



# FINAL ACTIVITY REPORT

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

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

## Contents

Project information .....	1
Executive summary .....	2
Project objectives .....	3
Activities .....	7
Deliverables .....	8
Calendar of activities .....	10
Project communications and visibility .....	11
Final evaluation findings and conclusions.....	12
Sustainability plans.....	13
Recommendations and lessons learned.....	13
Annex – Sources of verification .....	14

## Project information

<b>Main contact person and role:</b>	Simon Mahood, Senior Technical Advisor
<b>Institution/network/agency affiliation:</b>	WCS Cambodia
<b>BIFA Project ID:</b>	BIFA_37
<b>Project title:</b>	Mobilizing a country-wide, long-term camera trap dataset in Cambodia
<b>Start date and end date of the reporting period:</b>	1 April 2018 – 21 June 2019
<b>Country in which the activities take place:</b>	Cambodia

## Executive summary

*Provide a brief explanation of the project and its implementation, the context and the approach taken for the final evaluation, and a summary of the objectives achieved, lessons learned and conclusions.*

Cambodia's unique and globally important wildlife often exists over large areas, at low densities, adopting human-avoidance behaviours that make them increasingly elusive, meaning camera traps are an important tool for biodiversity monitoring across a range of taxa. A wealth of camera trap images and data have been collected by WCS over the last 2 decades across the country, first using film-based camera traps and subsequently using digital camera traps as the technology became available. This dataset provides important information on species distribution and relative abundance for large and small mammals, as well as birds.

With multiple projects across many protected areas collecting a large number of images, data management is an important issue. Different data and metadata have been collected and stored in different manners by different principal investigators. This made reuse, federation, and sharing of data complex, if not impossible.

This project aimed to centralise disparate datasets into a single unifying system. An estimated 135 000 camera trap image files were planned for assessment, collected between 2001 and 2015. The total number of these that contained occurrence records was unknown as the proportion of blank images or duplicates was unknown. Following the indexing and centralisation of these images, the project planned to identify and adopt an image management system. The identified software which best met all management needs, developed by WCS with partnership with other stakeholders, was due for release early in 2019. Due to unforeseen delays, the launch will take place following the completion of this project. Following discussion with the BIFA team, it was decided that the most effective use of resources was therefore to reallocate funding originally planned for training and adoption of this system to increasing the image processing effort and expanding the temporal coverage of data processed under this project to include 2016 – 2018 data.

As such, a total of 295 285 images were processed. From these, a total of 16 710 occurrence records covering 79 species across 4 major landscapes were derived and published to GBIF.

Once the selected software solution is publically launched, these data will be uploaded, and additional occurrence records will be derived from images that have not yet had species identified; an estimated 10,000 further records.



## Project objectives

*This section should include the list of objectives included in your original project proposal, stating for each how far you advanced towards their achievement. Also include any additional objectives that were defined during the implementation of the project. In the event of unexpected challenges prevented you to reach a planned project objective, please provide detailed explanations and indicate how you plan to reach these objectives post project.*

The original goals were:

### 1. Adoption of appropriate camera trap image management system

This system, Wildlife Insights, has been identified and meets all the specified requirements of an effective camera image management solution. Developed by partners including WCS, the system includes tools such as machine vision for identifying blank/occupied images, and machine learning for automated species identification. Full launch has been delayed, and so the component for training staff on its use has not been completed. Instead, additional data processing took place (see Goal 2).

### 2. Importation of existing camera trap data into appropriate system

The original goal was to process an estimated 135 000 camera trap image files were planned for assessment, from 2001-2015. With delays in reaching Goal 1, additional effort was allocated to image processing for the original period, and the temporal range was extended to include 2016-2018 images.



In preparation for loading into Wildlife Insights, image metadata were extracted and prepared into a format following the Camera Trap Federated Minimum Data Standard 1.3. This standard uses Darwin Core terms and retains compatibility in modified fields.



This standardised data will be used to load images and image metadata directly into Wildlife Insights, allowing retention of species identifications and other manually classified data.

A total of 265 295 images were processed from the period 2001 - 2015, and a total of 29 990 images from the period 2016-2018. From these images, 20 491 observations of animals were made. Removing humans, and observations without complete data (e.g. missing latitude and longitude: 3279 animal observations, see Figure 1.) leaves 16 710 full occurrence records (with coordinates) for wildlife species, and a total of 21 439 occurrence records (including those with only a locality). These cover four major biodiversity areas in Cambodia: the Northern Plains Landscape, the Eastern Plains Landscape, the Tonle Sap Flooded Forest, and coastal Koh Kong (see Figure 2).



Due to two factors, the coordinate precision was reduced to two decimal places (around 1000m at 12 degrees latitude). Firstly, poaching is prevalent across these landscapes. Although these are historical records, sampling focused around key hotspots including water holes and other landscape features, which could be identified through this data if kept at a higher precision. Secondly, data loss from older records (for example, not recording the geodetic datum used during sampling) and the fact that different datums have been used in different surveys (WGS84, Indian 1960) means a small offset error may be present in some reported coordinates. This would not be a concern for most application of this dataset, but if used for habitat modelling, significant impacts on resulting models may be caused.

Additional occurrence records can be derived from some of the remaining images, as not images have been manually assessed for animal presence. Further work in this area will wait until the adoption of the Wildlife Insights system, as the process will be greatly sped up by automation tools.

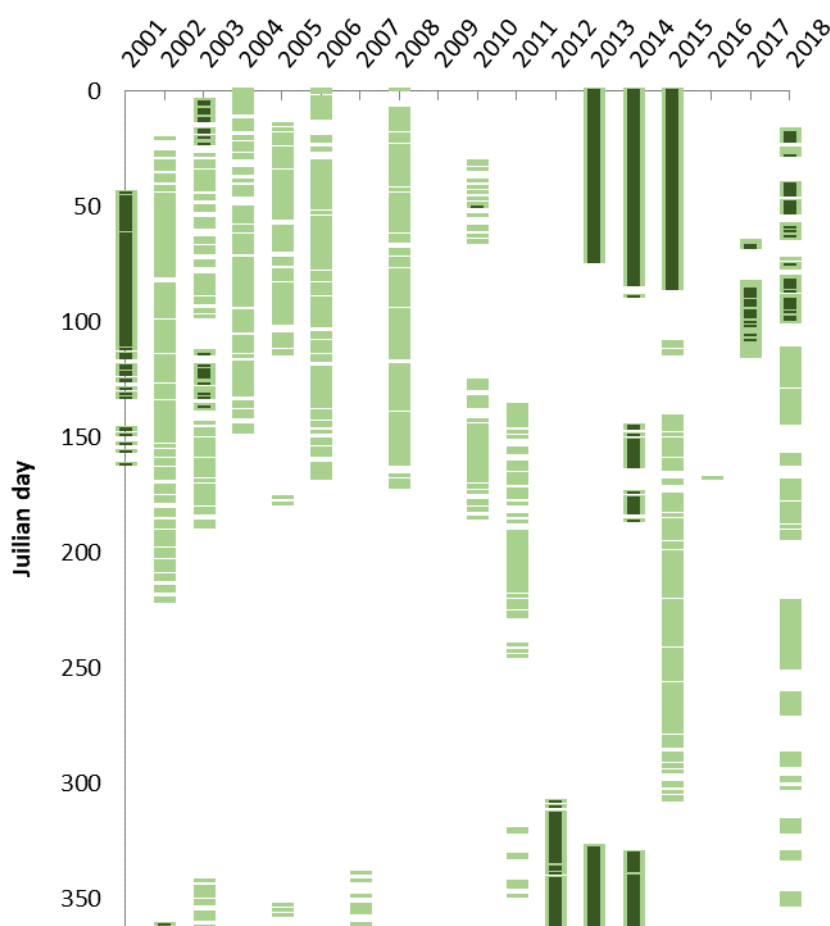
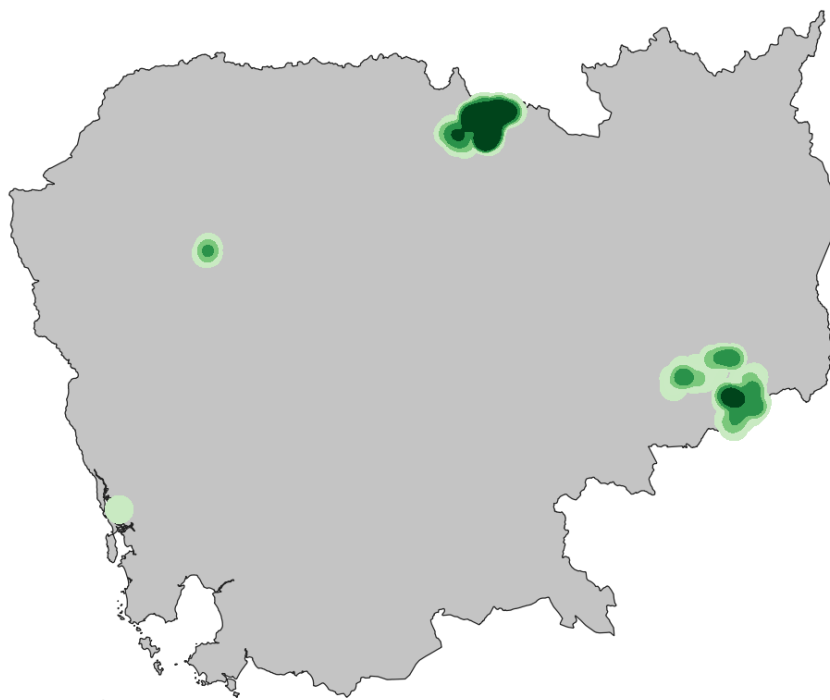


Figure 1. Temporal coverage of processed images with date recorded, and occurrences. Each light green line represents an image and its corresponding date of capture, by year and Julian day. Each smaller dark green line represents an occurrence record. For years with no occurrence records (e.g. 2006, 2008) observations of animals were made. However, location data was not recorded so cannot be included as full occurrence records. Work will continue to identify localities for these observations. For newer data (e.g. 2015, 2018), additional occurrences will be extracted using Wildlife Insights, which will greatly speed up the process of identifying images containing animals and species.



*Figure 2. Geographic coverage derived occurrence records across Cambodia. Darker green represents more processed images.*

### 3. Publication of camera trap dataset through GBIF

At the beginning of May, a test batch of around 1000 occurrence records were uploaded to GBIF, to highlight any issues that might arise in the full upload. At the end of May, the full set of 16 710 images were uploaded to the France IPT, updated to 21 439 records in July. This data has now been published and is publically available.





## Activities

Please indicate the status of the activities as outlined in the project proposal, at the time of final reporting. The table below should be completed in the same way as in the full proposal but should include information and updates on the status of each activity.

In the event of unexpected delay please provide detailed explanatory notes and indicate planned completion date after the end of the project. Add as many rows as needed.

In the event of any additional activities having being completed during the implementation of the project, please add rows as required.

Description of activity	Partners involved	Contribution of activity to goals listed in table 4.3	Status of activity as of final reporting Completed? Yes/No	Explanatory notes, inc. planned completion date if necessary	Source(s) of verification
<b>Compiling inventories of biodiversity data holdings (for example, by implementing metadata catalogues)</b>					
Data management standard selection	WCS	Required for achieving Goal 1	Yes		Report
Purchase of appropriate hardware	WCS	Required for achieving Goal 1	Yes	Hardware changed from server for image hosting, to laptops for image processing	Finance records and asset management system records
Biodiversity monitoring staff training on selection standard	WCS	Required for achieving Goal 1 and Goal 2	No	Effort and staff time reallocated to additional indexing and image processing	n/a
Importation of indexed data	WCS	Required for achieving Goal 2 and Goal 3	Partial	Data prepared into import formats, but not yet uploaded. Awaiting full release of solution	Photos, indexed data
Indexing and importation of additional data	WCS and SFS	Required for achieving Goal 3	Yes	Additional effort on image processing and temporal range	Photos, indexed data



## Deliverables

*This section should summarize the project deliverables completed by the final reporting date, with a description of the associated outputs. Please highlight any changes from the original plans provided in the full project proposal.*

*In the event of unexpected delay, please provide detailed explanatory notes and indicate planned completion date. Add as many rows as needed.*

*In the event of any additional deliverables having being completed during the implementation of the project, please add rows as required.*

### a. Data

*Details of datasets mobilized and/or pending mobilization as an outcome of the project: Please use list from mid-term report and update this as at final reporting.*

*If the dataset is not yet published, please indicate it as “not published” and provide a detailed explanation and expected date of publication. Add rows as required.*

Title of dataset	Taxonomic/geographic scope	Approx. number of records (specimens)	Current format (e.g. undigitized, digitized)	Status of dataset: Published/not published – inc. date/expected date of publication	Explanatory notes	DOI or URL
WCS Cambodia camera trap occurrence data	2001-2018, Cambodia, mammals, birds, reptiles.	21 439 occurrence records		Published July 2019	Hosted on the France IPT	<a href="https://doi.org/10.15468/tjl4lg">https://doi.org/10.15468/tjl4lg</a>
WCS Cambodia camera trap images - Processed but unidentified images	2001-2018, Cambodia, mammals, birds, reptiles.	300,000	Standardised, ready for import in Wildlife Insights	Will be imported (images and metadata) into Wildlife Insights are past of beta-testing. Public launch Oct 2019	WI will greatly speed up identification of blank images, and also process of species identification. These images are ready to imported into that system.	



## b. Other deliverables

*Describe other deliverables (e.g. publication of data papers, catalogues, reports etc.). produced and/or planned to be produced as a post-project deliverable.*

*Please provide indicative dates/estimated time for completion for planned post-project deliverables.*

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

Name and type of deliverable	Status of deliverable  Published/not published – inc. date/expected date of publication or estimation of time for completion	Explanatory notes	Source(s) of verification
A Conservationist's Lens: A Glimpse at Biodiversity in Keo Seima Wildlife Sanctuary through Camera Trap Data	Published, 2018	Student project output, part of occurrence record extraction (4500 images, 1100 occurrence records)	Attached report.



## Calendar of activities

*The calendar should be completed in the same way as in the Full Project Proposal (4.6) but should include any changes. Please provide reasons for any changes in the Notes column in the table below.*

Proposed dates	Activity	Lead partner	Notes
April 2018	Selection of appropriate management solution	WCS	
April/May 2018	Preparation of unindexed data at headquarters and field sites by WCS staff and SFS students	WCS/SFS	
May 2018	Purchase and installation of required hardware	WCS	Implemented May 2019, hardware type changed from server for image hosting to laptops for image processing
June 2018	Importation of digitized film data at headquarters	WCS	
June 2018	Publication of two SFS student analyses	SFS	
June/July 2018	Attendance of project team member at BIFA Capacity Enhancement Workshop	WCS	
July/August 2018	Staff training on selected solution at headquarters	WCS	Delayed, effort reallocated to image processing
August-December 2018	Importation of digital images at headquarters	WCS	
September 2018	Field staff training on selected solution	WCS	Delayed, effort reallocated to image processing
September/October 2018	Importation of digital images at field sites	WCS	
November 2018-March 2019	Continued use of selected solution, support, and	WCS	Delayed, effort reallocated to

	coordination between Project coordinator and field sites for newly collected data		image processing
November 2018-March 2019	Continued enrichment of dataset (species identification, counts of individuals, etc) by project staff and volunteers	WCS	Additional effort allocated, increasing image number processed and temporal range
March 2019	Publishing of dataset through GBIF	WCS	Took place May 2019 due to delay caused by Project Lead taking compassionate leave. Updated in July.

#### a. General explanatory notes

Due to a family bereavement, the WCS Project Coordinator took a leave of absence towards the end of the project. As this caused delays to the project, and extension until May 31 was approved by the BIFA team.

## 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> . Highlight any additional documents, events, news items or links that you would like to add to your page and provide links/attachment in the Annex.*

Following public release of the dataset through the GBIF platform, the WCS Cambodia Media Officer will produce a number of press released, social media, and website updates highlighting the project's success. The GBIF program will be credited in scientific and popular articles produced based directly on this project.

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## Final evaluation findings and conclusions

*This section of the report should cover for example:*

- ② *An evaluation of the project activities and their outputs/deliverables*
- ② *An assessment of the overall outcomes, impacts of the project and how it contributes to the overall objective of the BIFA programme*
- ② *Comments on the project implementation and completion, and its efficiency and effectiveness, strength and weaknesses etc.*
- ② *Any feedback on the project's relevance from the partners and stakeholders*
- ② *Indications and reasons for any changes which have been made to the project's original plans, and actions to follow-up*
- ② *The management arrangements for the project, including support from the GBIF Secretariat*
- ② *Areas of success to build on, after the project's implementation period*
- ② *Conclusions from your experience during the implementation of the project*

Overall the project succeeded in processing considerably more than the target number of images. This supports meeting the BIFA objectives, as the derived occurrence records are now uploaded to GBIF awaiting approval for publication.

Financial reporting requirements were higher than expected, and the project's finance team was unable to produce reports to meet the deadlines. Although the delay is the responsibility of project implementer, providing grantees with example copies of financial reports at the beginning of the project may aid the timely submission of financial reports.

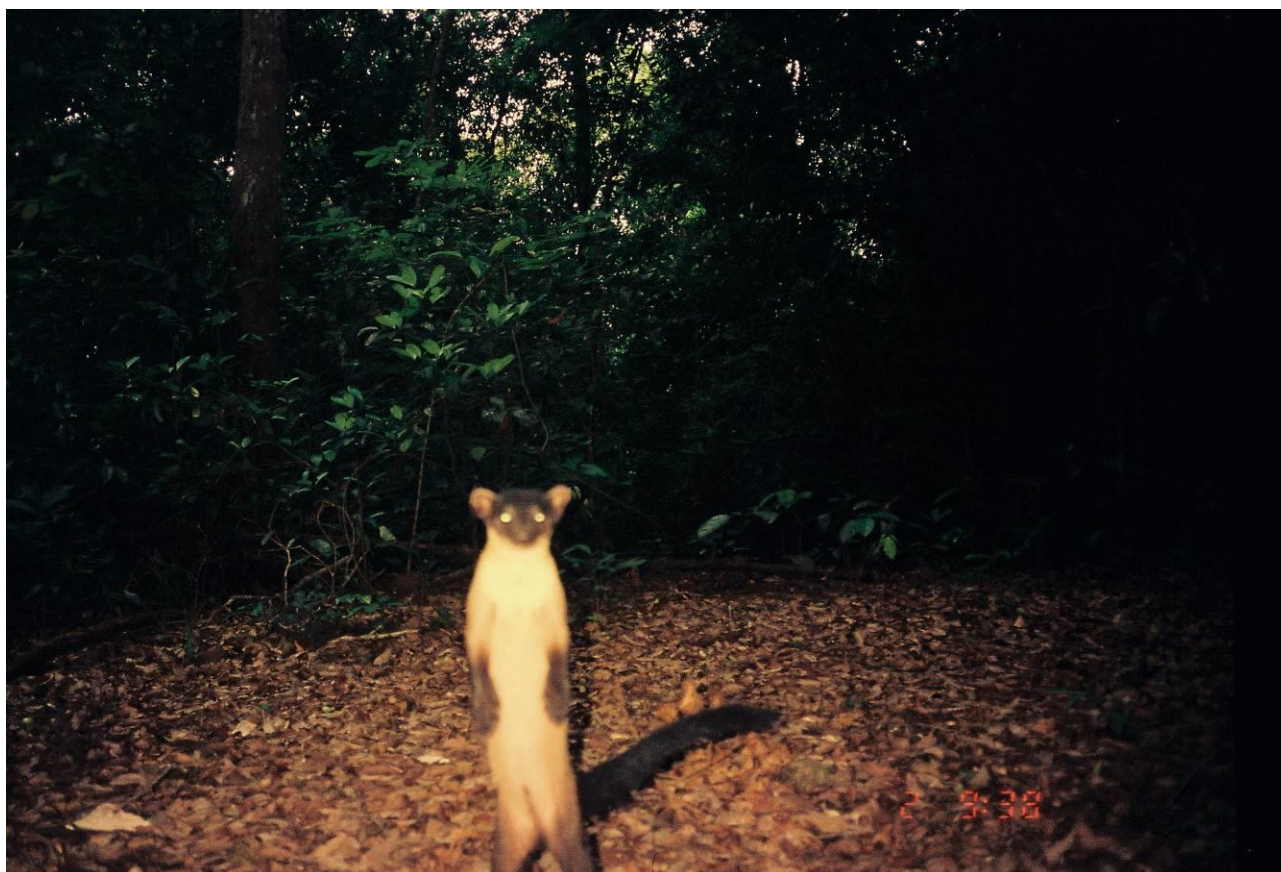
A second, unavoidable delay was caused by a family bereavement for a key project staff member. However, with good communication from the BIFA a two-month extension was arranged, and no negative impact was caused to the project aside from a delay in project completion.

Although changes were made to the activities, due to the identified software solution not being released within the project period, the revised activities were successful and led to an increased number of images being processed.

The utility of even the pre-upload, cleaned and centralised dataset has already been demonstrated, with staff finding a number of interesting records that had been forgotten about with staff turnover.

Aside from the specific goals of this project, the BIFA training has led to a wide discussion of data publishing within WCS and with government partners. Additional datasets have been earmarked for later publishing. These will be the first Cambodian biodiversity records published through GBIF, and we hope we will lead the continued practice of ensuring the most value comes from biodiversity data.






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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.*

Sustainability and the long-term use of outputs and outcomes of this project are at its core. Adopting a functional system will allow all future data to be integrated, allowing more powerful longitudinal studies, and make this complex dataset useable by a range of staff, from media teams to biodiversity teams to national students.

The need for on-going use of a centralized system was highlighted during the project, with significant data loss from older datasets.

Next steps for this project are adoption of the identified system, and staff training in its usage. Additional occurrence records will be derived, through the use of Wildlife Insights, and through finding location data and other missing data from older records.

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## Recommendations and lessons learned

*This section should describe your experiences that could help in designing and implementing biodiversity mobilization projects more effectively, including the best practices to adopt and the pitfalls to avoid.*

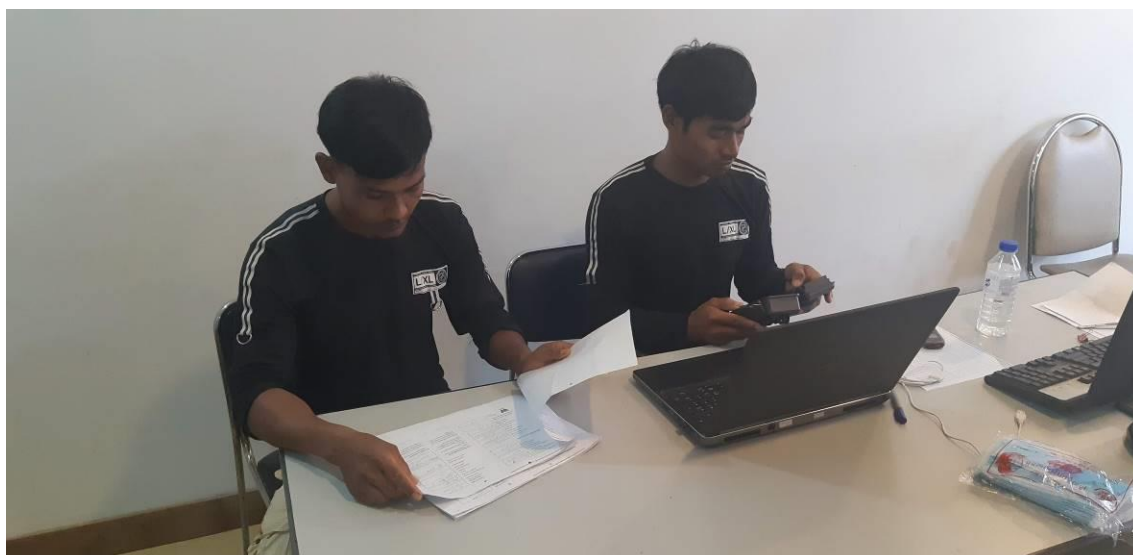
Providing grantees with example copies of financial reports at the beginning of the project (or even with proposal documentation so organisations can make an assessment before submitting applications) may aid the timely submission of financial reports.

## Annex – Sources of verification

*Sources of verification are for example links to relevant digital documents, news/newsletters, brochures, copies of agreements with data holding institutions, workshop related documents, pictures, etc.*



*Figure 3. Field staff receive training on image processing at Keo Seima Wildlife Sanctuary, WCS Cambodia Monduliri Office*



*Figure 4. Field staff in Mondulkiri enter deployment data*



*Figure 5. Field staff in Preah Vihear process images and enter data*





*Figure 6. Mondulkiri Biodiversity Team Leader reviews data entered by field staff*



*Figure 7. The Project Coordinator supports an intern to clean and process the compiled database*



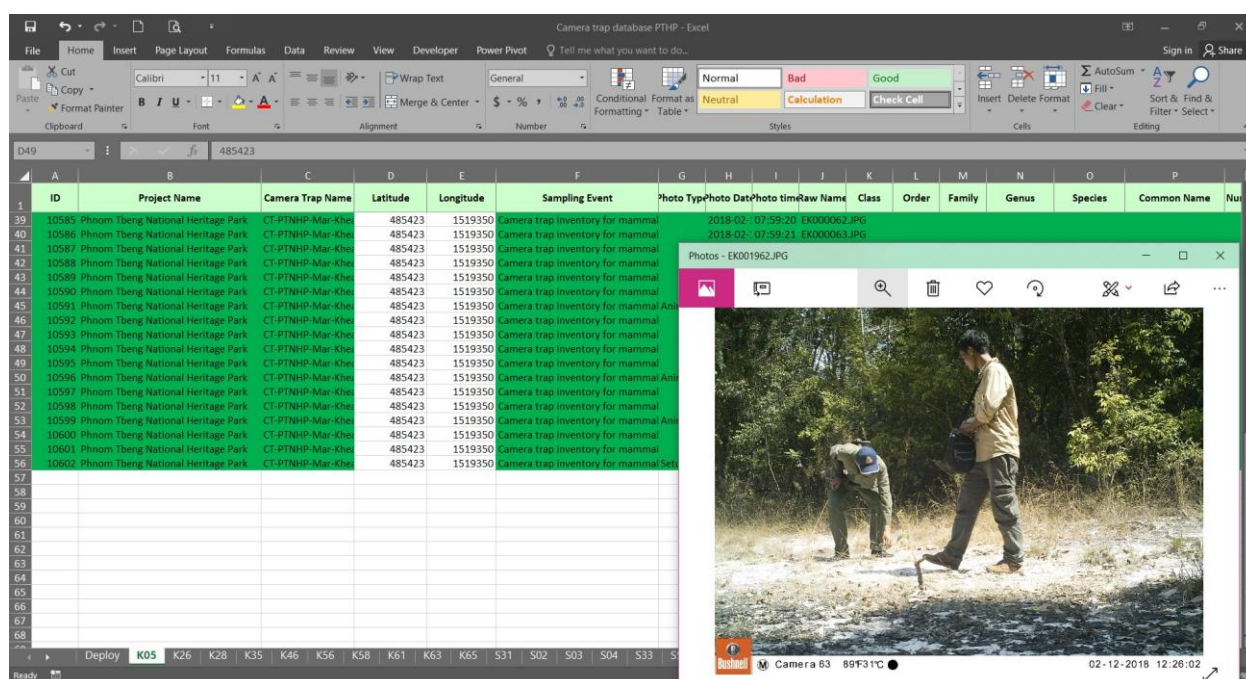


Figure 8. Screen shot of a biodiversity officer processing camera trap data during the project

Signed on behalf of the project partners

Date

19/06/2019

p.p.

Simon Mahood, Senior Technical Advisor

p.p. Oliver Griffin, Data Analyst and Operations Technical Advisor