

Benthos classification after Markovski, (1966): in brackets the extended categories characteristic for bivalves.

1. Attaching (attaching themselves by a byssus) – *Lima*, *Chlamys* (young)
2. Lying (loosely on the substratum, cementing) – *Spondylus*, *Ostrea*.
3. Moving (swimming, jumping) – *Pecten*, *Chlamys*, *Lima*.
4. Burrowing – *Macrosolen*, *Venericardia*, *Crassatella*, *Tellina*, *Venus*, *Cardium*.

The determination of various regions and zones in them of marine habitats is based mainly on the bathymetric data for the relevant part of the marine basin. The bivalves found and researched by us lived in the littoral and sublittoral zones of the marine basin, whose coastal region was situated in the area of today's Northern Rhodope slopes.

For the quantitative representation of the proportional relations between the separate bivalve genera we have used semi-quantitative methods, and the results are graphically shown on histograms (Fig 13)

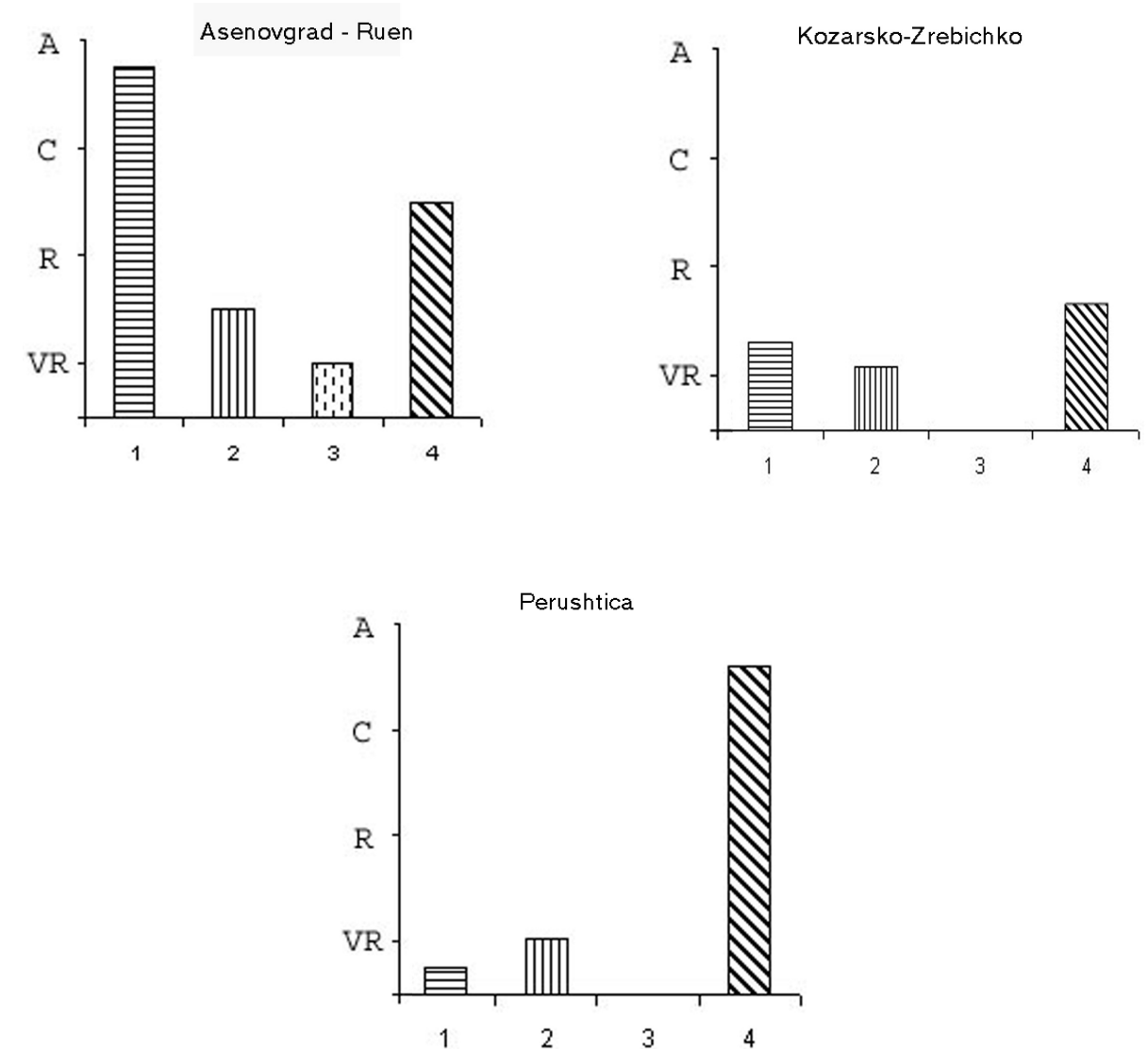


Fig13- Histograms for the ecological diversity of the paleocommunities

Ordinate:

- Vr (very rare-1-2-specimens)
- R (rare-3-5 specimens)
- C (common 6-10 specimens)
- A (abundant 11-15 specimens)

Abscissa:

- 1-swimming and free lying
- 2-attached by byssus or cementing
- 3-burrowing-sludge processors
- 4-burrowing filterers

Assenovgrad – Rouen site:

This is where the largest number of bivalves were found, in different ratios – *Ostrea*, *Pecten*, *Chlamys*, *Macrosolen*, *Spondylus*, *Tellina*, *Venus* and *Cardium*. They will be considered according to their way of life. This site is characterized by highly varying substratum – soft (clay), clay-limestone, sand and bottom outcrops of Precambrian metamorphic rocks. The soft, clay substratum is an indicator for a normal gas concentrations in the near-bottom, relatively calm water and favourable conditions for bivalve life. The paleocommunities' representatives lived below the intertidal zone, that is, within the sublittoral but not very deep.

Very well preserved shells of *Pecten* and *Chlamys* were found, as representatives of the moving category of filterers. These are bivalves with a dual way of life (nekton - benthos) characterized by thin shells with a hinge. The effectively swimming have symmetrical hinges and large apical angle.

The infauna was the most numerous, represented by burrowing forms like *Macrosolen*, *Tellina*, *Venus* and *Cardium*. Two genera, *Macrosolen* and *Tellina*, are related to the sludge-processors. They had long siphons, which allowed them to collect particles. We consider that the remaining genera representatives lived in sandy substrata (some maybe in clay ones).

Of the byssus attaching bivalves, shells of the genera *Venus*, *Cardium*, *Ostrea* and *Spondylus* were found. They are characterized by equally-shaped valves and vertically oriented valve-connection line. They led a semi-burrowing way of life and were attached by byssi.

The cementing category was represented by the genera *Ostrea* and *Spondylus*. *Ostrea* representatives were largest and probably formed *Ostrea* beds. Their shells are thick and heavy. They have irregular form and one muscle imprint. Because of the insufficient surface of hard (metamorphic) substratum they cemented themselves on the shells of older specimens.

All bivalves found are filterers with the exception of *Macrosolen* and *Tellina*, which are sludge-processors.

Peroushtiza site:

The site is part of a bay-like southward intrusion of the sea-basin that existed in the region of the Northern Rhodope slopes. Here, bivalves of the genera *Lima*, *Venus*, *Venericardia*, *Crassatella* and *Spondilus* were found, two of which, (*Crassatella* and *Spondilus*), for the first time in the region.

The infauna here was represented by burrowing forms, free-lying (*Lima*) and one cementing (*Spondilus*). Here, too, the presence of burrowing forms is an indicator of a normal gas concentrations in the sludge – *Venus*, *Venericardia*, *Crassatella*. They are with relatively elongated shells, well-manifested siphon area and faint ornamentation. Some are smooth-surfaced. They inhabited an unstable, sandy, soft substratum, according to their way of feeding they were filterers, they burrowed in shallow waters near the shore and were thermophilic.

The free-lying forms were represented by singly occurring specimens of the genus *Lima*.

One specimen of the cementing type was found of the genus *Spondilus*.

This fauna, too, is characteristic for a shallow-water, dynamic sea environment within the littoral.

Kozarsko and Zhrebichko site:

The sediments found here were formed in a calm, deeply cutting into the Rhodope land, bay. The sediments are chiefly sandy, and they determine the character of the substratum. The latter is soft, sand-silty, inhabited by infauna, which is an indicator for a normal gas concentrations in the bottom layer of water, which was calm and provided favourable living conditions. Here, too, the representatives of the paleocommunities inhabited the sublittoral zone.

Representative of the following bivalve genera were found on this site: *Venus*, *Venericardia*, *Crassatella* and *Pecten*.

The typical infauna is represented by species of the genera *Venus*, *Venericardia* and *Crassatella*. All of them are shallow burrowers and have fine, elongated shells. The venericardia were found in the form of nodes.

Of the cementing type we found singly occurring specimens of the genus *Ostrea*, relatively small-sized. Singly occurring specimens of the free swimming genus *Pecten* were found too.

CONCLUSION

The representatives of the class Bivalvia constituting the three described paleocommunities differ in their composition. Part of the reasons are determined largely by the type of bottom sediments. On the Assenovgrad – Rouen site they are most varied, which, respectively, determines the larger biodiversity and quantity representation. Other factors contributing to the character of sedimentation are the hydrodynamics, depth, geomorphology and shape of the coastline. The sites were in well formed bays with calm water and normal gas concentrations. The discovered infauna of sludge processors provides data about that. The bivalves found inhabited the littoral and sublittoral zones of the sea basin. The coastline was situated in the region of the present-day Northern Rhodope slopes.(fig.13.)

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