Taiwan bees- a bilingual open source checklist and digitization of Taiwan's bee fauna

Programme:BIFA
Project ID: BIFA6_033
Project lead organization: Taiwan Forestry Research Institute
Project implementation period:1/9/2021 - 28/2/2023
Report approved: 15/5/2023

Narrative Final report

Executive Summary

Implementations and achievements
We accomplished a majority of our four goals: 1) around half of all known species were photographed, as were nearly 80% of all specimens in the Taiwan insect collections, 2) we digitized almost all bees from 6 of the 7 collections, including giving each a unique identification code, 3) around 30 species of the bees in Taiwan were barcoded, and 4) collecting occurred in novel areas such as Kinmen and Green Island, based on our regional sampling gaps. We have completed all the data collection for the first species level bilingual checklist. Our team also hosted a workshop for members of the public interested in learning how to identify Taiwan bees to the genus level, for which a key in Chinese was made.

Key lessons and best practices
Some key lessons that came from the grant are that we could have applied for more funding to accomplish our desired results. This work will best be used as a foundation, or backbone, for what comes next in terms of bee conservation and systematics priority. We hope that our work will make it possible for students and researchers in Taiwan to confidently pursue non-Apis bee studies.

Unexpected challenges
These included the ongoing global pandemic, as cases rose in Taiwan during our grant period in 2021, making it challenging for research both within the country and visitation by external colleagues to progress. Disbursement of funds through our institutions was also a challenge.

Post-project activities
We are still working on synthesizing our findings for publication into natural history notes, species descriptions, and the complete bilingual checklist. Imaging and molecular work are also ongoing, but we made significant progress. The goal is to write and submit the publications during this year, 2023.

Progress against milestones

Has your project completed all planned activities?: Yes

Has your project produced all deliverables?: Yes

Report on Activities

Activity implementation summary

1-1. Review the activities planned in your project proposal and describe your achievements☐

1). Checklist and collection visits- This was outlined above, but as mentioned we were able to confirm

180 bee species with voucher specimens as being present in Taiwan. These vouchers can be found in 6 of the 7 national collections (National Taiwan University, the Taiwan Forestry Research Institute, Taiwan Agricultural Research Institute, the National Museum of Natural Sciences, National Chiayi University, and National Chung Hsing University), as the 7th (Academia Sinica) did not have bees as we had originally thought. We found that Taiwan Agricultural Research Institute has the most specimens, with nearly 8000 spanning from the Japanese colonial period until the 1980s.

2). Analyze material- This is the last progressed part of our project as data collection took the longest and all members of the team have also been busy with other work. The most advanced staged analyses are that of the CO1 barcoding, counts, and the creation of a taxonomic key. However, we plan to continue doing analyses for the collection records, which may even include body size data over time, and a more quantitative dive into the checklist information, such as use of geographic data.

3). Barcoding and collecting- Both of these aspects have had significant progress through the work of grant members at National Chiayi University and Taiwan Forestry Research Institute. Some of the collecting efforts have yet to be readied for digitization as label data is still being transcribed, and not all barcodes have been posted publicly, as they are awaiting publication.

4).Data completion and workshop- The workshop was a success with twenty-one attendees from institutes, museums, and the public. Melissa Liu (from the Asia support and TaiBIFT) also very kindly joined in and informed the attendees on how to upload data into the GBIF portal, as Taiwan has a very strong and active participation node. We have completed collection of data at least for the initial species paper and around 3 more subsequent publications.

1-2. Achievements Assigning a name with traditional Chinese writing, in which Taiwan is among the last countries and cultures to use, to each bee species known in the region. We are really excited about the translation aspect of our work as it is something that is not usually taken into consideration for checklists, and will make our study more relevant to those in the country.

2. New activities implemented

Include attending the Society of Systematic Biologists (SSB) stand alone meeting/ conference in Mexico City and presenting a poster on our work. Additionally, our colleague Wen-Chi Yeh created a generic level key in both English and Chinese which he presented to workshop attendees.

3. Delayed activities

Include completion of the data cleaning and analysis and creation of the bilingual website for a public facing side of the checklist, both of these have an anticipated finish in 2023. Causes for delay include limited personal working on grant activities and the ongoing global pandemic. All goals mentioned in the grant will be done post-grant period if not done yet, as outlined above.

Completed activities

Activity name: Checklist

Description: Completed collection of data for checklist and have confirmed ~180 species in Taiwan using vouchers
Start Date - End Date: 1/12/2022 - 28/2/2023
Verification Sources: Taiwanbeelist_Chinesenames (attached)

Activity name: DNA barcoding

Description: DNA barcoding of bees both native and endemic to Taiwan- we did not complete obtaining a CO1 for every specimen but made significant progress
Start Date - End Date: 1/9/2022 - 28/2/2023
Verification Sources: Barcoding document attached

Activity name: Digitization

Description: 1232 specimens from the Taiwan Forestry Research Institute (TFRI) have been digitized and converted to DarwinCore standard, then uploaded to GBIF. We also have nearly 10,000 dorsal view photos of bees in other insect collections from around Taiwan that have not yet been uploaded to GBIF.
Start Date - End Date: 1/9/2022 - 28/2/2023
Verification Sources: TFRI document attached

Activity name: workshop

Description: Digitization and identification workshop of Taiwan Bees for local museum, institute and

some public amateurs
Start Date - End Date: 6/9/2022 - 6/9/2022
Verification Sources: documents uploaded

Report on Deliverables

Production of Deliverables - Summary

1). New records and species- We have yet to quantify the amount of new records and species, as some were in the collections but just not published on. So far though we have less than 10 new species and over 20 new records. Recently, a review of the Lasioglossum (Leuchalictus) (Hymenoptera, Apoidea, Halictidae) in Taiwan cooperation with Japanese colleague Dr. Ryuki Murao. Three are three species are recognised, including a new species: Lasioglossum subinoum sp. nov. will be publishing.
2). DNA barcodes- Recent collections of Taiwanese bee species have been sequenced for COI barcodes using LCO1490/HCO2198. Nearly 70 species of barcodes have been sequenced using CO1 gene region, however, 30 species are yet published publicly as we are awaiting to complete an associated paper to do so.
3). Bilingual and open source checklist- The bilingual aspect has been completed thanks to the efforts of Wen-Chi Yeh as attached namelist file. The open source aspect has been started but is not yet ready for public view, this is via Wix, and will potentially be converted to an html format.
4). Workshop- As highlighted above, the workshop was held during summer 2022 and a success. We held it in Taiwan and had folks from the public to academic spheres, which is exactly the level of impact we are interested in creating and maintaining with this work.
5). Digitization- All bees in the Taiwan insect collections that were visited were digitized, this results in over 10000 specimens. This data is not yet cleaned for submission to GBIF in DarwinCore format. Some collections from the South not originally considered would be interesting for future inclusion into the dataset and digitization efforts. As written above, all the digitized bees were photographed in dorsal view with a scale bar and label data included. The exceptions to this were collections where visitation was time limited or there were too many duplicates of a common species, for these a photo was taken of the whole drawer. Stacked images were taken for some specimens, especially types and those from Taiwan Forestry Research Institute, due to it being the newest collection and with spreading that had photography in mind.
6). Conference presentation- Conferences presented at were Entomological Society of America meeting in Vancouver British Columbia Canada, the 2nd year symposium at the American Museum of Natural History in New York City New York in the United States of America, the Society of Systematic Biologists in Mexico City Mexico, the Taiwan Entomological Society meeting and National Chung Hsing University Entomology seminar both in Taichung Taiwan.
New deliverables- As mentioned above the new deliverables are primarily photos of most digitized specimens and the generic level key.
Delay on deliverables are due to time and personal constraints as well as the pandemic.

Production of deliverables

Title: Checklist

Type: Data Papers
Description: All species recorded as being present in Taiwan are finalized as per current information we have access to, such as voucher specimens present in the collections. Additionally, all of those around 180 species have been given a name in traditional Chinese, the writing system used in Taiwan.
Sources of verification: Around 180 species have been given a name in traditional Chinese, the writing system used in Taiwan. The checklist will also be available on a website and through publication. The plan is to have this all published by the end of 2023.

Title: Digitization specimens records

Type: Dataset

Status update: The digitization has been completed for all intended collections with bees in Taiwan. The photos and data will be cleaned and ready for uploading by summer 2023.
Dataset scope: Bee collection of Taiwan}
Expected number of records: 4000
Data holder: Taiwan Forestry Research Institute
Data host institution: Taiwan Forestry Research Institute
Sampling method:
% complete: 40
DOI:

Expected date of publication: 2023-11-30

Impact of COVID-19 pandemic on project implementation

In order for the non-Taiwanese collaborator to enter the country during the anticipated timeline of summer 2022, they had to apply for an alternate visa which made the timeline to visit collections and digitize specimens shorter than originally planned for. In addition, Taiwanese collaborators have some shutdowns occurring in 2021 due to a spike in COVID cases. All of this equates to a slight shift in the project being publication ready, however, data collection was still a success.

Events

Workshop on bee ID and use of GBIF

Dates: 2022-08-16 - 2022-08-16
Organizing institution: Taiwan Forestry Research Institute and National Chiayi University
Country: Taiwan
Number of participants: 22
Comments: We had an excellent turnout from both researchers, enthusiasts, and the public. In total there were 5 lectures, an introduction from Dr. Lu, one on a newly developed generic level key on Taiwan bees (in Chinese) from Wen-Chi Yeh, one on the work of Dr. Sung, one on GBIF data mobilization with Melissa Liu, and one on the checklist from Rin.
Website or sources of verification: attached workshop document and photo

Communications and visibility

Forest Arthropod Collection of Taiwan Forestry Research Institute, would help to continue communicated with the project stakeholders for further broader GBIF community.

Monitoring and evaluation

Final Evaluation

1). We produced all of our intended deliverables, it is only the timeline that has shifted.
2) Strengths of the project were our collaborations and ability to accomplish tasks despite time constraints. Weaknesses were challenges related to disbursement of the funds and a large list of ambitions despite limited personnel and time.
3). We are very grateful for the opportunity to participate in this grant, as with it we were able to accomplish important milestones and make discoveries that will be critical for bee studies in the nation moving forward.
4). No changes have been made for project proposal, but all data has yet to be posted soon.
5). We are grateful to have had much support in answering questions and helping with posting of data from BIFA Coordination Team, and Melissa Liu in particular, and many folks on the GBIF team. The workshop held virtually on data mobilization was also very informative.
6). Continue with digitization efforts and create a protocol to standardize this method for any new bees that enter the Taiwan bee collections.

Best Practices and Lessons Learned

Digitization efforts are a manpower in this project, how can be work in more efficient way, and can apply to other taxa too should be a good lesson to learn.

Post Project Activity(ies)

We will continue to reach our aims of the project,

Sustainability plans

All the partners would continue collaborative work on the bees of Taiwan, and continue update their data available to the GBIF.

GBIF