

# FINAL NARRATIVE REPORT

*Guidelines on how to complete this report are included in italics.*

*Use the information included in your BIFA Full Proposal (reproduced in Annex 1 of your BIFA contract) as a baseline from which to complete this report.*

*Remember that this report will be made available on your project page on the GBIF website and therefore should not include any contact information, unless you have permission from all mentioned in the report that their contact information can be published.*

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## Project information

<b>Main contact person and role:</b>	Rahul Khot, PI
<b>Institution/network/agency affiliation:</b>	Bombay Natural History Society (BNHS)
<b>BIFA Project ID:</b>	BIFA4_052
<b>Project title:</b>	Addressing the taxonomic and geographical shortfall for amphibians and reptiles using specimen data from the collection of Bombay Natural History Society, Mumbai, India.
<b>Start date and end date of the reporting period:</b>	May 2019 to November 2020 (Extension Dec 2021)
<b>Country in which the activities take place:</b>	India

## Executive summary

*Please provide a brief summary of your project's objective(s), its implementation and achievements. You should also describe the context and the approach taken for the final evaluation of your project, and also the key best practices and lessons learnt identified. Remember to include any additional objectives that were defined during the implementation of the project and explain why they were added to the project's initial objectives. In the event of unexpected challenges which have prevented you to reach a planned project objective, please provide explanations and indicate if and how you plan to reach these objectives post project.*

*(Max. 350 words.)*

The BNHS museum is one of the finest natural history repositories in Asia of faunal specimens collected from across the Indian subcontinent. We aim to digitize the reptiles and amphibian specimens and associated metadata to address the gap in taxonomy and distribution of Indian herpetofauna.

A major hurdle during the project was unavailability of digitized information. We initiated a process to enter verbatim data from registers into excel files for all the reptile and amphibian specimens in the collection. This critical but humongous task was completed by the end of December 2019 with nearly 10,000 entries. This was then cross checked for errors, missing information and updated with current taxonomic changes. Many of the specimens in the collection are over a century old and there has been lot of taxonomic changes since their initial description. Also, some of the specimens were badly preserved and lack detailed description. Hence, updating their taxonomic status was a challenge and took time to study each specimen in detail. BNHS houses a number of type specimens related to reptiles and amphibians and this number is growing regularly. Documenting the information related to type specimens is priority as it helps researchers from across the globe in their studies. We have published an updated catalogue of type specimens of reptiles and amphibians respectively from the collection in GBIF. We also published a catalogue of sea snake specimens in the collection in GBIF. We have also published and updated the checklist for all the reptile and amphibian species present in the collection of BNHS. Workshops targeting taxonomy, use of ERDAS imaging software and photography and image processing were conducted to train participants in morphological studies, mapping and specimen photography. A major aspect of the project towards visiting museums across India to study type specimens got severely delayed due to COVID 19 restrictions. We finally managed to visit and study the type specimens in the Zoological Survey of India (ZSI, Kolkata) in November 2021. Finally, we were able to digitize a total of 9766 occurrence records for reptiles and amphibians from the collection of BNHS.

## Progress against expected milestones

*Please indicate the status of the expected milestones as outlined in Annex 3 of the contract, at the time of final reporting. Please provide links in the sources of verification.*

*In the event of unexpected delay(s), please provide detailed explanatory notes.*

Expected milestones	Completed? Yes/No	Explanatory notes	Sources of verification
Gain certification at BIFA Capacity Enhancement Workshop <b>(Mid-term report milestone)</b>	Yes	Received Advance Level Badge for Biodiversity Data Mobilization	Annex 5: badge_162429_all.pdf
At least one dataset has been published to GBIF.org <b>(Mid-term report milestone)</b>	Yes	<ol style="list-style-type: none"> <li>1. Catalogue of sea snakes in the collection of BNHS.</li> <li>2. Reptile type specimens in the collection of BNHS.</li> </ol>	<a href="https://cloud.gbif.org/bifa/resource?r=bnhs_seasnakes">https://cloud.gbif.org/bifa/resource?r=bnhs_seasnakes</a>  <a href="https://cloud.gbif.org/bifa/resource?r=bnhs_typespecimens_reptiles">https://cloud.gbif.org/bifa/resource?r=bnhs_typespecimens_reptiles</a>
All deliverables have been produced <b>(Final report milestone)</b>	Yes	<p>Published and updated digitized catalogue of reptile types and updated catalogue of amphibian types; catalogue of sea snake; published an updated checklist of reptiles and an updated checklist of amphibians.</p> <p>A total catalogue including 9766 records of amphibian and reptile specimens from the collection has been prepared and published.</p>	<p>Links added:</p> <ul style="list-style-type: none"> <li>• Amphibian and reptile specimens at the Bombay Natural History Society Museum</li> </ul> <p><a href="https://cloud.gbif.org/asia/manage/resource?r=bnhs_herpetofauna">https://cloud.gbif.org/asia/manage/resource?r=bnhs_herpetofauna</a></p> <ul style="list-style-type: none"> <li>• Catalogue of Sea snakes in BNHS collection</li> </ul> <p><a href="https://cloud.gbif.org/bifa/manage/resource?r=bnhs_seasnakes">https://cloud.gbif.org/bifa/manage/resource?r=bnhs_seasnakes</a></p> <ul style="list-style-type: none"> <li>• Updated catalogue of type specimens of reptiles in the collection of BNHS</li> </ul> <p><a href="https://cloud.gbif.org/asia/manage/resource?r=reptiletypesbnhs_v2">https://cloud.gbif.org/asia/manage/resource?r=reptiletypesbnhs_v2</a></p> <ul style="list-style-type: none"> <li>• Catalogue of type specimens of amphibians in the collection of BNHS</li> </ul> <p><a href="https://cloud.gbif.org/asia/manage/resource?r=amphibian_type_specimens_bnhs_collection">https://cloud.gbif.org/asia/manage/resource?r=amphibian_type_specimens_bnhs_collection</a></p> <ul style="list-style-type: none"> <li>• List of reptiles in the collection of BNHS</li> </ul> <p><a href="https://cloud.gbif.org/bifa/manage/resource?r=reptile_checklist_b">https://cloud.gbif.org/bifa/manage/resource?r=reptile_checklist_b</a></p>

Expected milestones	Completed? Yes/No	Explanatory notes	Sources of verification
			<a href="#">nhs</a> <ul style="list-style-type: none"> <li>List of amphibians in the collection of BNHS</li> </ul> <a href="https://cloud.gbif.org/bifa/manage/resource?r=amphibian_checklist_bnhs">https://cloud.gbif.org/bifa/manage/resource?r=amphibian_checklist_bnhs</a>
Sustainability and next steps have been documented <b>(Final report milestone)</b>	yes	Long-term digitization of the entire collection at BNHS has been initiated and in progress. We have successfully completed imaging all the type specimens of reptiles and amphibians focusing on important characters for identification. High resolution images of specimens are being used to create species specific templates that will be later uploaded on a museum portal along with digitized catalogue information. Following the learnings from the project we have also initiated digitizing information for other specimens of birds, mammals, insects etc. from the collection of BNHS.	Over 500 amphibian type specimens and over 250 reptile type specimens has been photographed from various angles to cover all characters. Images are backed up in multiple harddrives in the museum.

## Activities

Please indicate the status of the activities as outlined in the BIFA Full Proposal (section 4.4), at the time of final reporting.

The table below should be completed in the same way as in the BIFA Full Proposal, but should include information and updates on the status of each activity. Please indicate relevant source(s) of verification and **provide links, or a copy of the source of verification** mentioned if no links are available. Attachments should be provided in the Annex.

In the event of unexpected delay(s), please provide detailed explanatory notes and indicate new planned completion date(s).

Please include any additional activities completed during the implementation of the project that were not originally outlined in the BIFA Full Proposal.

Add rows as required.

Activity name	Expected deliverable	Contribution to goals listed in table 4.3 of the BIFA Full Proposal	Status of activity at final reporting: Completed? Yes / No (inc. % complete)	Explanatory notes, including new planned completion date if necessary	Source(s) of verification
Entering raw data from registers into excel sheets and inter-related tables	Digitized catalogue of species and updated checklist	This activity will contribute specific data towards creating and updating digital database of museum collection.	Entering raw data and data cleaning, 100% completed.	Completed	Part of corrected and cleaned data has been published as occurrence records and checklists.
Identifying and sorting amphibian and reptile specimens using morphological characters and measurements	Digitized catalogue of species and updated checklist Checklist and species identification templates Identified new distribution records	This activity contributed towards creating and updating digital database of museum collection.  This activity helped to address taxonomic ambiguities of complex and cryptic species and create updated	Completed, taxonomically confusing specimens have been identified and sorted following comparison with type specimens from ZSI museum.	Morphological studies on specific groups of reptiles like sea snakes, geckos, agamids, burrowing frogs have been completed. These are being regularly updated based on recent taxonomic publications. Studies on cryptic groups will be continued and periodically updated following upcoming changes in taxonomy.	The study on sea snakes was used to create occurrence records for preserved specimens in the museum. Published in GBIF, morphological studies also helped in publishing corrected checklist for reptiles and amphibians. The visit to museum helped complete the

Activity name	Expected deliverable	Contribution to goals listed in table 4.3 of the BIFA Full Proposal	Status of activity at final reporting: Completed? Yes / No (inc. % complete)	Explanatory notes, including new planned completion date if necessary	Source(s) of verification
		checklist of species.			final occurrence dataset of over 9700 records.
Georeferencing species occurrence localities	Digitized catalogue of species and updated checklist Species occurrence and distribution records New locality records	This activity will contribute towards mapping species distribution ranges based on species occurrence records	70% completed	Many of the specimens in the collection lack precise collection locality records or have older names. Hence, georeferencing is taking lot of time. Old literature review is in process to acquire authentic locations for collections. With recent changes in taxonomy and splitting of widely distributed species, this activity is being redone and will be continued and regularly updated in the datasets.	Georeferenced data has been used to provide occurrence records for all published datasets.
Specimens will be photographed from multiple angles with high-end DSLR cameras with macro lenses and stereo microscopes with attached DSLR cameras to create focus stacked high resolution clear images. A workshop will be conducted for research staff and volunteers working in the project to train them in specimen	Compiled Image database	This activity will contribute towards creating a digital database of species-specific images to be linked with the species catalogue	100% completed for all type specimens of reptiles and amphibians; 40% species specific imaging completed for other collection. This activity will be continued for long term and will include all new additions to the collection.	Species specific photography, processing and layout preparation is in process and will continue for long-term since new specimens are being added to the collection on a regular basis.	Example image templates attached as Annex 1. Reference images of photography and image processing workshop is attached as Annex 2.

Activity name	Expected deliverable	Contribution to goals listed in table 4.3 of the BIFA Full Proposal	Status of activity at final reporting: Completed? Yes / No (inc. % complete)	Explanatory notes, including new planned completion date if necessary	Source(s) of verification
photography and image processing.					
A digitization and project promotion meeting will be conducted to communicate the project highlights and to influence future long-term work	Inform researchers, stakeholders and cofounders on the prospects of digitization	This activity will contribute towards overall digital database creation as well as understand potential use of archived data. Additionally, this activity will influence stakeholders and other museums towards data mobilization and collaboration	Yes	The outcomes from the project were communicated to various stakeholders through a presentation in the GBIF Asia Virtual summit 2020. The findings were also communicated and discussed across all the researchers of BNHS, associated members and stakeholders through an audio-visual presentation during the Annual research seminar in December 2021.	

## Deliverables

*This section should summarize the project deliverables as outlined in the BIFA Full Proposal (section 4,5), at the time of final reporting. Please highlight any changes from the original plans.*

*If no result has been achieved on a specific point, or in the event of unexpected delay(s), please provide detailed explanatory notes and indicate new planned completion date(s).*

Please include any additional deliverables completed during the implementation of the project, that were not originally outlined in the BIFA Full Proposal.

Add rows as required.

**a. Data**

Details of datasets published and/or pending publication as an outcome of the project. The table below should be completed in the same way as in the BIFA Full Proposal but should include information and updates on the status of each dataset. **Please provide links in sources of verification.**

If the dataset is not yet published, please indicate this as “not published” and provide a detailed explanation, % of digitization and expected date of publication.

Add rows as required.

Title of dataset	Data type (checklist/occurrences/ sampling event) <sup>1</sup>	Estimated number of records (specimens)	Status of dataset:  Published / not published and % of digitization and expected date of publication	Data holding institution agreed to publish its data via GBIF.org (Yes/No)	Explanatory notes	Source(s) of verification:  DOI or URL
Updated catalogue of type specimens of reptiles in the	Occurrence	267	<i>Published</i>	Yes	This includes a list of all type specimens of reptiles currently housed in BNHS. It will be updated	<a href="https://cloud.gbif.org/bifa/manage/resource?r=reptiletype_nhs_v2">https://cloud.gbif.org/bifa/manage/resource?r=reptiletype_nhs_v2</a>



Title of dataset	Data type (checklist/occurrences/ sampling event) <sup>1</sup>	Estimated number of records (specimens)	Status of dataset:  Published / not published and % of digitization and expected date of publication	Data holding institution agreed to publish its data via GBIF.org (Yes/No)	Explanatory notes	Source(s) of verification:  DOI or URL
collection of BNHS					periodically	
Catalogue of type specimens of amphibians in the collection of BNHS	Occurrence	513	<i>Published</i>	Yes	This includes a list of all type specimens of reptiles currently housed in BNHS. It will be updated periodically	<a href="https://cloud.gbif.org/bifa/manage/resource?r=amphibian_type_specimens_bnhs_collection">https://cloud.gbif.org/bifa/manage/resource?r=amphibian_type_specimens_bnhs_collection</a>
Catalogue of sea snakes in the collection of BNHS.	Occurrence	235	Published	Yes	This includes a list of all sea snake specimens in BNHS. It will be updated periodically	<a href="https://cloud.gbif.org/bifa/manage/resource?r=bnhs_sea_snakes">https://cloud.gbif.org/bifa/manage/resource?r=bnhs_sea_snakes</a>
A catalogue of reptiles and amphibians in the collection of BNHS	Occurrence	9766	Published	Yes	A complete catalogue of all reptile and amphibian specimens in collection of BNHS, with updated taxonomic changes.	<a href="https://cloud.gbif.org/asia/manage/resource?r=bnhs_herpetofauna">https://cloud.gbif.org/asia/manage/resource?r=bnhs_herpetofauna</a>
Checklist of reptiles in the collection of BNHS	Checklist	565	<i>Published</i>	Yes	This includes a list of all correctly identified reptile species in the BNHS museum. It will be updated periodically	<a href="https://cloud.gbif.org/bifa/manage/resource?r=reptile_checklist_bnhs">https://cloud.gbif.org/bifa/manage/resource?r=reptile_checklist_bnhs</a>

Title of dataset	Data type (checklist/occurrences/ sampling event) <sup>1</sup>	Estimated number of records (specime ns)	Status of dataset:  Published / not published and % of digitization and expected date of publication	Data holding institution agreed to publish its data via GBIF.org (Yes/No)	Explanatory notes	Source(s) of verification:  DOI or URL
Checklist of amphibians in the collection of BNHS	Checklist	243	<i>Published</i>	Yes	This includes a list of all correctly identified amphibian species in the BNHS museum. It will be updated periodically	<a href="https://cloud.gbif.org/bifa/manage/resource?r=amphibi an_checklist_bnhs">https://cloud.gbif.org/bifa/manage/resource?r=amphibi an_checklist_bnhs</a>

**b. Other deliverables**

*Describe other deliverables (e.g. publication of data papers, analysis, reports etc.) produced by the project. In the event of unexpected delay(s), please provide detailed explanatory notes and indicate if the deliverable(s) are to be produced post-project, and if so, indicate expected completion date(s).*

***Please provide links in the sources of verification. Attachments should be provided in the Annex.***

Name and type of deliverable	Status of deliverable:  Completed?  Yes / No (inc. % complete)	Explanatory notes	Source(s) of verification
Data paper related to occurrence of sea snakes in the museum	<i>90% completed</i>	Final analysis in process	

Name and type of deliverable	Status of deliverable: Completed? Yes / No (inc. % complete)	Explanatory notes	Source(s) of verification
Data paper on checklist of reptiles and amphibians in BNHS museum	90% completed	Final analysis in process	

### Events organized as part of the project

Please indicate the status of the events as outlined in the BIFA Full Proposal (section 4.6), at the time of final reporting.

The table below should be completed in the same way as in the BIFA Full Proposal, but should include information and updates on the status of each event. **Please provide links to any documents or web pages documenting the event(s) in the sources of verification. Attachments should be provided in the Annex.**

In the event of unexpected delay(s), please provide detailed explanatory notes and indicate new planned completion date(s).

Please include any additional events organized as part of the project that were not originally outlined in the BIFA Full Proposal.

Add rows as required.

Event title	Organizing institution	Date held / expected dates	Number of participants	Explanatory notes	Source(s) of verification
An introduction to reptiles and amphibians	BNHS	2 <sup>nd</sup> June 2019	25	This event was organised to introduce participants to reptiles and amphibians and also to provide training on taxonomy using museum specimens	Event description and images attached as Annex 2.

Event title	Organizing institution	Date held / expected dates	Number of participants	Explanatory notes	Source(s) of verification
An introduction to ERDAS Imagine software	BNHS	13 <sup>th</sup> -14 <sup>th</sup> May 2019	15	This training session was conducted to train participants in Georeferencing, using and creating maps using ERDAS Imagine software	Event description and images attached as Annex 3.
Photography and image processing workshop	BNHS	December 2019	10	This training session was conducted to train participants in specimen photography and image processing	Event description and images attached as Annex 4.
Visting ZSI museum to study type specimens		November 10-16 2021	2	2 researchers from BNHS visited Zoological Survey of India to study type specimens of reptiles and amphibians to address taxonomic ambiguities.	Images attached as Annex 8.

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## Calendar of activities

*The calendar should be completed in the same way as in the BIFA Full Proposal (section 4.7) but should also clearly indicate and include any changes (e.g. use of colour-coding to indicate expected changes and/or delays). Please provide explanations for any changes in the “Notes” column. Please provide general comments on the calendar of your activities in the ‘General comments on project implementation’ section.*

Activity	2019								2020				2021			Notes	
	M	J	J	A	S	O	N	D	J	F	M	D	O	N	D		
Activity: Project initiation: Meeting of team members to brief about project requirements, design schedule and standardize data tables, acquire essential equipment and compile raw data	X																
Activity: Entering raw data from registers into excel sheets and inter-related tables	X	X	X	X			X	X	X	X	X						Raw data entry was extended due to data cleaning and correction issues
Activity: Photography and image processing workshop								X									Workshop time was changed due to unavoidable circumstances (flood and heavy rains in monsoon)
Activity: Specimen photography using focus stacking and image processing	X	X		X		X	X	X	X	X			X	X	X		Photography stopped due to lockdown from March-Nov 2020. To be continued for long-term to capture as many specimens as possible
Mandatory attendance of a project team member to the BIFA Capacity Enhancement Workshop (expenses for attending the workshop are covered by the BIFA programme)			X														
Activity: Meeting of team members to discuss and rework project plan based on learning from BIFA Capacity Enhancement Workshop				X													
Activity: Identifying and sorting amphibian and reptile specimens using morphological characters and measurements, data analysis for species delimitation		X	X	X	X		X	X		X	X		X	X			Activity had to be stopped abruptly due to lockdown
Activity: Preparing interim report and uploading publishing dataset					X	X											

<p>Deadline for mid-term report – 31 October 2019 Mandatory milestones attached to the mid-term report</p> <ul style="list-style-type: none"> <li>-Gain certification at BIFA Capacity Enhancement Workshop</li>   <li>- At least one dataset has been published to GBIF.org</li> </ul>																		
<p>Activity: Georeferencing species occurrence localities</p>			X	X	X		X	X	X	X	X			X	X	X		Georeferencing will be extended due to unavailability, uncertainty of proper location data, restricted access to data due to COVID-19 pandemic. To be continued for long-term to for new specimens and with unreliable geographic information
<p>Activity: Visiting local museums to study type specimens and resolve taxonomic ambiguities</p>															X			Museum visit conducted in Nov. 2021
<p>Activity: Stakeholder meeting towards digitization and project promotion</p>																X		Virtually communicated findings through audio visual presentations

Activity: Create species distribution maps and refer historical data to fill gaps									X	X	X	X		X	X	X	Mapping for species will continue along with corrected georeferencing
Activity: Compile and update data, create updated data sets, data papers and final report											X	X		X	X	X	Compiling data completed; data papers in process
Deadline for final reporting – 31 December 2021 Mandatory milestones attached to the final report: - All deliverables have been produced - Sustainability and next steps have been documented																	Deadline extended to December 2021

**a. General comments on project implementation**

*(Max. 200 words)*

Cleaning data for errors in taxonomic names, spellings, locations is a time-consuming process and needs to be done thoroughly to avoid misrepresentation. Hence, even though entry of raw data is completed but data cleaning required extended attention. This increased the overall time period for developing catalogue for the entire collection. Lot of the location data associated with older specimens is either missing or not precise. Many of the location names have changed over time which caused delay in getting a precise collection locality. To address this lack of information we have to verify the locations from literature. Additionally, many older specimens were collected during long journeys and expeditions and hence getting precise locality and date is impossible if not originally provided. Thus, georeferencing and acquiring precise coordinates for most of the older specimens got extended due to unavailability, uncertainty of proper location data. Due to the sudden outbreak of COVID-19 across the country, making visits to other museums to study reference type specimens was not possible. This hindered accurate identification of some species. Hence some of the overall expected outcomes got delayed. Visit to the museum was only possible in November 2021 following which the final dataset was updated. We will keep on updating the database in GBIF platform periodically as more specimens gets added and as and when the taxonomy gets sorted.

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## Project communications and visibility

*Describe the way the results of your project have been and will continue to be communicated and shared with the project stakeholders and broader GBIF community.*

*Please also review the page describing your project available from <http://www.gbif.org/programme/bifa> and highlight any additional documents, events, news items or links that you would like to add to your page and provide links/attachments in the Annex.*

*(Max. 300 words)*

Workshops like the introduction to reptiles and amphibians using museum specimens, specimen photography and image processing helped in training participants in taxonomic methods and photography, essential tools when digitizing museum collections and associated information. This helped in efficiently digitizing the type specimens in the collection and publishing respective catalogues in the GBIF platform. Some of the reference images for type specimens are attached below in Annex 1. These catalogues will be updated regularly to keep up with the increasing number of type specimens deposited in the collection and in turn help researchers across the globe to access these specimens. Catalogues and checklists for general specimens, especially for data deficient groups have been created to address data gaps. In line with this a catalogue for sea snakes, checklist of reptiles and amphibians has been published in GBIF. Following museum visit, cataloguing of the entire reptile and amphibian collection was finally possible. Following the learnings from this project, data mobilization workshop will be conducted to promote study of museum collections as well as importance of digitization. Images, datasets from the project will be shared with GBIF community through the project page as well as related social media sources once published. The project activities were covered in the October 2019 and April 2020 issues of the BNHS newsletter 'ecoScapes' which communicated to all the members of the organisation. This helps in spreading the word and promoting the project across a vast array of people. The following annexes can be added to the project page to communicate project activities to stakeholders.

Annex 1: Example template images of reptile and amphibian specimens in the collection of BNHS.

Annex 2: Workshop on Introduction to reptiles and amphibians

Annex 3: Workshop on introduction to ERDAS Imagine software

Annex 4: Photography and image processing workshop

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## Monitoring, evaluation and lessons learned

*Please indicate the results of the monitoring and evaluation plans, as outlined in your BIFA Full Proposal (section 4.9), at the time of final reporting.*

*Ideally this section should also include the following:*

- *An evaluation of the project activities and their outputs/deliverables*
- *An assessment of the overall outcomes, impacts of the project and how it contributes to the overall objective of the BIFA programme*
- *Comments on the project implementation and completion, and its efficiency and effectiveness, strength and weaknesses etc.*
- *Any feedback on the project's relevance from the partners and stakeholders*
- *Indications and reasons for any changes which have been made to the project's original plans, and actions to follow-up*
- *Areas of success to build on, after the project's implementation period and best practices that could be useful for the community*
- *Main lessons from the project experience that could be applied in other contexts*
- *Conclusions from your experience during the implementation of the project and recommendations for the GBIF Secretariat or the community to reinforce the success of the project*

A total of 9766 records digitized for reptile and amphibian occurrence after cleaning, correcting taxonomic status and updating of the same. This includes occurrence information from 23 countries, for specimens collected between 1880 to 2019. 2310 occurrence records are supported with geo coordinates. 235 occurrence records for 30 species of sea snakes belonging to three families published in GBIF. Additionally, an updated catalogue of reptile type specimens including 267

occurrence records with verbatim as well as rectified decimal coordinates has been published. Another catalogue for amphibian type specimens in the collection has also been published with 513 occurrence records. A checklist of reptiles with 565 species and a checklist of amphibians with 243 species has also been published in GBIF. Some of the major challenges observed during the project work was missing data, in the form of collection localities, badly preserved specimens causing hurdles in conducting taxonomic investigations and missing proper registration numbers especially for really old specimens. Also, poor condition of raw data in the form of damaged old registers, missing pages were some of the other hurdles that extended the process of data entry. Old registers need to be handled very carefully to avoid damage, some of the writings has also become faint over time causing trouble in accurate data entry. To avoid further damage of the registers have photographed, each page and these photographs will be used instead to original registers to extract data in the future. This might reduce the efforts in data entry and help in finishing task faster. Publishing three occurrence datasets have helped in understanding the who data publishing process and was also a learning process which will enhance future dataset publications.

Another major aspect of the project was to visit natural history museums across the country to study type specimens that would help in accurately addressing taxonomically ambiguous groups. Unfortunately, this wasn't possible in the planned time due to the sudden outbreak of COVID-19 pandemic. This obstacle inadvertently delayed the project progress since access to the museum specimens and data had to be stopped due to the lockdown. A visit to the ZSI museum was only possible in November 2021. The georeferencing and imaging work will be continued after the period along with updating nomenclature periodically when more taxonomic and distributional studies are published.

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## Sustainability plans

*Please provide a description of how the partners involved will build on the results of this project in their future work. This could include future collaborative activities, such as plans to complete any unfinished project activities and how the future impact of the project could be monitored and/or measured.*

*(Max. 200 words).*

To promote the importance of museum specimens and associated metadata, the natural history collection department at BNHS has initiated a long-term digitization of the entire collection. This project in digitizing the reptiles and amphibian collection will contribute to the larger goal of digitizing museum specimens of various organisms. This collection is also growing due to contribution of specimens from researchers from all across India.

The experience gained during this project work is helping in creating a framework for mitigating problems which might occur during the digitization process. The data acquired during this project will be updated frequently based on new specimen additions to the museum. Occurrence data for selected groups of reptiles and amphibians like endangered and data deficient species will be used in association with bodies like the IUCN to address data gaps. Some activities like visit to museums and taxonomic evaluation of all the specimens couldn't be completed in the project period due to unavoidable conditions. These activities will be carried out along with the other digitization work and will be regularly updated on the GBIF platform. A workshop would be conducted to promote importance of data mobilization and seek potential collaborations for long-term data digitization projects.

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## Annex – Additional sources of verification

*Sources of verification are for example links to relevant digital documents, news/newsletters, brochures, workshop related documents, pictures, etc.*

Annex 1\_Example template images of reptile and amphibian specimens in the collection of BNHS

Annex 2\_Workshop on Introduction to Reptiles and Amphibians

Annex 3\_Workshop on Introduction to Erdas Imagine software

Annex 4\_Photography and image processing workshop

Annex 5\_badge\_162429\_all

Annex 6\_BNHS newsletter ecoscapes vol 2(2) October 2019

Annex 7\_BNHS newsletter ecoscapes vol 3(1) April 2020

