Journal of Life Sciences & Biomedicine, vol. 6(79), No 2, p. 75-79 (2024)

“Year of solidarity for the Green World”: the importance of zoological research for biodiversity conservation in Azerbaijan

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Received: September 5, 2024; Received in revised form: October 30, 2024; Accepted: December 10, 2024

In 2024, Azerbaijan declared the "Year of Solidarity for the Green World" to address environmental challenges and promote sustainable development, aligning with global efforts against climate change. The article explores key tasks in modern zoology, focusing on innovative methodologies, such as remote sensing, Geographic Information Systems (GIS), ecological modeling, and citizen science. Recent studies conducted by the Institute of Zoology highlight the application of these modern methods. Research on soil ciliates and the biodiversity in the Kura River basin ciliates showcases the importance of ecological parameters in ecosystem dynamics, and the study of mammals and reptiles once again confirms the importance of the information obtained in the preservation of biodiversity.

Research on the reintroduction of large mammals in territories liberated from occupation and Karabakh highlights opportunities for ecological restoration. As a result, these studies demonstrated the commitment of Azerbaijan's zoologists to leverage innovative technologies for biodiversity conservation, addressing the challenges posed by climate change and habitat loss of fauna species while fostering a deeper understanding of the region's rich fauna.

Keywords: *Azerbaijan, green world, climate change, biodiversity conservation, innovative technologies*

INTRODUCTION

The "Year of Solidarity for the Green World" was adopted by the Azerbaijan Republic in 2024 through a decree by President Ilham Aliyev as a national initiative to address pressing environmental challenges and promote sustainable development. This initiative aligns with global efforts to combat climate change and protect biodiversity, emphasizing the role of research and innovation in these efforts. In the context of zoological research, the declaration plays a critical role by encouraging the study of Azerbaijan's rich fauna, the effects of climate change on wildlife, and the application of advanced technologies to monitor and conserve the country's unique ecosystems. This synergy between national policy and scientific research aims to safeguard biodiversity, protect ecosystems, and enhance environmental resilience.

MATERIALS AND METHODS

Existing literature information was used in writing the article. Modern zoological science has an array of critical tasks. These tasks not only focus on understanding and mitigating the impacts of climate change on wildlife but also leverage technological advancements to enhance conservation efforts. This article explores key tasks within modern zoological science, backed by literary sources that highlight recent research and advancements in the field.

RESULTS AND DISCUSSION

Modern zoology employs a range of innovative methodologies that are essential for

https://doi.org/10.59849/2710-4915.2024.2.75
Available online 31 December 2024

understanding and conserving biodiversity in the face of ongoing environmental challenges. These contemporary techniques not only enhance research capabilities but also provide critical insights for effective conservation strategies. This overview highlights several modern methods, including advancements in genetic technologies, the integration of remote sensing and Geographic Information Systems (GIS), the application of ecological modeling, and the promotion of citizen science initiatives. By leveraging these advanced approaches, zoologists are better equipped to address the pressing issues related to climate change and habitat loss.

Advancements in genetic technologies have significantly transformed conservation efforts within modern zoology. Conservation genetics has become a crucial tool for understanding genetic diversity within and between populations, which is essential for ensuring species' resilience to environmental changes (Frankham, 2010). Techniques such as DNA barcoding and genome sequencing are now widely employed to assess genetic diversity and inform effective conservation strategies (Hebert et al., 2003).

The integration of remote sensing and Geographic Information Systems (GIS) has also become indispensable in contemporary zoological research. These technologies facilitate large-scale data collection, allowing scientists to monitor habitat changes and model species distributions under various climate scenarios (Turner et al., 2003; Pettorelli et al., 2005). By utilizing these tools, researchers can gain valuable insights into how environmental changes impact wildlife.

Ecological modeling and simulation represent another cutting-edge methodology in modern zoology. These approaches help elucidate complex ecological processes and predict future scenarios by simulating the impacts of climate change on ecosystems and species interactions (Urban et al., 2016). Such predictive modeling is crucial for conservation planning and prioritizing efforts to protect vulnerable species.

Furthermore, promoting citizen science initiatives has emerged as a vital strategy in modern zoology. Engaging the public in data collection not only enhances research efforts but also raises awareness about conservation issues, fostering a deeper connection between communities and nature (Silvertown, 2009; Bonney et al., 2009). Citizen science empowers individuals to contribute to biodiversity monitoring and conservation, creating a sense of ownership over local ecosystems.

The analysis of recent publications by the employees of the Institute of Zoology highlights a broad spectrum of scientific research utilizing advanced methodologies in various fields of biology and ecology. A key area of focus has been the role of trophic factors in the microzonal distribution of soil ciliates, as explored by I.Alekperov. His study emphasizes the influence of food availability and ecological parameters on the distribution of these organisms across different microzones, offering critical insights into ecosystem dynamics and soil community structures (Alekperov, 2021).

Building on this, I.Alekperov, together with E.Tahirova, has conducted an extensive examination of the biodiversity of free-living ciliates in the Kura River basin. By employing modern classification techniques and detailed morphological analysis, they assess the biological diversity of these microorganisms and underscore their ecological significance within river ecosystems, further expanding the understanding of freshwater biodiversity (Алекперов, Тагирова, 2020).

In parallel, Morhun et al. have made significant strides using molecular markers and scanning electron microscopy (SEM) to uncover pseudocryptic diversity in the amphipod species *Dikerogammarus bispinosus*. Their work reveals previously hidden species diversity, which holds important implications for managing biological invasions in the Ponto-Caspian ecosystems. This kind of research is vital for informing strategies to control invasive species that threaten ecological balance (Morhun et al., 2022).

In Azerbaijan, the work carried out in the field of increasing rare and endangered species and their reintroduction to the areas where they were historically inhabited is of great importance. For example, based on international experience, was launched in order to achieve restoration of gazelles in new areas by releasing them to their historical areasthe project "Protection, reintroduction and restoration of historical areas of gazelles in the territory of the Republic of

Azerbaijan". The project started in 2010 is being implemented by the Ministry of Ecology and Natural Resources with the support of the Heydar Aliyev Foundation, IDEA Public Union and WWF Azerbaijan Representation.

Conservation efforts of carnivorous mammals in the South Caucasus are also well represented in the work of E.Askerov and colleagues. In a pivotal study from 2015, they provided the first evidence of the leopard (Panthera pardus) reoccupying its historic range in the region, using field data to confirm this critical biodiversity event (Askerov et al., 2015). This finding was later expanded upon in 2018 when E.Askerov et al. emphasized the importance of the southeastern Lesser Caucasus as a crucial landscape for leopard conservation. They outlined key conservation strategies and highlighted the necessity of cross-border cooperation to ensure the survival of this iconic species (Askerov et al., 2018).

Another essential contribution to biodiversity research comes from N.Snegovaya et al., who employed genetic data to develop a molecular phylogeny of the dragonfly family *Aeshnidae*, with particular attention to species in the Western Palearctic. This study not only refines species classification but also contributes to a deeper understanding of their evolutionary history and biogeographical patterns, showcasing how genetic tools can illuminate species' past and present dynamics (Schneider et al., 2023).

Shifting the focus to the post-conflict region of Karabakh, A.Eyvazov's research examines the potential for reintroducing large mammals to the liberated territories. His work assesses the current state of fauna in the region and explores the opportunities for restoring populations of endangered species, reflecting the growing interest in post-war ecological restoration (Eyvazov, 2021). Complementary to this, a study by A.Eyvazov, T.Iskenderov, and G.Gasimova investigates the reptiles inhabiting the same region. The detailed description of these species not only contributes to understanding the biodiversity of the area but also highlights the ecological significance of their habitats (Eyvazov et al., 2022).

F.Rzayev and his colleagues have also made notable advancements in understanding environmental health, focusing on the bioaccumulation of aluminum nanoparticles in simplified aquatic food chains. Through microscopic methods, their research assesses the impact of these nanoparticles on different trophic levels, offering crucial insights into the potential ecological consequences of nanoparticle contamination in aquatic ecosystems (Rzayev et al., 2021).

In addition to these studies, E. Yusifov and E. Ahmadov (2021) summarized the results of the studies conducted at the Institute of Zoology and it was emphasized that the fauna of Azerbaijan includes over 40,000 species.

Their work notes that the ornitofauna comprises 405 species from 19 families, many of which are included in the IUCN Red List. The fish fauna consists of 99 taxa, while mammals, reptiles, and arachnids include 115 species, 63 species, and 1,837 species, respectively. Class Insecta is represented by over 10,000 species (Yusifov and Ahmadov, 2021).

For the first time, the categories and criteria used in the compilation of the IUCN Red List were taken as the basis for determining the statuses of the species included in the III edition of the "Red Book" (2023). In this book, species have been assessed using the IUCN Red List categories and criteria, version 3.1 before applying the IUCN Guidelines for Application of IUCN Red List Criteria at Regional and National Levels.

As a result of an assessment according to IUCN categories and criteria, 7 species of aquatic invertebrates, 82 species of insects, 11 species of fish, 6 species of amphibians, 18 species of reptiles, 78 species of birds, 39 species of mammals are included in the III edition of the Red Book, published in 2023. The number of species included in the pink list, compiled for the first time, is 41 (Red Book of the Republic of Azerbaijan. Fauna, 2023).

As a result of multi-year research conducted in the Institute of Zoology in recent years, now fauna includes more than 2000 species of free-living and parasitic protozoa, more than 2000 species of helminths that parasitize humans and animals, more than 400 species of phytohelminths, up to 290 species of rotators, more than 360 species of crustaceans, more than

14,000 species of insects, More than 1200 species of arachnids, more than 1100 species of ticks, more than 181 species of mollusks, and the vertebrate animal kingdom is represented by 701 species, including 1 cyclostomi, 104 fish, 11 amphibians, 63 reptiles, 407 birds, and 115 mammals (Taxonomic spectrum of Azerbaijani fauna (*Protozoa* and *Helminths*), 2022; Information system of Azerbaijani fauna (*Vertebrates*), 2023).

Together, these studies underscore the Institute of Zoology's commitment to applying a variety of methodological approaches-molecular markers and scanning electron microscopy to in-depth ecological analyses to address pressing problems in biodiversity and ecosystem research. This body of work not only advances scientific knowledge but also provides practical insights for conservation and environmental management efforts in Azerbaijan and beyond.

CONCLUSION

The adoption of the "Year of Solidarity for the Green World" by Azerbaijan highlights the critical intersection of national policy and scientific research in addressing environmental challenges. By leveraging innovative methodologies and technologies, the zoological community is well-equipped to tackle the impacts of climate change and habitat loss, ensuring the preservation of biodiversity and ecosystems in Azerbaijan. This commitment to advancing research and conservation efforts will contribute significantly to understanding and protecting the region's rich fauna, ultimately fostering a more sustainable future.

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