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## RESEARCH ARTICLE

# AVIAN COLLECTION OF STATE MUSEUM LUCKNOW: SCOPE OF PRESERVED SPECIMEN

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### ABSTRACT

The taxonomic importance of the specimens preserved in any museum has been established. The genetic study of the genes preserved in the muscles and tissues of the taxidermy skin of the museum specimens has led to the hypothesis of evolutionary theories in the field of biology. In the museum collection some of the species have been preserved for long and have a scope of reidentification, because such species have been wrongly identified. The Natural History section of the State Museum, Lucknow has a rich collection of avian diversity. George Reid the first incharge of Natural History Section in 1890 mentioned 783 species (as per Nineteenth Century taxonomy), represented by 5,360 specimens. Zarrin, 2023 has listed 780 different species of birds preserved in the collection. But this is not the final list as there is a vast scope of verification and re identification. Modern research has revealed that barcode analysis may produce the final data and it is a boon for identification of species. Author co-supervised research conducted during 2011- 16 on the avian specimens preserved in the State Museum Lucknow and during the documentation of the specimens of the natural history collection of the State Museum, Lucknow a new species– Pink Headed Duck was re identified. At the time of verification, the specimen was found labelled as Spot billed duck. The same species was documented by George Ried in his catalogue of Avian collection of State Museum Lucknow, published in 1886. He revised the catalogue in 1890. In Salim Ali, 1960 prepared a list of Museums of world, where the specimen of Pink Headed Duck is preserved, but he has not mentioned the State Museum, Lucknow. This species is categorized as critically endangered under the IUCN list of species. According to Birdlife Data zone this species has not been conclusively seen in the wild since 1949. Like this species there are a number of species going towards extinction every day. The rate of extinction is much higher than the identification. Less than 10% of the total number of species present in the world has been identified till date. Identifying a species with its morphological character is now talk of the past, because it is time taking as well as not very accurate. There is rapid extinction of species due to various factors involved. It is an urgent need of the hour to document the species diversity as much as possible. DNA is the unique marker for each species and it will prove a revolutionary method if we document genetic diversity of maximum species. It will consume less time in comparison to traditional morphological and physiological identification of species. An International consortium of Barcode has been signed by several countries. This International scientific network will create a library of DNA sequences or Barcodes that is unique to each species. This library will provide a means to identify organisms rapidly and inexpensively, even from fragmentary remains. In this research the taxidermy specimens preserved in different Museums will be a resource pool. Another important aspect of genomic research is the research and analysis of historical RNA (coding type: m-RNA, t-RNA and noncoding type: mi-RNA) of preserved specimens. Scientists from Stockholm University, the Arctic University of Norway, Lund University and Karolinska Institute have extracted, sequenced and analyzed historical RNA from muscles and skin tissue of 130-year- old *Thylacines cynocephalus* preserved in desiccation room temperature in Stockholm Museum collection. Such researches can be initiated on pan India basis. It will definitely be a revolution in the field of Cytology, Genomics, Taxonomy and other allied branches of Biology. The avian specimens preserved in Indian Natural History Museums can be a resource pool for creating Library of DNA sequences or barcoding as well as research and analysis of RNA.

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## INTRODUCTION

State Museum, Lucknow is one of the oldest multipurpose museums of India established in 1863 by the then Commissioner of Lucknow Division, Colonel Saunders Alexius Abbot. This Museum was established as Municipal Museum and initially only Natural History specimens<sup>[1]</sup> were preserved in the museum. In 1885 it was declared as Provincial Museum, Lucknow. During this period collection of the

museum was divided into; Natural History (General), Ornithology, Art, Archaeology and Economic Product section. In 1950 as a result of reorganization of Indian State, the State of Uttar Pradesh was created and Provincial Museum, Lucknow was renamed as State Museum, Lucknow. Like other museums, establishment of the State Museum also aimed to conserve and preserve the heritage of the region. Over time, the museum's objectives became multifaceted and in pursuit of these goals, the State Museum, Lucknow has actively acquired, documented, displayed interpreted and researched various

forms of art as a part of its collection. In its early stages, the museum was primarily involved in acquisition, preservation, conservation and display of its collection. However, as time progressed, in 1964 a comprehensive documentation policy was implemented, leading to the documentation of entire collection of the Museum. It was categorized into Natural History<sup>[1]</sup>, Archaeology<sup>[2]</sup>, Numismatics<sup>[3]</sup>, Art ware<sup>[4]</sup> and Decorative Art<sup>[5]</sup> Section. The museum is continuously dedicated to achieve its objectives. The Natural History collection in the State Museum is not only significant within the State but also holds immense importance at the National level. Collection comprises wet and dry preserved specimens of vertebrates and invertebrates, many of them belong to rare and endangered species. Wet preserved specimens are preserved in liquid medium, while dry preserved specimens are in the form of cabinet skin and mounted specimen preserved through taxidermy technique. The Zoological collection<sup>[6]</sup> of the Natural History section of the Museum preserves a rich collection of fishes, reptiles, birds and mammals along with eggs and horns. Apart from Indian species specimen of birds and animals, a rich collection of horns, eggs and skins of different species from Australia, China, South Africa, Malaysia, Myanmar, New guinea, Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka, England, Scotland etc. are preserved in the collection. The section also preserves Botanical<sup>[7]</sup>, Ethnography<sup>[8]</sup>, Egyptian<sup>[9]</sup> and Geological<sup>[10]</sup> collection.

Avian collection of the State Museum, Lucknow comprising approximately 780 different species of birds is one of the largest collection of birds in Indian Subcontinent. Though Bombay Natural History Society (BNHS) and Zoological Survey of India (ZSI) has a larger collection but they are not for public display. The Museum has approximately 400 eggs of different species of birds<sup>[11]</sup> presented by George Ried<sup>[12]</sup><sup>[13]</sup><sup>[14]</sup> and other eminent collectors including A.O. Hume. State Museum, Lucknow preserves more than 3700 specimens of birds. Many specimens have been destroyed over the years due to its organic nature. Presently conservation of objects is going on in the Natural History section of the State Museum, Lucknow under the joint project of State Museum Lucknow and Aligarh Muslim University, Aligarh<sup>[17]</sup>. George Ried, the first incharge of the Natural History section of the Museum and published "A catalogue of Birds of the Provincial Museum Lucknow" in 1886<sup>[16]</sup> and later on revised the catalogue in 1890<sup>[18]</sup>. George Reid in 1890 mentioned 783 species (as per nineteenth century taxonomy), represented by 5,360 specimens<sup>[19]</sup>. His catalogue included Scientific and English names, locality and provenance of specimens, number of male and female specimens of a species, name of the collector<sup>[20]</sup> or presenter<sup>[20]</sup> of the specimens, references to species in the British Museum catalogue. He also added some important remarks about specimens wherever needed (Zarrin, A. 2023)<sup>[21]</sup>. After the publication of George Reid's work on the documentation and cataloguing of avian collection of State Museum Lucknow. Prof Iftekhar Alam Khan<sup>[22]</sup> incharge of Natural History Section, State Museum, Lucknow documented the avian collection in 1964 but it was not published. Only the accession cards were prepared. In 2010 Ms. Nazia Irshad<sup>[23]</sup> and Ameerza Zarrin<sup>[23]</sup>, digitally documented approximately 900 species of birds. Ms. Ameerza Zarrin pursuing Ph.D. from Department of Museology<sup>[24]</sup>, Aligarh Muslim University, Aligarh conducted research under the co-supervision of the author on the topic "Documentation and study on the conservation status of avian collection of State Museum, Lucknow" and published her finding in the form of Ph.D. thesis. For the identification of avian species Salim A., 1960<sup>[28]</sup> Tordeff A.W., Appleton T., Eames J. C., Eberhardt K., Hla H Thwin M.M.K., Zaw M. S., Moses S., Aung M. S., 2008<sup>[29]</sup>, Praveen J., Jayapal, R., & Pittie, A., 2014,<sup>[30]</sup> Grimmett, R., Inskipp, C., & Inskipp, T., 2011<sup>[31]</sup> and Pittie, A., 2023<sup>[32]</sup> has been referred. Zarrin has revised the list in 2023 and published her new finding in the Journal Indian BIRDS, Vol. 18 (6) under the topic "Documenting the bird collection in the State Museum, Lucknow (Uttar Pradesh, India)" (Zarrin, A. 2023). But the list prepared by Zarrin is not the final one it has lots of scope of verification and re-identification. There is a lot of scope for changing the number of species because most of the specimens are more than Century old and in due course of time their plumage color is faded and there may not be accurate identification of bird. That is why regular verification and re documentation of avian collection of any

museum is quite important. She has listed 780 different species of birds preserved in the collection (Zarrin, A. 2016)<sup>[25]</sup>. The most accurate identification can be done through the DNA sequencing process of each species. During the research (2011-16) the avian species of the State Museum, Lucknow were documented a new species—Pink Headed Duck was re identified, the specimen was labelled as Spot billed duck, this species was documented by George Ried in his catalogue presented in 1886<sup>[16]</sup><sup>[17]</sup><sup>[26]</sup>. In 1960 Salim Ali prepared a list of Museums of world, where the specimen of Pink Headed Duck is preserved but he has not mentioned the State Museum Lucknow in the list of Institution<sup>[27]</sup>. This species is categorized as critically endangered under the IUCN list of species. For the identification of avian species Salim A., 1960<sup>[28]</sup> Tordeff A.W., Appleton T., Eames J. C., Eberhardt K., Hla H Thwin M.M.K., Zaw M. S., Moses S., Aung M. S., 2008<sup>[29]</sup>, Praveen J., Jayapal, R., & Pittie, A., 2014,<sup>[30]</sup> Grimmett, R., Inskipp, C., & Inskipp, T., 2011<sup>[31]</sup> and Pittie, A., 2023<sup>[32]</sup> has been referred.

**Scope of research and development in natural history museums:** Museum world has progressed both in term of display and research but the Natural History collection has not reach to its zenith still. The collection which was previously supposed to be archaic importance and has immense scope for research in the field of Biology and its allied branches like genomics and cytology. The taxonomic importance of the specimens preserved in any Museum has been established. The genetic study of the genes preserved in the tissue of the taxidermy skin preserved in the museum has led to the hypothesis of evolutionary theories in the field of biology. In the museum collection some of the species have been preserved for long and they have a scope of reidentification because such species have been wrongly identified due to various reasons. One of them may be that the specimen is closely related to different group of birds from that in which it is currently placed (P. Christopher, 1987)<sup>[32]</sup>. Bird collections in museums are organized repositories that contain scientific bird specimens. When preserved properly, these specimens are valuable for centuries. Museum collection should be regularly researched because there are lots of scope of research and identification of species (Winker, 1991)<sup>[34]</sup>.

**Barcoding of DNA:** Museum collection is not only the specimens what we see on display, rather more important collection is in reserve or storage section. Due to the lack of space in museums major collection is preserved in the reserve/storage collection. And it has vast scope of research and development. Now a days Natural History Museums have paved ahead in this field. Thorough research in the field of taxonomy, evolutionary biology as well as genetic studies have been conducted. Genome sequencing of the specimens will prove a step ahead in the re identification of the specimens with great efficiency and accuracy. One of such study has been conducted on the genomic sequencing of 350 species of birds. Most of the samples were taken from Museum collection. It has been published in the Journal Nature in November 2020. This research is a part of the Bird 10,000 Genome (B10K), a project initiative led by a multinational consortium of academic institutions. This group of Institutions has a target of deciphering the genomes of all bird species. In this academic research Royal Ontario Museum of Canada is an important participant, which has also provided blood sample of the Magellanic Plover species. The outcome of the Genomic study will prove a mile stone in the field of genetic research and also serve as a genetic pool for the forth coming study in the field of biology and evolution of birds including the discovery of the genetic underpinning of innumerable aspects of their biology. Higher studies of avian genome will have effect on the poultry farming and in turn on the health as well as economic sector of any region. A large population is dependent on protein source from different bird species and this research will deliver promising result in nutritional health care sector. In another study published in the journal Science researcher has used a diverse group of Passerine birds preserved in Museum collection. Through the research it has been discovered that the rate at which they are evolving is dependent on the present environmental condition. During the genomic research, apart from extracting DNA from traditional museum skins, samples were also taken from skeletal remains. These skeletal structures are also

important in the assessment of temporal scale of evolutionary tree of avifauna. Through this research we can find that how such diversity of birds has come into existence. Application of modern statistical method can infer more inferences from these extracted data of evolutionary history (Claramunt, S. 2010) [35]. There are a number of species going towards extinction each day. The rate of extinction is much higher than the identification but less than 10% of the total number of species present in the world has been identified till date. In a traditional method of identifying a species with its morphological character is now talk of the past because it is time taking as well as not very accurate. There is rapid extinction of species due to various factors involved. It is an urgent need of the hour to document the species diversity as much as possible. DNA is the unique marker for each species and it will prove a revolutionary method if we document genetic diversity of maximum species. It will consume less time in comparison to traditional morphological and physiological identification of species.

**International Consortium of Barcode:** An International consortium of Barcode has been signed by several countries. This International scientific network will create a library of DNA sequences or Barcodes that is unique to each species. This library will provide a means to identify organisms rapidly and inexpensively, even from fragmentary remains. The barcode collection of species will definitely advance researches. It will allow researchers to understand and manage biodiversity with profound societal and economic implications. In the field of pest and disease control, food safety, conservation and other allied disciplines it will revolutionaries the world. In the international Consortium of Barcode, the Royal Ontario Museum (ROM) of Canada is playing a pivotal role. On April 28 and 29, 2008, the ROM hosted the 2nd Annual Canadian Barcode of Life Network Science Symposium, where the latest information on barcoding for Canadian and global biodiversity was presented. Over 160 delegates from ten countries attended the plenary and poster sessions on specific research themes (Claramunt, S. 2010) [36].

#### **Research and Analysis of RNA (Coding Type: m-RNA, t-RNA and Noncoding Type: mi-RNA)**

Another scope of preserved specimen in the museum is to study the RNA preserved in the muscles and tissues of taxidermy skin. Latest research on Tasmanian tiger (*Thylacinus cynocephalus*) published in the Journal Nature on 19 September, 2023 is quite interesting and important. An article by Miryam Naddaf [37] on "Tasmanian tiger RNA is first to be recovered from an extinct animal" published in the Journal Nature explains Genetic sequences from a museum specimen. It offers fresh clues about the physiology of Thylacines, which went extinct in the 1930s.

Scientist from Stockholm University, the Arctic University of Norway, Lund University and Karolinska Institute have extracted, sequenced and analyzed historical m-RNA from muscle and skin tissue of 130-year-old *Thylacines cynocephalus* preserved in desiccation room temperature in Stockholm Museum collection. The fossil record shows that this species appeared approximately 4 million years ago. Recent study on de extinction of thylacines whose natural habitat is preserved will definitely help in maintaining equilibrium in ecosystem as it has been disturbed after the species' extinction (Lazaro, D.E 2023) [37]

## **CONCLUSION**

The Natural History Collection of State Museum, Lucknow is quite rich in avian species preserving approximately 780 specimens and it has lots of scope in ancient DNA Study, Genome sequencing as well as analysis of historical RNA. There are many endangered and rare specimens preserved in the museum's Natural History collection. A fully intact specimen of Pink Headed Duck preserved in the Museum is older than the 137 yr. It is listed in Critically Endangered category of IUCN. Last confirmed sighting of the bird by C. M. Inglis was from Bhagownie, Darbhanga District, in June 1935. Sidney Dillon Ripley considered its likely extinction in 1950. According to Birdlife data zone this species has not been seing in wild since 1949. A study on the research and analysis of coding and noncoding RNA for genome sequencing of Pink headed specimen preserved in the Natural History collection will proof an un parallel research finding in the field of Biology. Like 10k genome project discussed in this paper, India can also launch its own such type of project for genome sequencing of important avian specimens preserved in different museums of the Country. It will give a chance to create a library of Barcode for the avian species of Indian Subcontinent. Like Royal Ontario Museum, Canada the Natural History Collection of State Museum Lucknow can play pivotal role in this research.

## **REFERENCES**

- State Museum, Lucknow has Natural History specimens collected since 1823.
- Apart from this it preserves archaeological remains of medieval and modern period in the form of pottery, inscription, seal, sealings, architectural remains, beads etc.
- The Gold coin section preserves one of the richest collections of Gupta and Kushana period the Museum has a rich collection of gold jewellery since Mauryan period.
- Metal art, Porcelain, China clay, Ivory and Wood collection are remarkable one.

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