Assessment of Diversity and Conservation Value of Reptile Specimens in the Animal Specimen Museum of Xinjiang Agricultural University

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Abstract: Specimens of animals are very significant in the study of faunal taxonomy, zoogeography, environmental ecology, and biological resources. For the purpose of enhancing the functions of the Animal Specimen Museum of Xinjiang Agricultural University in university education, academic research, and public education, and realizing the true potential social and scientific values of the museum, this paper conducted a thorough investigation and categorization of the reptile specimens preserved in the Animal Specimen Museum. It involved improving the specimen numbering process, applying proper specimen naming procedures based on current taxonomy lists, and utilizing different techniques like morphology analysis and conservation status of endangered species assessment.Information from the specimens was then analyzed using statistics and digitized electronically. The number of species of reptiles held at the museum is 54, which fall into 3 orders, 12 families, and 27 genera.In this regard, 9 species are found on the National List of Key Protected Wildlife Species, 45 species are included on the List of Terrestrial Wildlife with Significant Ecological, Scientific, and Socio-Cultural Importance, while 53 species can be seen in the China Biodiversity Red List.In conclusion, this study has been successful in digitizing 6,271 reptiles and taking 31,355 photos. The study findings suggest that the reptiles within the museum collections are found within the key geographical areas of Xinjiang, representing a high number of species and underscoring the need for reptile resource conservation within Xinjiang.Further research will be conducted to understand more about the diversity of reptiles and their compositions in Xinjiang, which will provide theoretical foundations for future research into morphologies of reptiles, habitats, and the current conservation status of endangered reptiles.

Keywords: Animal specimen museum; Reptiles; Diversity; Specimen preservation; Conservation list

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Specimen collections are permanent archives of scientific knowledge acquisition and human natural history. As basic samples in biology study, anatomy study, and science promotion, the importance of specimens in animal taxonomy, geographic distribution, ecology, and biological resources cannot be underestimated[1][2]. University specimen museums serve not only as important venues for teaching and scientific research in majors such as life sciences, but also as key bases for science popularization education and patriotism education, as well as important windows for domestic and international cultural exchanges[3][4]. To fully leverage the teaching, research, and social education functions of the specimen museum, it is particularly necessary to systematically sort out its collection resources and explore their potential social and scientific values.

Existing studies have shown that multiple university specimen museums, such as Fujian Normal University[5] and Northwest Normal University[6], as well as institutions including the Shaanxi Institute of Zoology[7] and the Wuhan Natural History Museum[8], have carried out work such as verification, sorting, filing, and statistical analysis of collected specimens, providing data support for the scientific utilization of specimen resources. These practices fully prove that specimen reorganization and analysis are key steps in the scientific management of specimen museums, resource integration, and biodiversity research, and are of great value for biodiversity conservation.

Located in the border area of northwestern China, Xinjiang has a vast territory and complex terrain, covering various ecological environments such as mountains, deserts, and oases, which have nurtured rich biodiversity. As a bridge connecting aquatic and terrestrial ecosystems, reptiles play an important role in maintaining ecological balance, promoting biological evolution, and advancing ecological civilization construction[9]-[11]. The Animal Specimen Museum of Xinjiang Agricultural University currently houses more than 12,000 specimens, among which reptile specimens are abundant and of high quality, ranking among the top in Xinjiang. A total of 6,271 specimens were digitized in this study, and the systematic sorting of these specimens is of great research and practical significance.

1 Materials and Methods

1.1 Overview of the Research Objects

The Animal Specimen Museum of Xinjiang Agricultural University has more than 12,000 specimens, which have been collected, produced, identified, and managed since the early 1950s, embodying the efforts of several generations of scientific researchers. In recent years, relying on projects such as the Third Comprehensive Scientific Expedition of Xinjiang, the number of collected specimens has continued to increase, providing abundant materials for this study.

1.2 Research Methods

（1）Specimen Sorting: Re-verification of classification and identification, as well as information improvement, were conducted for the specimens. Nomenclature was standardized with reference to the Updated Checklist of Chinese Amphibians and Reptiles[12] and the

Catalogue of Life China[13]. The numbering system was improved, and information was input into Excel spreadsheets for filing.

（2） Morphological Analysis: External morphological characteristics of the specimens, such as body length and tail length, were measured. Data were recorded in detail and input into Excel spreadsheets, providing a basis for species classification and adaptability research.

（3） Analysis of Original Geographical Distribution: Information on the collection locations of the specimens was counted and filed. Focus was placed on analyzing the distribution rules in Xinjiang to provide scientific support for the protection and management of ecosystems.

（4） Analysis of Endangered and Protected Species: With reference to the National Key Protected Wild Animal List[14] released in 2021, the List of Terrestrial Wild Animals with Important Ecological, Scientific and Social Values[15] issued by the State Council in 2000 (updated in 2023), and the China Biodiversity Red List[16], the number and types of protected species in the collected specimens were counted.

（5） Specimen Digitization: Photos were taken of the whole specimens and parts like their heads and backs using a camera from different angles. The process of digitally documenting the specimens was completed by recording data about the collection.

（6） Data Statistical Analysis: Statistical analysis, including percentage species composition and geographical distribution frequency, was performed using Excel for the analyzed data, which helped identify the reptile community structure and diversity distribution pattern in Xinjiang.

2 Results and Analysis

2.1 Analysis of the Group Distribution of Collected Reptilia Specimens

The Animal Specimen Museum of Xinjiang Agricultural University houses a total of 54 species of reptile specimens, belonging to 3 orders, 12 families, and 27 genera. The distribution of each family is shown in Figure 1.

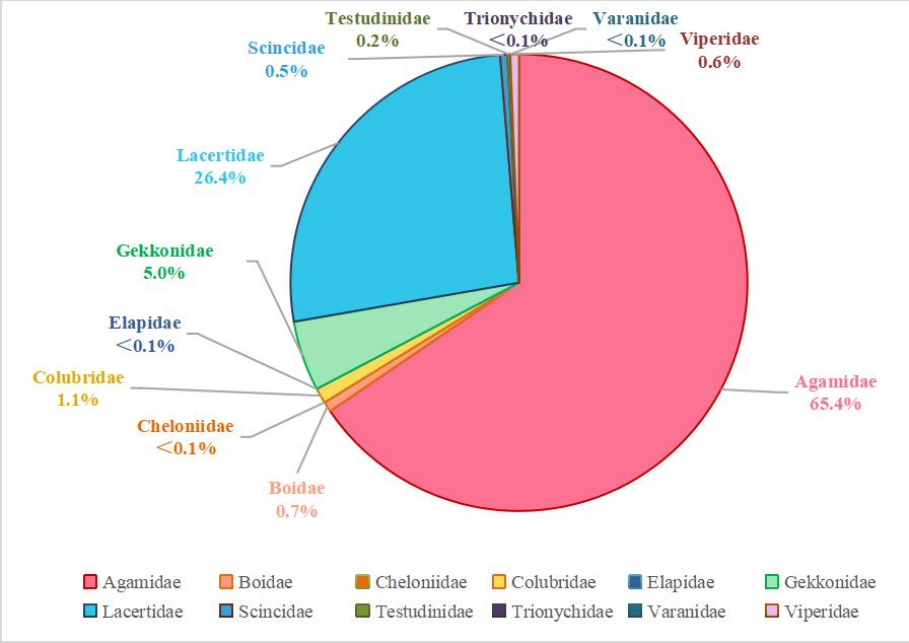

Fig.1 Taxonomic composition of the reptile collection by Family

2.2 Analysis of the Original Geographical Distribution of Collected Reptilia Specimens

The collection locations of the reptile specimens cover Xinjiang, Gansu, Tibet, and other regions, among which 43 species of specimens were collected in Xinjiang, distributed in Urumqi, Tacheng, Ili, and other areas. Statistics show that Ili Prefecture has the largest number of specimen species (17 species), reflecting that the suitable ecological environment in this region provides good living conditions for reptiles.

2.3 Analysis of Key Protected and Endangered Reptile Specimens in the Collection

Among the 54 species of reptile specimens in the collection, 9 species are included in the National Key Protected Wild Animal List (4 Class I species and 5 Class II species), totaling 123 specimens, accounting for 1.96% of the total number of reptile specimens; 45 species are included in the List of Terrestrial Wild Animals with Important Ecological, Scientific and Social Values, and 53 species are included in the China Biodiversity Red List; there are 5 endemic species in China, namely *Phrynocephalus forsythii*, *Phrynocephalus vlangalii*, *Eremias brenchleyi*, *Teratoscincus roborowskii*, and *Laudakia wui*.

2.4 Digitization of Collected Reptile Specimens

In this study, the digitization of 6,271 reptile specimens was completed. Multi-angle photos of the morphological characteristics of the specimens were taken, and a total of 31,355 photos were collected. Some digitized photos are shown in Figures 2~5, providing convenient conditions for specimen resource sharing and subsequent research.

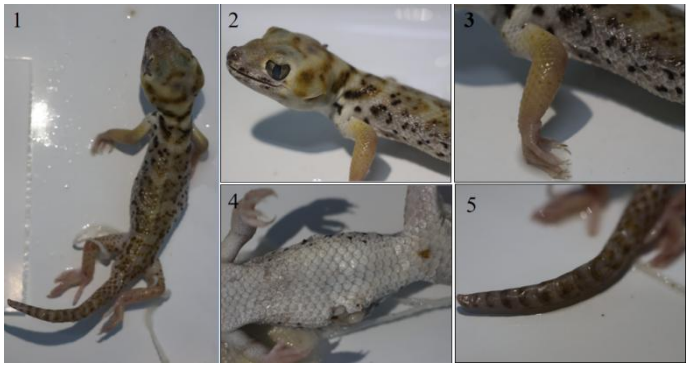

Fig.2 *Teratoscincus przewalskii*

1: Whole body 2: Head 3: Foot 4: Abdomen/Ventral side 5: Foot

Fig.3 *Vipera berus*

1: Teeth 2: Dorsum 3: Tail 4: Head 5: Whole body 6: Ventrum

Fig.4 *Trapelus sanguinolentus*

1: Whole body 2: Abdomen 3: Claws 4: Head 5: Tail

Fig.5 *Eryx tataricus*

1: Head (dorsal view) 2: Head (ventral view) 3: Tail (ventral view) 4: Dorsal view 5: Whole body 6: Tail (dorsal view)

3 Discussion

3.1 Importance of Specimen Sorting and Classification

During this sorting process, it was found that some specimens had problems such as damage, label loss, and incomplete information due

to long-term storage and frequent handling, which affected their scientific research value. At the same time, with the development of taxonomic research, some species names need to be updated and standardized. For example, the old name "*Agama stoliczkana*" was renamed "*Laudakia stoliczkana*"; specimens originally identified as "*Phrymoephalus albolineafu*" with reference to Fauna Sinica·Reptilia Volume 2 (Squamata: Lacertilia) were renamed "*Phrynocephalus melanurus*"; and the synonym "*Eryx orentalisxinjiangensis*" of the genus *Eryx* was unified as "*Eryx tataricus*"[17]. Standardized classification, identification, and sorting have improved the specimen numbering and naming system, clarified the taxonomic composition of 54 reptile species in the collection, and laid a foundation for the management, resource integration, and subsequent research of the specimen museum.

The morphological data such as body length and tail length measured in this study provide support for the study of species morphological differences and classification. Studies have shown that different habitats can affect species evolution; for example, rock-dwelling species have a relatively larger brain capacity[18]. The morphological differences among species of the genus *Phrynocephalu*s reflect their adaptive differentiation, and the morphological characteristics of the same species are related to their habitat. For example, the snout-vent length of *Phrynocephalus putjatai* is significantly negatively correlated with latitude, significantly positively correlated with altitude, and significantly positively correlated with temperature[19]. These data also provide a basis for the study of species ecological habits.

3.2 Analysis of the Richness of Reptile Specimens in the Animal Specimen Museum of Xinjiang Agricultural University

According to the Catalogue of Life China 2025 Edition, there are 50 species of reptiles found in Xinjiang, and 43 species of these can be found in the university's specimen museum, accounting for 86%. This clearly shows that the species collected by the university are very rich. The collecting areas for these specimens include different places in Xinjiang, demonstrating the rich ecology in Xinjiang and the distribution pattern of reptiles in Xinjiang. In these different places in Xinjiang, the most abundant species are in Ili Prefecture.

Geographic distribution analysis is extremely important in terms of protecting biological diversity. This can be illustrated by a case study conducted on soil animals in typical karst landforms of Guizhou, where geographic latitude plays an important role in determining the distribution of soil animals[20]. The information about the geographical distribution of the collected specimens from this university will be useful in understanding the diversity and ecology of the reptiles found in Xinjiang and their regional protection priorities.

3.3 Enlightenment from the Analysis of Endangered Species Protection

Statistics provided by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) show that there are more than 600 endangered species worldwide, with China having about 24%[21], highlighting the urgency of wild animal protection. Out of 54 types of reptiles found in the university, most of them have been placed under different protection categories, and the delicate ecological conditions of Xinjiang make the task of conservation more difficult.

The protection of habitats is key to wildlife conservation efforts. Studies show that more than 91% of all amphibians and reptiles inhabit protected lands, which would help counteract any adverse effects of global warming on their survival[22].In such cases, ecological rehabilitation becomes essential. For example, in Yunnan Province's Qinghuahai Wetland, rehabilitation measures for aquatic ecosystems have created better living conditions for amphibians and reptiles[23]. Additionally, climate models can be used to forecast the survival pressures on species, thus developing proactive measures[24]. The direction of public participation is equally important to create a synergy between conservation efforts and ecological equilibrium.

3.4 Advantages of Specimen Digitization

In educational practice, reptile specimens can be used as effective educational tools, while standardized construction and storage of databases containing these specimens are very important for both educational and scientific purposes[25]. In this study, 6,271 specimens were scanned and 31,355 pictures were obtained, which not only increased the efficiency of specimen use and provided a theoretical basis for biodiversity conservation, but also provided conditions for publicizing the protection of animal resources and animal science education.

4 Conclusion

In this study, the reptile specimens collected in the Animal Specimen Museum of Xinjiang Agricultural University were systematically sorted out, the numbering and naming system was improved, the digitization of 6,271 specimens was completed (with 31,355 photos collected), and the species composition, geographical distribution, and protection level of the collected specimens were clarified. The results show that the reptile specimens collected in the university are rich in species and cover major regions of Xinjiang, highlighting the importance and urgency of protecting reptile resources in Xinjiang. Future research will further deepen the understanding of the species diversity and composition characteristics of reptiles in Xinjiang, providing a theoretical basis for the study of species morphology, living environments, and endangered protection levels.

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