NATURAL HISTORY COLLECTIONS AT THE BOMBAY NATURAL HISTORY SOCIETY

BNHS INDIA CONSERVING NATURE SINCE 1883

BNHS MISSION

"Conservation of nature, primarily biological diversity, through action based on research, education and public awareness."

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CONTENTS

1. INTRODUCTION

"Nothing will ever replace the taxonomic knowledge and training that museums provide; funding in this area should become a national priority. Otherwise, knowledge of this planet's biodiversity and of all the potential benefits therein, will be lost." - Suarez &Tsutsui, 2004

Natural history collections are essential to biodiversity research, as they are the foundations of all biological information. Besides serving as the basis for taxonomic identifications, the data associated with specimens contributes to the overall understanding the evolution of species, ecological process and relations of a species with other living forms and abiotic factors. They provide the baseline data for measuring environmental changes as experienced by the living world. Specimens have associated core data that is recognized as fundamental to discipline-specific research, as well as broader global issues such as invasive species, ecological/conservation issues, climate change, and emerging diseases. Natural history collections are also demonstrably important - not just for education and cultural reasons, but for wider environmental reasons too. If we want to maintain our biodiversity and understand changes in our environment we need to sustain our natural history collections.

Zoological collections are considered to be one of the most important tools for the study of faunal diversity of a region. Properly identified and classified specimens with complete data such as date, locality of collection and interesting remarks act as a time machine and provide information on the status, abundance and distribution of a species in the past, thus helping in strategic planning for the survival of the species. A well-preserved collection is also a tool for molecular systematics, which is the basis of biological science, and natural history collections are the foundation on which the science of systematics is built. Researchers in the fields of ecology, evolution, pollution and climatic changes often require reference to museum specimens. Collections are also useful for taxonomic studies and are extensively used by biologists for identifying the species, which is essential for any field studies.

The Bombay Natural History Society (BNHS) since its inception in 1883 has been involved in the study of flora and fauna of the Indian subcontinent. What started as just a monthly meeting of eight naturalists to exchange notes, exhibit interesting specimens and otherwise encourage each other in the field of natural history in 1883 has slowly become one of the finest collections of natural history in Asia. Since its initiation, many renowned naturalists like W. H. Evans (1876 -1956) and T. R. Bell (1863 –1948) for insects; Frank Wall (1868 – 1950), J. C. Daniel (1927 – 2011), Humayun Abdulali (1914 - 2001) for amphibian and reptiles; Sálim Ali (1896 –1987), Humayun Abdulali (1914 - 2001) for birds; T. C. Jerdon (1811 – 1872), W. T. Blanford (1832 –1905), S. H. Prater (1890 –1960), R. C. Wroughton (1849 – 1921) for mammals and others like W. S. Millard (1864–1952), Charles McCann (1899 –1980), E. H. Aitken (1851 – 1909), Sir N. B. Kinnear (1882 –1957)etc. were directly or indirectly associated with the BNHS. These naturalists and many more, painstakingly collected specimens from across the Indian Subcontinent for more than

a century and deposited them in the collection of the BNHS. As result of this currently the BNHS collection is one of the finest natural history collections in Asia having 1,20,000 faunal specimens. Contribution of these naturalists created a strong platform for natural history studies in the Indian Subcontinent.It is a unique index of the biodiversity of the Indian Subcontinent and is an invaluable database of Indian biodiversity especially of mammals, birds, reptiles, amphibians and some orders of insects. As the collections were mainly made during pre-independence days, these include specimens from the oriental region, mainly the present day India, Pakistan, Afghanistan, Bangladesh, Nepal, Bhutan, Myanmar and Sri Lanka. These meticulous efforts of over a period of 135years resulted into a dynamic collection of about 19,000 mammals, 29,000 birds, 5500 bird eggs, 10,000 amphibians and reptiles which is growing rapidly with discovery of new species, 60,000 insects and 5000 other taxa specimens are maintained. Simply put, the BNHS collection is priceless. It is impossible to evaluate the actual value of the collection, which is the storehouse of the genetic information of more than a century of the Indian subcontinent.

Natural History Specimens at BNHS are repositories of geographical and temporal variations in the individuals. Specimens collected before DNA was even known are now able to provide information about how populations have changed over time and how that might influence conservation of threatened species. Molecular methods have been successfully used on museum collections for the study of population genetics and collection of historical genetic information, in the recent past.

The Collection of BNHS posses fairly good number of type and general specimens of mammals, birds, reptiles, amphibians, insects, spiders and scorpions. Following table gives number of specimens of each taxa present in BNHS;

Table 1. Number of specimens in collections

Sr. No.	Taxon	Number of type specimens	Total number of specimens
1	Mammals	06	20000
2	Birds	65	30000
3	Bird eggs	00	5500
4	Reptiles	58	6000
5	Amphibians	150	4000
6	Fish	15	600
7	Insects	245	64500
8	Scorpions and spiders	20	200
9	Other Invertebrates	10	5000
	Total approx.		1,35,800

1.1 A brief account of the specimens in BNHS Collection

A. Bird Collection

There are about 29,000 specimens of birds in this collection. The bird collection is arranged as per the 'Synopsis of Birds of India and Pakistan' by Ripley. For easy accessibility the specimens are classified and arranged systematically in 63 cabinets, each cabinet consisting of various trays or boxes.

Bird specimens in the BNHS collections

Bird egg specimens at BNHS collections

This collection also houses the specimens of endangered and extinct species of birds. The most important holding in the bird collection is the five specimens of Pink-headed Duck. This species is thought to be extinct as the last reliable record of this bird in the wild was in 1935. There are 275 specimens of Pheasants including five skins of Western Tragopan (*Tragopanmelanocephalus*), four Nicobar Megapode (*Megapodius nicobariensis*) and six Cheer Pheasant (*Catreuswallichii*) (all vulnerable). A part from this there is a single specimen of Jerdon's Courser (*Rhinoptilusbitorquatus*), one Siberian Crane (*Leucogeranusleucogeranus*), six Long-billed Vulture (*Gyps indicus*), 13 White-backed Vulture (*Gyps africanus*), seven Great Indian Bustard (*Ardeotisnigriceps*) and nine Bengal Florican (*Houbaropsisbengalensis*) (all critically endangered), 10 White-winged Wood Duck (*Asarcornisscutulata*) and five Lesser Florican (*Sypheotides indicus*) (endangered) are also present in the Collection.

Apart from the collection of specimens, these surveys potentially resulted in some of the pioneering publications in the field of ornithology like *The Birds of Kutch* (1945); *Indian Hill Birds* (1949); *The Birds of Travancore and Cochin* (1953) revised and renamed as *Birds of Kerala* (1968); The *Birds of Sikkim* (1962) and *The Birds of Eastern Himalayas*. The collection also formed the basis for the ten volumes of '*Handbook of Birds of India and Pakistan*' (1968-1974). The series of research papers based on these surveys and published by Mr. Humayun Abdulali on Birds of Andaman & Nicobar Islands are equally valuable reference to ornithologists.

B. Mammal Collection

There are about 19,000 mammal specimens in the collection, most of which are skins and skulls. Like birds, these specimens are also properly classified and arranged systematically in 64 cabinets. The smaller mammals are stored in trays whereas the larger mammals in boxes. Mammal collection is arranged as per the '*Checklist of Mammals*' by Ellerman & Scott, 1951.

Mammal specimens in the BNHS collections

The collection is equally broad in its systematic coverage with 347 species (633 species and subspecies). The mammal collection is also equally rich as there are type specimens of Greater short-nosed fruit bat(*Cynopterus sphinx gangeticus)* Anderson, 1910 (Paratype), Salim Ali's fruit bat (*Latidenssalimalii)* Thonglongya, 1872 (Holotype), Kolar leaf-nosed bat (*Hipposideroshypophyllus)*Kock & Bhat, 1994 (Paratype), Iraqi wildcat (*Felissilvestrisiraki)*Cheesman, 1921 (Paratype), Sri Lankan spotted Chevrotein (*Moschus meminna)*Erxleben, 1777 (Topotype), Lesser mouse-deer(*Traguluskanchillampensis)* Miller, 1903 (Topotype).

Endangered species of mammals to named a few,, Lion-tailed Macaque, Hoolock Gibbon, NilgiriTahr, Hispid Hare,Red Panda, Large Spotted Civet andBonhote's Mouse,are in the mammal's collection.

C. Herpetofauna Collection

The herpetology collection is divided in two section, amphibians and reptiles. These specimens are mainly deposited by the experts from BNHS who carried out short surveys in different parts of Indian subcontinent. In recent years there have been considerable contribution from researchers and experts working on herpetofauna in different parts of India as well. As this is a wet collection, the specimens are stored in glass jars containing rectified spirit and are arranged systematically in 12 cabinets. There are more than 500 type specimens of amphibians and reptiles in the collections. All the type specimens are stored in state of art fireproof cabinets.

Amphibian Section

The collection has about 4000 specimens belong to 150 species of amphibians of the Indian subcontinent. This section holds one of the largest collections of Indian caecilians in the world, which comprises of 21 species from 4 families. There are specimen of Himalayan Newt (T*ylototritonverrucosus*), the only known tailed amphibian from India, AmboliToad (*Xanthophrynetigerinus*), one of the smallest and endemic species of toad, Malabar Tree Toad (*Pedostibes tuberculosis*) and Purple or Pig-nosed Frog (*Nasikabatrachussahyadrensis*) in this collection. Apart from these type specimens of most of the newly described species of caecilians and frogs are present in this collection. There is an exceptional collection of the type specimens of frogs and toads in this collection. Interestingly, the type specimens of most of the recently described species of frogs from India are present in this collection.

There is collaboration between experts on caecilians from BNHS and Natural History Museum, London. This partnership is responsible for the discovery of two new species of caecilians from Maharashtra. Another major contribution from this group is the first report of viviparity in Asian amphibians and Indo-Seychellean caeciliids.

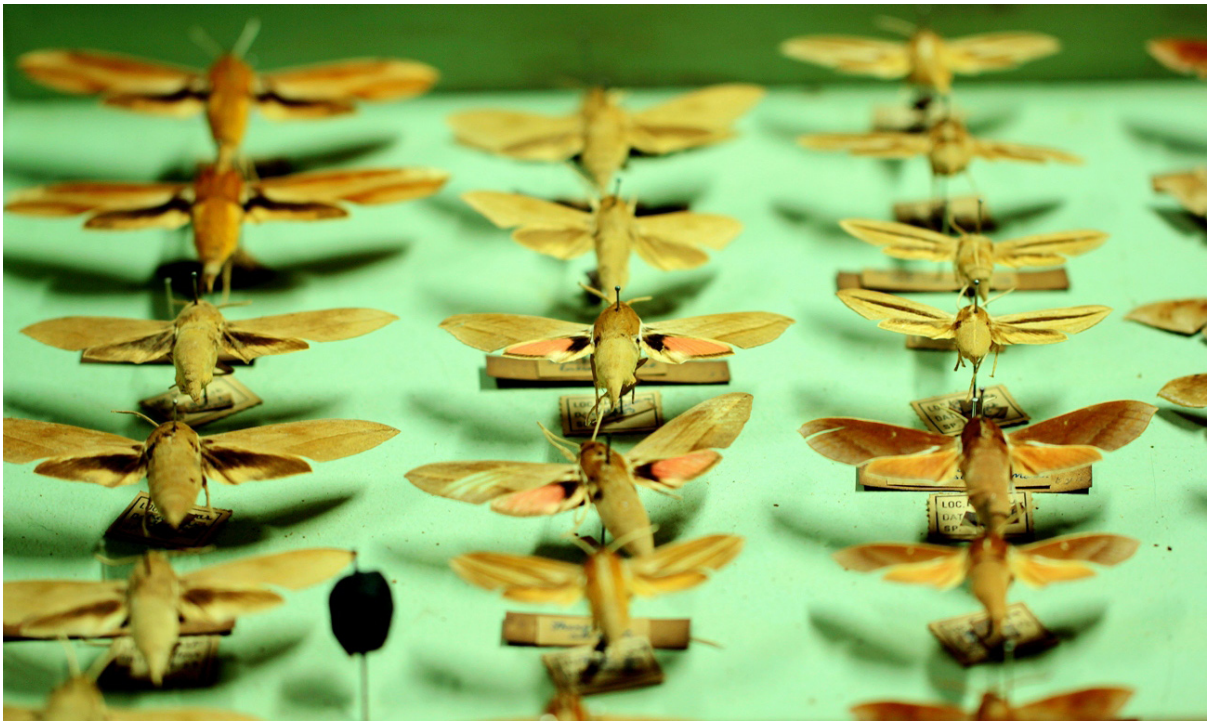
Reptile Section

This collection is mainly divided into two parts: lizards and snakes. The rich collection of lizards with about 2500 preserved specimens belonging to 11 families and more than 220 species collected from the Indian Peninsula represents the uniqueness of the collection. This diverse collection of lizards is responsible for recent publications on the taxonomic status of some of the endemic geckos of India. BNHS collaboration with Indian and other foreign institutes has resulted in the discovery of numerous new species of lizards.

With a total of about 3400 specimens from 10 families and 240 species, the collection of snake is also equally diverse. Apart from this few extra-limited species of snakes are also present in the collection. One of the invaluable holding is the specimen of Indian Egg Eater (*Elachistodonwestermanni*). This species was thought to be extinct and was recently rediscovered in Maharashtra by Mr. Ashok Captain and his team.

D. Insects Collection

This is one of the important insect collections in India. There are about 50,000 insects in the collection. The geographical areas covered are India, Pakistan and Myanmar. The major groups represented in the collection are Lepidoptera (Butterflies & Moths). Out of the 1500 species of butterflies found in India, around 730 species are present in the collection. Some of the butterflies were collected from Myanmar and are difficult to get in the present circumstances. There are also collection of beetles (Coleoptera), bugs (Hemiptera), Wasps, bees and ants (Hymenoptera), Grasshoppers and crickets (Orthoptera), Mantodea (Prying mantids), Stick and leaf-insects (Phasmatodea) and Cockroaches (Blattaria). The insects are preserved and stored in wooden boxes and cabinets. The butterflies from Sri Lanka collected by Mr. Ormiston are also present in the collection. The collection is referred by students/scientists from Forest Research Institute and was basis for the book "Butterflies of Sikkim Himalayas".We have 245type specimens of insects in the collection.



Insect specimens at BNHS collections

2. USE OF COLLECTION

Study of the specimens in the BNHS collection has resulted in various noteworthy publications and thus has supported advancement of science. Natural history notes and taxonomic articles published in the Journal of Bombay Natural History Society and other national and international journals based on Collection of the BNHS are still used as a standard reference material for field biology and natural history museum studies in the Indian Subcontinent as well as in the World. Besides that, the collection is also a source material for various popular field guides like Book of Indian Birds by Salim Ali, Book of Indian Animals by S. H. Prater, Book of Indian Reptiles and Amphibians by J. C. Daniel, Butterflies of Sikkim Himalaya by Meena Haribal and Book of Indian Butterflies by IssacKehimkar.

These collections are regularly referred by wildlife researchers from various Indian universities and institutes such as Wildlife Institute of India, Dehradun; Zoological Survey of India, Sálim Ali Centre for Ornithology and Natural History, Coimbatore; Zoo Outreach Organization, NCF, ATREE and Indian Institute of Science, Bangalore for the scientific studies. This collection is also referred by scientists and taxonomists of various international research institutes such as Smithsonian Institute, Washington DC; Field Museum, Chicago; Natural History Museum, London, U.K.; Harrison Zoological Museum, U.K. and several other organizations from SAARC countries.

The collections provide basis of identification of hair and feathers for wildlife crime for Wildlife Custom Officials and other enforcement agencies including various State Forest Departments. It is also being used by Ministry of Defense for the specific purposes of bird hazard to Indian Air Force.Apart from this the collection is also a good place to confirm your field observation pertaining to the identification and in this regard several individuals, amateur naturalists, ornithologists, lepidopterists, herpetologists and mammologists refer the collection.

This is also a very good tool to impart basic knowledge about the faunal diversity to the wider audience. For this purpose, students, trainee forest officers (IFS) and forest rangers regularly visit this collection. This department also organizes theme-based programs like know your birds and mammals and/or the world of amphibians and reptiles for the members of the Society on regular basis. Digitization of these collections is essential as converting these in electronic format and digitizing specimens would provide easy access to valuable baseline information and facilitate their better management.

3. THE NEXT STEP - DIGITIZATIONOF BNHS COLLECTIONS

Considering the importance of this historic collection, Government of Maharashtra has sanctioned Rs. 9 Cr. towards the digitization of the BNHS collection. This project will generate essential information on the evolutionary population genetics through research. By digitizing the BNHS collection it will possible to conduct research on above issues. To ensure efficient access, dissemination and exploitation of such an immense wealth of biodiversity relevant data, it is evident that a well-coordinated and streamlined approach to global digitization is required, in particular because it is absolutely essential for the scientific value of

Collection: Research & Reference

Sample collection for DNA studies

Reference for ecological studies

Taxonomic studies on birds

Taxonomic studies on Amphibians

Taxonomic studies on reptile

Collection: Educational Programme

Students learning about Indian birds

Students learning about Indian mammals

Lecture on Indian Insect diversity

Our wild animals

Learning about bird identification

Educational visit from Leh to BNHS

the generated data that the outputs (images, metadata, etc.) are linked together and also back to the original specimens via unique identifiers (uIDs). The BNHS museum houses specimens older than 100 years. These specimens are frequently handled for research and education activities. This may reduce the cabinet life of each specimen. Digitization of the specimens will make the images appended to its collection data available for reference work, which would reduce their frequent handling and enhance their preservation period. Also if the collection is digitized it will be used by more audience as it will be available on World Wide Web. Benefit of the digitized collection is to locate the relevant scientific information easier. This will boost scientific research due to easy availability of material. The knowledge and experience gained through the successful implementation of project will help us in future to assist other institutes in India in digitization of natural history specimens.

Converting this immense treasure of knowledge in electronic format and digitizing the specimens would provide easy access to valuable information for global scientific community. Good quality images of specimens along with associated data will help researchers from across the globe as well as support in collaborative data sharing across different global natural history museums. It also matters because digitized collections make it much easier for scientists to locate specimens anywhere in the world and put them to work in their research. Thus digitized specimen collections will help to answer questions about the natural range of different species and to predict whether they will be able to adapt to climate change. They also help to document the spread of invasive species and patterns of extinction. At this stage, only about 10 percent of specimens in collections worldwide are available through digitization. It will require a substantial commitment of time and money to complete the job. But as this trend strengthens, it will make natural history collections far more relevant to the pressing scientific questions of our day. Online public access to high-resolution images and metadata will likely enhance public awareness of the importance of local and national collections (as well as engendering a sense of shared ownership). Moreover, high quality images will open up the possibility for fast and reliable automated or semi-automated specimen identification and thus encourage environmental "citizen-science", such as recording distributional or abundance changes of key species. Increased demand for access to museum collections is driving a trend toward specimen digitization.

In recent years, substantial efforts and resources have been invested into the digitization of natural history collections, with museums and herbaria routinely employing specimen level collection databases to replace older, paper-based card indexes and ledgers. In theory, this should make dissemination of specimen data through biodiversity informatics portals such as the Global Biodiversity Information Facility (GBIF; http://www.gbif.org/) very simple and straightforward. Three dimensional (3D) digital images provide researchers with rapid on-line access and augment publications. The availability of accurate 3D digital images reduces the need for museums to loan specimens, and thus reduces risk of loss and/or damage.

Specimens have associated core data that is recognized as fundamental to discipline-specific research, as well as broader global issues such as invasive species, ecological, conservation issues, climate change, and emerging diseases. By digitizing the BNHS collection it would be possible to conduct research on above issues. During and after digitization, BNHS will conduct morphometric analysis of at least some specimens; this will help to solve taxonomic ambiguities in many taxa. This project will promote and encourage remote curation of unsorted specimens. It will also make easy to deliver specimen metadata to the scientist without visiting actual collections and assist with loan requests. This project will also enhance methods for

auditing the collection, improve the user experience and will encourage public engagement with biological collections. This will boost overall scientific research on biodiversity due to easy availability of material. The knowledge and experience gained through the successful implementation of this project will help us in future to assist other institutes in India in digitization of natural history specimens.

This project is also in line with Government of India's Digital India programme as it tackles the following problems mentioned under part of the 14-point museum reform agenda undertaken by the Ministry of Culture.

1. Special focus has to be given to the area of digitized documentation of the antiquities in the museums in various parts of the country.
2. Presently, in most of the museums status of documentation is not up to the mark and details of antiquities available in the museums are only available in physical form in the Accession Registers being maintained by the museums.
3. It has also been observed that in some cases information which is available in the Accession Registers is not authentic and has become obsolete. Therefore, with a view to modernizing the collections management system of these museums it is imperative that they resort to digital collection management system.

This enterprise envisages undertaking development of information system to facilitate collection, collation, storage and dissemination of data/information on various aspects of the natural history specimens. We are looking forward for your financial assistance to digitize one of the India's finest natural history collections.

4. OBJECTIVE

To digitize insect, amphibian, reptile, bird and mammal collection and related metadata and bring it in a public domain as a research and educational tool

Increased demand for access to museum collections is driving a trend toward specimen digitization. In recent years, substantial efforts and resources have been invested into the digitization of natural history collections, with museums and herbaria routinely employing specimen level collection databases to replace older, paper-based card indexes and ledgers. In theory, this should make dissemination of specimen data through biodiversity informatics portals such as the Global Biodiversity Information Facility (GBIF; http://www.gbif.org/) very simple and straightforward. Three dimensional (3D) digital images provide researchers with rapid on-line access and augment publications. The availability of accurate 3D digital images reduces the need for museums to loan specimens, and thus reduces risk of loss and/or damage.

5. RATIONAL

Natural history collections are of immense scientific and cultural importance. Specimens in public museums and herbaria and their associated data represent a potentially vast repository of information on biodiversity, ecosystems and natural resources for the widest range of stakeholders, from governments and NGOs to

schools and private individuals. Numerous examples of the uses to which biodiversity data derived from natural history collections have been put in research on evolution and genetics, nature conservation and resource management, public health and safety, and education are widely available.

The BNHS collection is being referred by a vast range of users such as, 1) The scientific community those seeking data for large scale organismal, taxonomic or ecological analysis, 2) the educator or students for formal educational requirements and 3) the general public.

The BNHS museum houses specimens older than 100 years. These specimens are frequently handled for research and education activities. This may reduce the cabinet life of each specimen. Digitization of the specimens will make the images appended to its collection data available for reference work, which would reduce their frequent handling and enhance their preservation period. Also if the collection is digitized it will be used by more audience as it will be available on World Wide Web.

6. EXPECTED OUTCOMES

The collection of BNHS is housing around 1,20,000 specimens that needs to be digitized for its sustainable usage and better management of data including collection, storage, analysis and dissemination. Digitization of the BNHS collection would provide the following outcomes;

1. The BNHS collection portal (Website) would help or even speed up solvingissuesrelated with environment conservation and wildlife crimes through giving access to this data, especially to government bodies and national and international NGOs engaged in environmental protection and conservation.
2. This data with other tools such as app or video conferences can be used for capacity building of the forest staff andyoung researchers/students for classification and identification of the animals which make them more scientific and resourceful.
3. This rich repository of data will be used by national and interactional education and research institutes for better understanding of living world around us.
4. This programme will engage nature amateurs, enthusiast, students and senior citizens to make them more aware about diversity of animals in our country and its conservation.
5. This initiative would be unique of its kind in Indian sub-continent and will be seen as model for similar projects in India and neighboring countries.
6. Besides scientific community, these digital images of the animals can be source of inspiration for artist e.g. natural history illustrators or other form of modern arts.

All the digitized information will be available to NBA on request and NBA can use this digitized data for scientific knowledge, databases, conservation, and policy development.

Storage and security of collection

All the wet collection is now housed in the state of are fireproof room with fireproof doors and has a separate ventilation system.

All the type and rare collections are stored in five state of art Godrej Fire Rated Steel Cabinets.

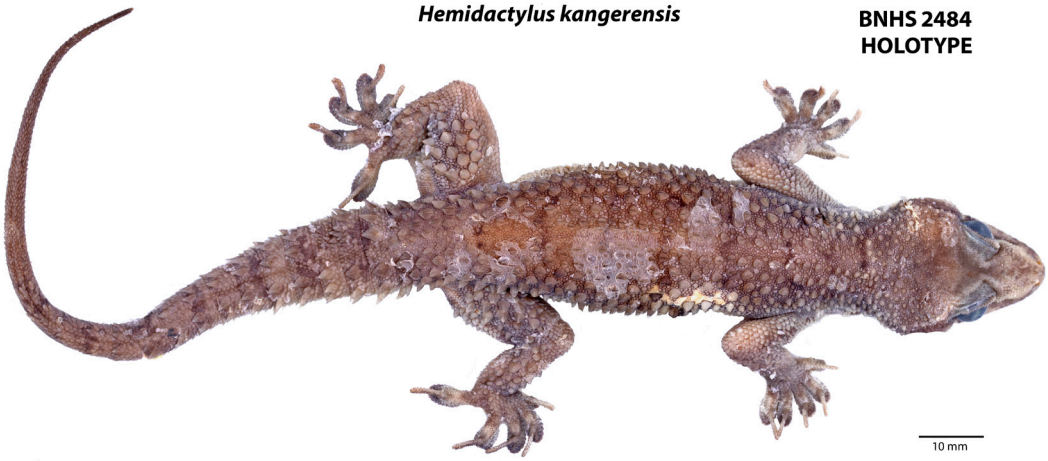
The collection is secured with control access biometric entry system and CCTV.

Examples of specimen Digitization

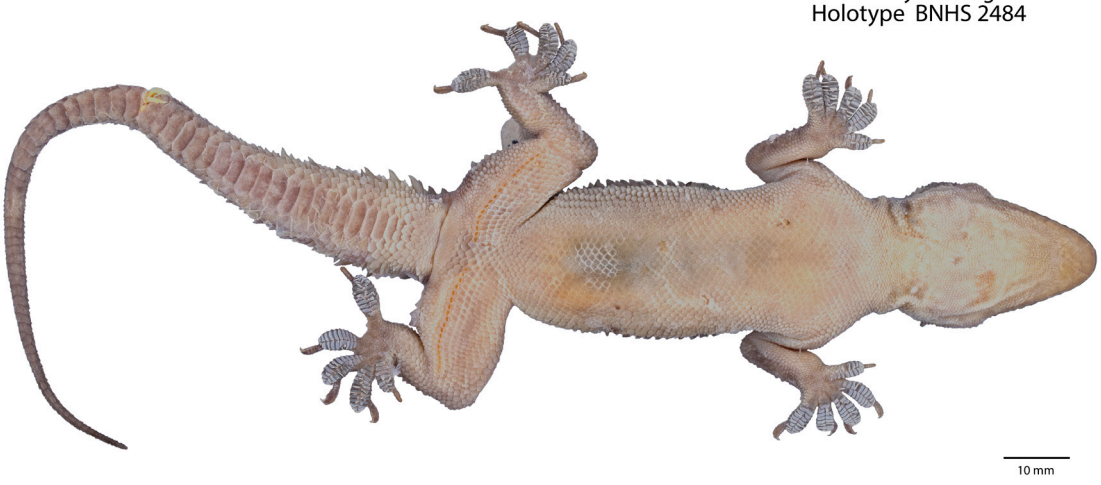
Cnemaspis amboliensis
HOLOTYPE BNHS 2458

Hemidactylus kangerensis

BNHS 2484
HOLOTYPE



Hemidactylus kangerensis
Holotype BNHS 2484




10 mm


BOMBAY NAT. HIST. SOCIETY Reg. No. 28988
Sp. Ceyx erithaca
Loc. Khargar New Mumbai
Alt.
Dt. 18-9-2011 Sex Juv. ♀
Reg. No. 28988
erithaca
Mumbai
Juv. ♀