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SOFIA UNIVERSITY
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SOFIA UNIVERSITY -
MARKING MOMENTUM
FOR INNOVATION AND TECHNOLOGICAL TRANSFER

National Recovery and Resilience Plan
OF THE REPUBLIC OF BULGARIA

DIGITIZATION OF MATERIALS FROM THE ZOOLOGICAL COLLECTION OF SOFIA UNIVERSITY "ST. KLIMENT OHRIDSKI" (BFUS)

INTRODUCTION

Fig. 1. A small part of the bird collection

Fig. 2. Skull of *Lutra lutra* (Linnaeus, 1758)

Zoological collections are invaluable resources for studying biodiversity, ecology, evolution, taxonomy, and for training Bachelor's, Master's, and PhD students. The Zoological Collection of Sofia University "St. Kliment Ohridski" (BFUS) is one of the most extensive in the country. It comprises over 120,000 specimens representing diverse animal groups (Figs. 1–3), including type specimens used to describe species new to science. Since the late 19th century, faculty and staff of the Department of Zoology and Anthropology have collected these materials not only from Bulgaria but also from other countries. Additionally, the collection includes specimens gathered during field practices conducted by students and faculty members.

Despite its size and scientific significance, a large portion of the collection remains unanalyzed, and its associated data unpublished. These data are of substantial scientific value, given the collection's long history and the wide geographical range of the collected materials.

Digitizing scientific collections greatly enhances their accessibility for research, the publication of taxonomic and faunistic data, and public access to these valuable resources.

PROJECT GUIDELINES

The project aims to establish a modern zoological collection enriched with multimedia resources, making it accessible for diverse scientific research and education in Zoology and related sciences. To achieve this, the following tasks are proposed: systematization and detailed investigation of specimens in the Zoological Collection of Sofia University "St. Kliment Ohridski"; creation of thematic sub-collections within a digital collection management platform; digitization of specimen-associated data, including primary collection details and identification records; development of a multimedia database featuring camera trap footage, audio recordings, and other visual resources; design and implementation of a web portal to provide global online access to the collection and its associated data.

METHODOLOGY

Fig. 3. Part of the teaching invertebrate collection

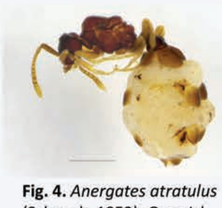

Fig. 4. *Anergates atratulus* (Schenck, 1852), Gozo Isl., Malta

The methodology combines innovative approaches for digitization and data management, ensuring the long-term scientific and cultural significance of the Zoological Collection of Sofia University "St. Kliment Ohridski".

1. Selection of Priority Groups and Species for Digitization

The prioritization of groups and species for digitization will be based on the following criteria: Unique collections of high scientific value; understudied groups; educational collections used in academic and training activities; type specimens used in the description of species new to science (Figs. 7, 8); rare and newly recorded species in the Bulgarian fauna; species of conservation significance; non-native species of ecological and biogeographical interest (Fig. 11).

2. Preparation of Collection Specimens

The preparation process includes the following steps: preparation and labeling of specimens to ensure their long-term preservation; identification of undetermined specimens by the experts from the department, using taxonomic literature and available databases; compilation of systematic collections from the selected groups, organized according to the latest taxonomic classifications.

3. Platform for Digital Collection Management

For efficient management and storage of the digitized data, a digital collection management platform will be selected. The platform will be configured as a web-based database hosted on a server, with thematic collections created to reflect the specific characteristics of each taxonomic group. This structure will enable efficient input, organization, and retrieval of data.

4. Digitization of Zoological Materials

The digitization process will involve the following steps: pre-input of metadata, including the taxonomic tree, collection and preparation methods, and other relevant information; entry of detailed information about the collection objects, such as taxonomic affiliation, geographical origin, and specific characteristics; high-quality imaging of representative specimens from different animal groups.

5. Dissemination and Accessibility

The digitized collection will be made accessible through an online platform, providing open access to the scientific community, educational institutions, and the general public. This approach will enhance the visibility of the Zoological Collection and promote its use for scientific research, education, and public engagement.

By following this methodology, the project ensures the comprehensive digitization, systematic organization, and accessibility of the Zoological Collection, enabling its usability for diverse purposes.

RESULTS

During the first year of the project, the following groups of invertebrate and vertebrate animals were selected as priorities:

- Invertebrates: Ixodidae, Analgoidea, Pterolichoidea, Hydrachnidia (Acari); Balanidae (Crustacea); Carabidae, Cleridae, Nitidulidae, Meloidae, Oedemeridae, Cerambycidae, Symphyta, Formicidae (Insecta).
- Vertebrates: Cephalochordata, Tunicata, Agnatha, Chondrichthyes, Actinopterygii, Amphibia, Reptilia, Aves, and Mammalia.

The teaching collection of vertebrate animals housed in the Department of Zoology and Anthropology, assembled since the early 20th century, has been inventoried (Figs. 1, 2). It contains 344 species, including a number of rare and endangered taxa of significant scientific value.

The Zoological Collection also preserves entomological materials from various geographic regions (Figs. 4 , 5).

Fig. 5. Representatives of the genera *Carabus*, *Cychrus* and *Scarites* (Coleoptera: Carabidae) from the Mediterranean region

Fig. 6. Part of water mites (Hydrachnidia) collection, preserved in BFUS

The processing of materials involves sorting and labeling specimens, identification, and the preparation of systematic collections (Figs. 5, 6, 10).

The digitization of the Zoological Collection at Sofia University (BFUS) was carried out using Specify 7, a specialized platform for digital collection management. The software was configured and installed on a server hosted by Sofia University, and it is accessible online at https://bfus.biofac.uni-sofia.bg/.

The platform was customized to include thematic sub-collections for different taxonomic groups, enabling the efficient organization of data. Information about each specimen was entered into the database, including taxonomic identification, label data, locality information with geographic coordinates collection date and method, number of specimens, etc.

The digitization workflow was streamlined using online data entry forms tailored to the specifics of each taxonomic group. These forms include general fields as well as group-specific fields to ensure the comprehensive documentation of specimen details.

Each specimen is assigned a unique catalog number that incorporates the official abbreviation of the Zoological Collection, "BFUS," followed by an abbreviation representing the taxonomic group. For example, the catalog number of a male holotype specimen of the *subspecies Morimus verecundus bulgaricus* Danilevsky, 2016 (Cerambycidae) is BFUS-CER000001 (Fig. 8)

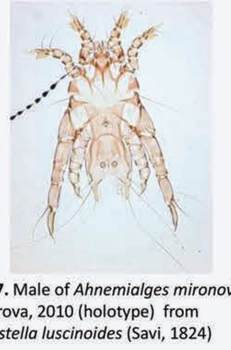

Fig. 7. Male of *Ahnemialges mironovi* Kolarova, 2010 (holotype) from *Locustella luscinoides* (Savi, 1824)

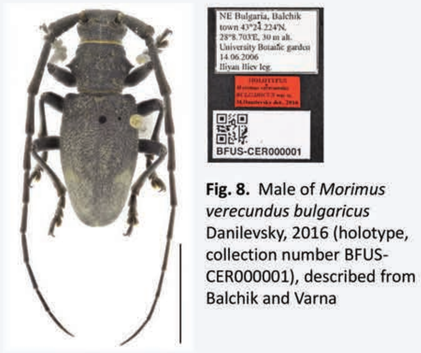

Fig. 8. Male of *Morimus verecundus bulgaricus* Danilevsky, 2016 (holotype, collection number BFUS-CER000001), described from Balchik and Varna

By the end of the first year, a total of 2,230 specimens from the prepared systematic collections had been digitized. These specimens represent 125 genera, 247 species, and 55 subspecies (Tabl. 1).

The digitization process and database maintenance are overseen by the curator of the Zoological Collection, Dr. Ognyan Sivilov, ensuring data accuracy and the sustainability of the digital repository.

As a result of the project work, Kolarova et al. (2024) published original data on the distribution of eight species of hard ticks (*Acari: Ixodida: Ixodidae*). In Fig. 9, an image of a specimen of *Rhipicephalus turanicus* Pomerantsev, 1936 is presented, a species known from several localities in the country.

Tabl. 1. Digitalized specimens from the prepared systematic collections by the end of the first year

Collection	Specimens	Genera	Species	Subspecies
Cerambycidae	776	41	69	45
Cleridae	590	11	20	3
Hydrachnidia	134	9	24	
Hymenoptera	418	40	94	
Meloidae	117	13	19	2
Nitidulidae	4	3	4	
Oedemeridae	191	8	17	5
Total number	**2230**	**125**	**247**	**55**

Eighteen species of the family Meloidae (*Coleoptera*) have been reported from the Bulgarian part of the Sakar Mountains (Gradinarov & Petrova, 2024a). All these species represent new records for the mountain's territory. Based on specimens housed at BFUS, a systematic collection of Meloidae was assembled (Fig. 10), and 117 specimens were digitized.

Fig. 9. Male of *Rhipicephalus turanicus* from Sakar Mts. A – dorsal; B – ventral (photo from Kolarova et al., 2024)

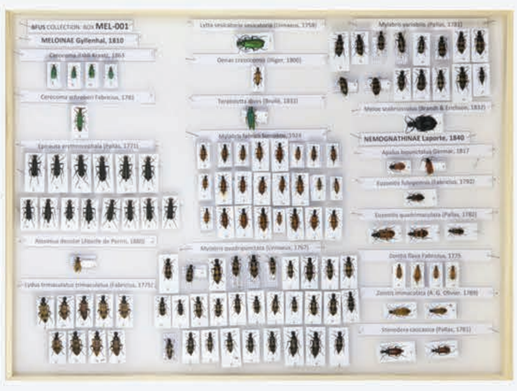

Fig. 10. Part of the Meloidae collection, preserved in BFUS – blister beetles from Sakar Mts (Gradinarov & Petrova, 2024a).

Data on the distribution and biology of four alien to Europe species from the family Nitidulidae (*Coleoptera*) were published by Gradinarov & Petrova (2024b). The species *Phenolia picta* (Fig. 11) was published for the first time for Bulgaria.

During the study of the distribution of non-native invertebrate species in the Black Sea fauna, Prof. Plamen Mitov rediscovered the striped acorn barnacle, *Amphibalanus amphitrite* (Crustacea: Balanidae), nearly 70 years after it was last recorded in the area (Fig. 12). This species is native to the southwestern Pacific and Indian Oceans. As a typical fouling organism, it has spread widely through global shipping activity. Its rediscovery is of significant biological and ecological interest. A manuscript presenting the findings is currently under review (Mitov, under review), and some specimens have been deposited in the Zoological Collection.

Fig. 11. Male of *Phenolia picta* (W. S. MacLeay, 1825) – newly found alien species in Bulgaria, collection number BFUS-COL000003 (photo from Gradinarov & Petrova, 2024b)

Fig. 12 . *Amphibalanus amphitrite* (Crustacea: Balanidae) from Black Sea, preserved in BFUS

CONCLUSION

The digitization, systematic organization, and enhanced accessibility of the Zoological Collection of Sofia University "St. Kliment Ohridski" (BFUS) ensure its long-term preservation and usability for research, education, and conservation efforts.

Publications

1) Kolarova N., Gradinarov D. & Petrova Y. 2024. Hard ticks (Acari: Ixodida) in Sakar Mountains, SE Bulgaria. Georgiev, D. & Yancheva, V. (Eds.*): Fauna of Sakar Mts, Part 1. ZooNotes*, Supplement 15: 20-31
2) Gradinarov D. & Petrova Y. 2024a. Blister beetles (Coleoptera: Meloidae) in Sakar Mountains, Bulgaria. Georgiev, D. & Yancheva, V. (Eds.) *Fauna of Sakar Mts, Part 1 ZooNotes*, Supplement 15: 32-42
3) Gradinarov D. & Petrova Y. 2024b. Four alien fruit-feeding sap beetle species (Coleoptera: Nitidulidae) from Sakar Mts, Bulgaria. In: Georgiev, D. & Yancheva, V. (Eds.). *Fauna of Fauna of Sakar Mts, Part 1. ZooNotes*, Supplement 15: 43-50
4) Mitov P. (under review). The alien acorn barnacle *Amphibalanus amphitrite* (Darwin, 1854) (Balanidae, Balanomorpha, Crustacea) newly recorded from the Bulgarian Black Sea Coast. *Acta Zoologica Bulgarica*

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