Hydro-geo-biological phenomena and climate change in Dobrogea, Romania - case study: Conacu-Negresti Valley

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Abstract

Conacu-Negresti Valley is located in the south-eastern part of Romania (southwest of Dobrogea), particularly in an area with excessive continental climate. The valley is characterized by a series of specific habitats, of which the most important are the dry steppe meadows, exposed limestone rocks and Conacu-Negresti Lake. This paper presents the data concerning the hydro-biological phenomena and climate change that have occurred in this geographical area. The data represent the results of the research activities developed within the framework of our scientific and educational program on the Conacu-Negresti Valley from 2002 until 2015.

Keywords: hydro-geo-biological phenomena, climate change, Conacu-Negresti Valley, Dobrogea Region, Romania

Introduction

Dobrogea is located on the northern Balkan Peninsula in southeastern Central Europe (44°17'03.77'' N, 28°21'53.27'' E). It occupies an area of approximately 23,142 km², of which 15,570 km² are located in Romania (making up 6.52% of the total area of Romania) and 7,572 km² in Bulgaria. Dobrogea Region is bordered by the lower Danube River to the southwest, west, northwest and north, the Danube Delta to the northeast, the Black Sea to the east and Ludogorie Plateau to the southeast and south (Figure 1. A; B). Conacu-Negresti Valley (Figure 1. C) is located in the extreme south-eastern part of Romania (south-eastern part of Europe), in the center of Cobadin Plateau, subunit of Negru-Vodă Plateau [1]; it falls within the following geographical coordinates: the parallel 43°58'48.93'' northern latitude and the meridian 28°10'05.12'' eastern longitude. Cobadin Plateau landscape consists of large and almost flat interfluves. There starts a series of short valleys discharging into the Danube River.
middle strata and marl clay at the base. Uppermost strata are dominated by debris facies with calcareous sandstones, micro-conglomerates, chalk, etc. [2-8]. The landscape of the valley consists of gorges with limestone walls, with limestones “up to day”, Conacu-Negresti Lake being located within this area, canyons, ravines, xerophyte steppe grasslands, grassy hills and bushes.

Material and Methods

By 2003, the valley was known only geographically. In 2003, we started a comprehensive long-term program of scientific research of the valley. Since then, we have carried on scientific research of the valley in geological, paleontological, paleo-biodiversity terms, and of conservation of its geo-biodiversity. During the scientific program carried out between 2002 and 2015, different stations were established for field observations, identification of species and sampling both from the lake and the valley. 10 stations were established at different points in the lake, taken differently depending on the nature of the substrate, lake depth and the existence of marsh, aquatic and floating vegetation. From these stations, samples were collected monthly. All samples were taken from the shore area of the lake, on the distance of two meters. For the land, 12 stations were established depending on the type of the existing habitats in the valley: limestone walls with “rocks to day”, grassy hills, plateaus, ravines, debris walls, limestone walls with fossil mollusks.

For identification, it was widely used field observations and photographs taken monthly by the team, during the field trips. Subsequently, all samples (both geological, paleontological and biological) have been transported, stored and examined / studied in our laboratories. The nomenclature of taxa and data processing is according to data from literature as well as to national and international legislation.

Results and Discussions

Dobrogea is distinguished by its special features from the rest of the country. Geographical position near the Black Sea, soil structure, climate, land history of Dobrogea, made this region show a characteristic fauna and flora, one mixture of Southern, Pontic-Caspian, Black Sea, European, Eurasian elements, etc. [9]. In South Dobrogea, the Conacu-Negresti Valley is located on a north-west to south-east axis.
It is a “Canara”, a term specific to Dobrogea, meaning a valley generally short, narrow, with limestone slopes, high and steep walls with small caves, partly covered with Sub Mediterranean xerophyte meadows and scrub forest vegetation [10]. The Conacu-Negresti Valley is distinguished by spectacular landscape beauty and is characterized by rich and diverse assemblage, with many rare or endemic species specific to Dobrogea Province. Its significance also is derived from its geological, geomorphologic, and paleontological characteristics [11,12].

The geo-diversity of the valley is very interesting, characterized by rare geological structures and geomorphological phenomena, as a result of a unique geological and paleontological history, specific to Dobrogea province [13,14]. So far, in the valley, we have identified a number of 101 terrestrial and aquatic species of invertebrates, belonging of 17 orders and 57 families [15-19].

Through the large number of specimens per species, the 22 terrestrial and aquatic species of gastropods identified thus far, belonging to 9 families grouped in 3 orders [20-25], have a very important role in the demonstration of climate change in the area. Among them, in the basin of the lake water (43059’15.94”N, 28009’24.52”E), 3 species of gastropods have a great scientific importance: Planorbarius corneus Linnaeus 1758, Esperiana esperi-Férussac 1823, Esperiana acicularis Férussac 1829 [26]. It is known that gastropod populations occupy an important place in the lake biocoenoses structure, by the specific and numerical diversity and biomass [27]. They are the first organisms that are investigated when examining a stagnant water. Their presence in large numbers indicates the level of oxygen in water, and therefore the presence of life in aquatic ecosystems. The presence of the gastropod P. corneus (Fam. Planorbiidae), in large number of specimens (464), species that indicates the existence of high levels of calcium ions in lake water, demonstrated that the valley has a strong limestone geological structure formed by the withdrawal of the former Sarmatian Sea. Moreover, the presence of this last-geological time sea is demonstrated in large numbers, by fossil species of mollusks present in large numbers here (such as Mactra sp.), and the limestone “to day” that dominates the valley. These fossil mollusks species are present in the limestone rocks from the coastal zone of the lake, on the limestone walls of the valley, in the canyons and ravines, on the Sarmatian coasts with “limestone rocks to day” [28-31]. The valley is a former branch of the Danube, linking the river and the Black Sea. This is demonstrated by the geological structure of the valley, shape and position of the two canyons in the south-west of the valley (Figure 2. A; B), and the presence in large numbers of three species of mollusks - one terrestrial xerophilous species (regional endemism spread on the Black Sea coast of Romania and Bulgaria) - Zebrina varnensis L. Pfeiffer 1847 (Fam. Enidae), and two aquatic species - Danubian and Pontic species (Southeast European-Pontian relics) – E. acicularis and E. esperi (Fam. Thiaridae).

Presently, Z. varnensis it found in numerous copies on the limestone walls with “rocks to day” (Figure 3. A), together with Chondrula tridens O. F. Müller 1774 and Zebrina detrita (syn. Helix detrita) Müller 1774, in the same family. Z. varnensis is a xerophilous species, highly resistant to drought, found on sunny slopes covered with herbaceous vegetation, in sandy areas [32-39]. Also, the fact that the valley is a former branch of the Danube is demonstrated by the presence of larvae of Paraponyx stratitata Linnaeus 1758 (Fam. Crambidae) from Lepidoptera, and Hebrus pusillus Fallen 1807 (Fam. Hebridae) from Heteroptera, species whose larvae have adaptations to aquatic life. These are rare species, known so far only from the Danube Delta [40-45]. In the north, the valley is dominated by the presence of the lake with the same name (Figure 3. B), of recent geological time, formed by natural damming. It was formed by water overflowing to another lake (Plopeni Lake) located south-west due to heavy amounts of rainfall. This natural phenomenon has led to frequent flooding of the downy oak forest that dominated the valley at the time [46,47].

Figure 2. A; B) Top views of some branches of the large canyon (original)
The lake has a sinusoidal form, shaped by the valley of the same name. During periods of heavy rainfall, the valley has a high level of water. And it can easily see ravines and small torrential bodies, which flows into this valley. Through the 60 years due to catastrophic flooding after heavy rains, water from Plopeni Lake located in the south and at an altitude higher than Conacu-Negresti Valley, poured over it, flooding it. Limestone structure of the valley, alluvium deposited after the flood, the ground water from groundwater sources in the valley, rainwater falling in the area led to the formation and maintenance of the lake today [48,49]. Along with the water was deposited an alluvial soil layer of about 1 cm, which reduced the infiltration of water into the soil, thus forming the Conacu-Negresti Lake. The limestone bed, which could not absorb water, the underground springs and intensive irrigation in the 1980s, favored the maintenance of this body of water.

The valley was previously dominated by a dense forest of pubescent oak (Quercus pubescens Wild. 1805), the remnants of which can be seen on the lake bottom. This forest was part of Cobadin Forest, part of the “Deliorman” Secular Forests (name from Cumana Language, which translated “Black Wood”). These forests, largely disappeared today, spanning in southern of two biogeographic regions, Dobrogea and Muntenia. Instead of these forests, dry steppe ecosystems emerged and developed [50-52]. This led to the disappearance of the wolf (Canis lupus Linnaeus 1758) from Southern Dobrogea. Although its presence is detected in the southern areas of South Dobrogea, the wolf disappeared completely from Conacu-Negresti Valley.

The existence of this forest is proved by the limestone walls tilt and the existing of herbaceous and shrub plant species in the canyons of the southwest of the valley or on the grassy hills and limestone walls, such as Prunus spinosa L. 1753, Crataegus monogyna Jacq. 1760, Prunes’ (Padus) mahaleb L. 1753, etc. [53-71].

Also, the proof that the valley was dominated by an oak forest is the presence of invertebrate’s species, such as gastropods Z. detrita and C. tridens, the insect Cerambyx cerdo Linnaeus 1758 (Fam. Cerambycidae), etc., which normally live together in an oak forest [72]. The presence of two species Z. detrita, large snail, and C. tridens (relatively common species in the foliage of oak forests) previously confirmed the existence of the pubescent oak forest (Q. pubescens); however, it is no longer found in Conacu-Negresti Valley today. These are xerophilous species belonging to the genera of West Asian origin.

Currently, the valley is dominated by the lake with the same name, and by limestone plateaus, and the two canyons located in the southwest of the valley, and rocky cliffs. Within these habitats, there have developed species of herbaceous plants and shrubs, and animals specific to dry and sandy steppe areas. Many of them are rare, endemic, specific to Dobrogea Province [73,74]. On the limestone slopes with “rocks to day”, on plateaus, hills and canyons in the southwest of the valley, it is worth mentioning many individuals of the gastropods Cepaea vindobonensis A. Férussac 1821 (common snail in the whole Dobrogea, widespread in our country) and Helicella ovia dobroudscha Clessin 1886 (xerophilous species, endemic to Dobrogea), both species from Family Helicidae. Compared with wolf, fox species Vulpes sp. Frisch 1775 is present in the sandy areas. They burrow in sandy canyon walls [75].

The valley is the “house” of three lizard species specific to Dobrogea. Of these, in crevices in stone walls, it can meet "the wall lizard" (Lacerta (Podarcis) muralis ssp. maculiventris Werner 1891). It was quoted only for wooded areas and with rocky walls in southern and northern Dobrogea. The presence of this lizard in the valley demonstrates, once again, the existence of downy oak forest [76-80]. The appearance of dry steppe ecosystems instead of mirkwood, leading to the appearance of the ground squirrel (S Linnaeus 1766) (Fam. Sciuridae), a species endemic to Europe, characteristic to steppe grasslands. Currently, it is strongly endangered due to strong human intervention in natural areas [81-84].

Figure 3. A) Grassy hill with “limestone to day”; B) The lake and geomorphological processes existing in the valley (original)
Conclusions

Until 2003, the valley was known only from the geographical field studies and research of Mrs. Dr. Sofia Iana, University of Bucharest, on the Negru Vodă Plateau, Dobrogea. In 2003, we developed a research project on the geo-biodiversity of Conacu-Negresti Valley. The own effort became a permanent research program, undertaking new research and public education projects for environmental protection of this valley. Currently, there is no research on the palaeo-bio-diversity, geological structures and hydro-geo-biological and climate change phenomena of this valley from Dobrogea Region. Our findings are unique. In the future, they will be upgraded with new data and research of laboratory and field.

Moreover, our research on the valley is singular. No literature data were found in this field on this region. The data presented in this work were compiled from field and laboratory studies conducted in 2003 - 2015. The valley is a former branch of the Danube River, formed on the former Sarmatian Sea. In the past, it was dominated by a dense forest of pubescent oak which, during recent geological time, disappeared due to the strong hydrological and climatic phenomena that occurred in the area. Currently, it is a dry valley. The fossil and actual species that have been discovered in this area gives us the possibility of reconstitution the palaeo-ecosystems in this region correlating them with current ecosystems, and also of it natural history. At present, the valley does not have a designated conservation status. Human impacts on different aspects may contribute to future declines in Conacu-Negresti Valley. Due to its unique nature, which resulted from its geological and paleontological past, the valley hosts many actual and fossil species, and geological structures and geomorphological phenomena, important to science and human well-being, some of these aspects have not yet been described. Such efforts will be the focus of future work in this research program.

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Conflict of interest

There is no conflict of interest between the two authors of the work.

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