Universiti Sains Malaysia Campus Nature Challenge: A Collaborative Citizen Science Initiative For Biodiversity Conservation And Environmental Awareness

Cik Ramlah Che Jaafar1*, Musa Mohamed Ghazali1, Mohd Ikhwan Ismail1, Noor Adilah Azmi1, Mohd Abdul Muin Md Akil2, Nadine Ruppert3

1Hamzah Sendut Library, Universiti Sains Malaysia (PHS), 11800 USM, Pulau Pinang, Malaysia
2Centre for Global Sustainability Studies (CGSS), Universiti Sains Malaysia, 11800 USM, Pulau Pinang, Malaysia
3School of Biological Sciences, Universiti Sains Malaysia, 11800 USM, Pulau Pinang, Malaysia

*Corresponding author email: cramlah@usm.my

ABSTRACT
Considering the growing global biodiversity crisis, citizen science initiatives have emerged as powerful tools for long-term ecological data collection involving non-experts in research. “USM Campus Nature Challenge”, a collaborative effort led by the USM Library in partnership with the School of Biological Sciences and the Centre for Global Sustainability Studies, aimed to create awareness about ecological concerns and biodiversity conservation within the university community by documenting biodiversity at USM’s main campus. Methodologically, the project organized a 6-week ‘bio blitz’ event open to citizen scientists to explore the flora and fauna of USM’s diverse campus habitats while cataloging species through the iNaturalist app. The results revealed that plant species dominated the observations, constituting 64.9% of recorded biodiversity and reflecting the rich botanical diversity on the USM campus. Further observations included insects (10.4%), fungi (7.6%), birds (6.3%), and various other species, underscoring the complexity of the ecological web of the campus. An evaluation of data quality revealed that 36.6% of the species identifications were categorized as “Research Grade”, 47.8% were designated as needing further identification, and 15.7% were graded as “casual”. In conclusion, the project leveraged the approach to create more public awareness about local ecological concerns and to strengthen the University community’s connection to nature. This USM Library’s pilot initiative closely aligns with the Open Science movement related to citizen science in Malaysia.

KEYWORDS: Citizen science, Academic library, Sustainable Development Goals, SDG15, Environmental conservation

1. INTRODUCTION
Citizen science in Malaysia is growing and showing great potential to involve non-science professionals in scientific data collection. In recent years, there has been an increasing interest in involving local communities and layman individuals in scientific research and environmental monitoring in diverse fields. This approach aligns with the global movement of engaging the public in scientific activities, offering an opportunity for non-scientists to contribute to scientific knowledge and decision-making. Citizen science has emerged as a promising and cost-efficient approach to engaging citizens in monitoring and conservation efforts (Potsikas et al., 2023). Engaging citizens in scientific projects not only increases data collection capabilities but also promotes public awareness, education, and a sense of ownership of environmental issues (Chapman et al., 2020).

Libraries play a crucial role in supporting citizen science initiatives by serving as a hub for information, resources, and community engagement. According to The European Association of Research Libraries (2024), research libraries are well placed to be “an active partner in citizen science and develop the necessary infrastructure to support public researchers in their work effectively”. In contributing to Open Science initiatives in Malaysia, the Universiti Sains Malaysia (USM) Library has willingly declared its preparedness to lead Open Science and Research Data Management (RDM) efforts at USM since 2021 (Kamal et al., 2022). According to Ismail et al. (2022), the USM library has implemented advocacy programs for open science, including talks,
roadshows, symposiums, and webinar series. These programs aim to provide the research community with insights and perspectives on various aspects of open science from experts and practitioners both within and outside the country. As a result, new initiatives, such as citizen science, situated within the sphere of Open Science, have been introduced to augment the library’s engagement and visibility within the USM community. The USM Library is the pioneer in partnering with various faculties to coordinate the citizen science program. The USM community actively participated in the USM Campus Nature Challenge, which was held from July until August 2023. In this context, to support the quantification of the United Nations (UN) indicators for Sustainable Development Goals (SDGs), applying citizen science can be a useful tool. Participants in citizen science activities can help to identify sustainability problems, set a research agenda, and contribute efforts and knowledge (Grossberndt et al., 2023; Sauermann et al., 2020). Therefore, the USM campus community plays a vital role in supporting the university’s sustainability agenda through citizen science data collection, community engagement, education, and awareness programmes (Universiti Sains Malaysia, 2024).

2. THE ESSENCE OF THE USM CAMPUS NATURE CHALLENGE

The USM Campus Nature Challenge, a collaborative effort between the USM Library, the School of Biological Sciences (SBS) and the Centre for Global Sustainability Studies (CGSS) represents a research-driven initiative at the intersection of citizen science, biodiversity exploration and education within USM’s main campus. The event was organized through a 6-week bioblitz event from 11th July to 31st August 2023 and was open to all students and staff from the main campus community in Penang Island. The importance of bioblitzes lies in their emphasis on inclusivity, involving diverse participants and stakeholders in the survey across taxa, from fungi to plants. Bioblitzes are crucial for biodiversity conservation as they facilitate rapid and collaborative data collection and engage various stakeholders and contribute significantly to highlighting the vital role of more inclusive approaches in advancing conservation efforts (Lowman et al., 2019).

iNaturalist (https://www.inaturalist.org/) was used as a platform for the event. The California Academy of Sciences and National Geographic Society are the hosts of this global, online biodiversity platform. It is a freely available, non-profit, open citizen science or social network that is enabled by mobile devices and is regarded as “one of the largest unstructured biodiversity survey initiatives covering the world” (Di Cecco et al., 2021). Based on participation and the amount of data gathered, it is also among the most successful programs in the world. In addition to producing data on biodiversity that is useful for science, its main objective is to reestablish human connections with nature. Users can contribute photo and sound observations and identify plants, fungi, animals and other creatures with the accompanying spatiotemporal coordinates; this makes it a very useful research tool for documenting and tracking biodiversity (Aristeidou et al., 2021). Observations are identified by other iNaturalist users at the lowest feasible taxonomic precision. According to Di Cecco et al. (2021), the vast amount of data available on iNaturalist has spurred a rise in using these data to address a variety of research problems. One of the most common study uses for iNaturalist data is the creation of species distribution models of various animals and plants. Furthermore, iNaturalist data have been used to determine a species’ tolerance to different climates and to supplement fieldwork to evaluate the conservation status of a taxon. Therefore, iNaturalist was the preferred platform for this programme based on several advantages. Firstly, iNaturalist offers robust data quality assurance mechanisms. Designed for use by a community of experts in biodiversity, iNaturalist allows community members to serve as moderators and curators for observations, thereby ensuring the quality and integrity of the data. Secondly, iNaturalist facilitates accurate data recording. Details such as location, date, time, and species identification recorded on the platform are valuable to the scientific community and adhere to high standards of reliability. Thirdly, iNaturalist promotes data accessibility by providing open access to data collected through its platform. This accessibility fosters transparency, collaboration, and further research, particularly in the field of biodiversity. Additionally, it aligns with open science initiatives, ensuring that the data benefits both the public and the research community (Goldberg, 2023). By harnessing the iNaturalist application, we facilitated the active engagement of USM students, faculty, and staff, empowering them to contribute valuable data to the existing USM campus biodiversity long-term database in iNaturalist.

The geographical area of observations was within the boundaries of the USM main campus situated in Penang Island, Malaysia (Latitude: 5.3667° N, Longitude: 100.3042° E; Figure 1). The campus spans an area of approximately 2.4 square kilometres in the Gelugor suburb of the island, known for its natural environments within an urban area, often called “campus in a garden.”

The campus is characterized by its lush greenery and recreational areas that surround academic buildings, research centres, and student accommodations. It is not only a hub for academic activities but also serves as a cultural and social centre for students and faculty members. In the vicinity of the campus, there are various residential areas, commercial establishments, and natural landscapes, including rainforest-covered...
hills and tropical beaches. This combination of urban and natural environments provides a unique setting for academic pursuits and extracurricular activities at USM.

2.1 Collaborative Role
The USM Library took on the pivotal role of acting as the secretariat, overseeing the logistical and administrative aspects of this programme. In parallel, biodiversity experts from the Centre for Global Sustainability Studies (CGSS) and the School of Biological Sciences (SBS) were entrusted with the role of co-organizers, advisors and judges for the competition, providing their expertise to assess the observations made across the USM campus, thereby offering essential guidance and validation of the collected data. This collaborative approach ensured that the survey maintained a high level of scientific rigour and accuracy, aligning with research standards.

In addition to the logistical and evaluative roles, the survey incorporated an educational component. A senior lecturer from SBS delivered a comprehensive talk on Malaysian biodiversity and conservation, and the aim of the programme (Figure 2). This lecture not only provided participants with essential knowledge about the importance of biodiversity but also instilled a sense of ecological responsibility to foster sustainability within the academic community. Under the expert guidance of the staff of CGSS, a campus nature tour to introduce the iconic flora and fauna was conducted at Eco Hub USM, a patch of natural rainforest (Figure 3). This educational expedition served as an exploration of the campus biodiversity fostering ecological awareness and comprehension among the citizen science participants, thereby contributing to the broader academic discourse on sustainability and biodiversity conservation. By intertwining the roles of the secretariat, judges, and educational resources, the programme demonstrated a holistic approach to advancing biodiversity research and creating a culture of environmental stewardship within the USM community.

Figure 1: Universiti Sains Malaysia (USM) main campus, Penang Island, Malaysia (5.3667°N, 100.3042°E)

Figure 2: Public talk about creating biodiversity conservation awareness and promoting the USM Campus Nature Challenge by Dr. Nadine Ruppert from the School of Biological Sciences, USM to the programme participants

Figure 3: Campus nature tour at Eco Hub USM
2.2 Promotion, Outreach, and Participation

The event was extensively promoted through a multi-channel approach to ensure comprehensive visibility and engagement within the USM community. Key platforms included USM Facebook (https://www.facebook.com/usmlibofficial1969), RDM USM website (https://lib.usm.my/index.php/academiciansresearchers/rdm-services), and road shows to various schools in USM. Regular posts leading up to the event included details about the challenge, how to participate, registration links, a comprehensive guide on how to use the iNaturalist app, and the significance of contributing to biodiversity conservation. The challenge saw active participation from a diverse group within the USM community, highlighting the inclusive nature of the citizen science initiative. Most of the 40 participants were students, with 27 individuals ranging from undergraduates to postgraduates from various fields of study. This demographic was crucial as students represent future researchers, conservationists, and policymakers. Their involvement not only contributed to the data collection effort but also served as an extra-curricular educational experience, enhancing their understanding of local biodiversity and the importance of conservation efforts. The remaining participants comprised USM staff, including both academic and non-academic members. This group’s involvement underscored the collaborative spirit of the initiative, bridging the gap between students and staff and fostering a sense of community responsibility towards environmental conservation.

2.3 Data Collection Method

The programme utilized iNaturalist as the platform to collect data gathered through observations by citizen scientists. The primary data collection method involved observing and recording biodiversity and sharing information in the app. Before the project commencement, the secretariat provided a briefing on iNaturalist registration and usage instructions tailored specifically for this project. The participants captured observations by taking photos of various taxa, ranging from fungi to plants to animals, as specified by the programme outline. These observations were then uploaded by the participants to the iNaturalist platform in a dedicated project called “USM Campus Nature Challenge” (https://www.inaturalist.org/projects/uscampus-nature-challenge). iNaturalist automatically recorded the location where an observation was made within the USM campus area using GPS coordinates.

Furthermore, along with location data, iNaturalist also captured the date and time of a recorded observation. Citizen scientists provided their species identification suggestions when recording observations in iNaturalist. Additionally, iNaturalist employs Artificial Intelligence (AI) to suggest possible species identifications based on previously uploaded data and the million-member large community of iNaturalist verifies or improves species suggestions. In addition, a USM biodiversity expert panel specifically aided in species identification of observations submitted to this challenge. The programme secretariat then compiled all species data recorded by the USM citizen scientists to be used for ongoing research. The flow of the data collection method is shown in Figure 4.

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**Figure 3:** Mr. Mohd Abdul Muin from the Centre for Global Sustainability Studies guided the nature tour to Eco Hub USM and taught participants about campus biodiversity on site.

**Figure 4:** Flow of Data Collection Method
During the USM Campus Nature Challenge, participants compiled a comprehensive dataset consisting of 582 observations representing a diverse array of 288 distinct species, as shown in Figure 5. The species were observed and documented across various taxonomic groups. The USM Campus Nature Challenge provided participants with an opportunity to explore and document the diverse array of life forms present within the campus environment while competing with other participants for the prized top spots for “Most Observations” and “Best Photo” of the challenge. Winners were announced at the end of the competition in a public award ceremony and best photos were showcased in a virtual exhibition. Here is a breakdown of the observed species, along with their respective percentages:

- Plants were the most abundant group, constituting approximately 64.2% of the observed species, with 185 species identified.
- Insects were well-represented, making up approximately 10.4% of the observed species, with 30 species documented.
- Fungi represented approximately 7.6% of the observed species, with 22 species documented during the challenge.
- Birds were a notable presence, representing approximately 6.3% of the observed species, with 18 species documented.
- Reptiles, including snakes and lizards, comprise approximately 2.4% of the observed species, with seven species identified.
- Arachnids, including spiders and scorpions, represented approximately 2.1% of the observed species, with six species recorded.
- Mammals, including various terrestrial and arboreal species, accounted for approximately 1.7% of the observed species, with five species recorded.
- Mollusks were relatively less common, comprising only about 1% of the observed species, with three species recorded.
- Ray-finned fishes were among the less common groups, accounting for approximately 1% of the observed species, with three species documented.
- Amphibians, including the Asian Common Toad (Duttaphrynus melanostictus), Asian Toads (Genus Duttaphrynus), and Common Southeast Asian Tree Frog (Polypedates leucomystax), comprised approximately 1% of the observed species, with 3 species identified.
- Other animals not falling into the specified categories constituted approximately 1.7% of the observed species, with five species documented.

Notably, plant species dominated, constituting 64.9% of the observed biodiversity, reflecting the rich botanical diversity on the campus. In addition to plants, the observations included insects (10.4%), fungi (7.6%), birds (6.3%), reptiles (2.4%), arachnids (2.1%), and mammals (1.7%) were also noted. Less common were mollusks and ray-finned fishes (both approximately 1%). Amphibians, including the Asian Common Toad, Asian Toads, and Common Southeast Asian Tree Frog, accounted for 1% of species. Protozoans, chromista and unknown species, constituting less than 1%, were also present, underscoring the area’s biodiversity. The diverse range underscores the ecosystem’s health and highlights the importance of habitat preservation for various taxa, benefiting research and conservation endeavors significantly.

![Figure 5: Number of observations (N=582) and species (N=288) in the iNaturalist project “USM Campus Nature Challenge” recorded by 40 observers from 11 July to 31 August 2023](image-url)
An evaluation of data quality revealed that 36.6% of the species identifications were categorized as “Research Grade”, ensuring their reliability for future scientific investigations. However, almost one half of all observations (47.8%) were designated as “ID” needing further identification, presenting an opportunity for more in-depth taxonomic and ecological exploration. In comparison, the remaining 15.7% were graded as “Casual”, indicating the potential for further verification and contextualization. This remarkable dataset not only highlights the richness of biodiversity at USM but also underscores the potential for ongoing research and ecological stewardship within the academic community and outside the campus. The resulting dataset serves as a crucial resource for ongoing scientific investigations, while educational outreach efforts promote a deeper understanding of biodiversity conservation. This challenge not only exemplifies academic-community collaboration but also demonstrates a commitment to novel research methodologies and environmental stewardship, showcasing the potential for integrated citizen science in advancing ecological knowledge.

The USM Campus Nature Challenge employed a data curation and evaluation process based on several criteria defined by the committee prior to the competition. The criteria for choosing a competition winner included assessing the number of species documented by participants and the rarity or conservation value of the species, highlighting the importance of biodiversity conservation within the USM campus. The visual quality of photographic documentation was also evaluated, ensuring that data not only hold scientific merit but were also visually engaging and educational to a public audience. Adherence to the designated time frame of the competition for data collection was closely monitored to maintain data integrity, while precise location information within the USM main campus allowed to document the spatial distribution of species, a valuable aspect for long-term ecological research. This comprehensive set of judging criteria showcased the research-oriented nature of this competition, aimed at generating high-quality data beneficial for ecological research, biodiversity conservation, and environmental stewardship of biodiversity at USM.

The project’s timeline for the biodiversity survey at USM spanned from 11th July 2023 to 31st August 2023, marking an almost two-month period of intensive data collection and observation. Following the data collection phase, the judging process commenced on 1st September 2023 and continued until 15th September 2023. During this period, judges meticulously reviewed and assessed the observations to ensure accuracy and scientific rigor, reflecting the research-level commitment to data quality. Next, the observation was selected based on specific data quality criteria set by the committee, as shown in Figure 6.

2.4 Virtual Exhibition
The findings of this bioblitz were disseminated to a broader audience through a virtual platform, as shown in Figure 7. On 1st November 2023, an online exhibition was launched, accessible via the USM Library’s official website: https://lib.usm.my/index.php/academicians-researchers/rdm-services.

Figure 6: Selected flora and fauna of the USM Campus Nature Challenge recorded in iNaturalist
This exhibition served as a reward for the participants who submitted high quality photos and showcased the rich biodiversity documented within the campus, providing a comprehensive repository of the research outcomes and insights gleaned during the project. By making these findings publicly available, the USM community and the wider public could further engage with this programme, fostering greater awareness and appreciation of the local ecosystem and the importance of biodiversity conservation, thus demonstrating the university’s long-term commitment to research-driven environmental education and outreach.

3. CONTRIBUTIONS TO THE SUSTAINABLE DEVELOPMENT GOALS (SDGS)

Citizen science data and activities are already starting to contribute to most of the indicators of the United Nation’s Sustainable Development Goals (SDGs) (Head et al., 2020). As for this program, it significantly contributed to the SDGs in various ways:

a) SDG4 Quality Education:
The USM Campus Nature Challenge provided a hands-on educational experience for students and staff, fostering environmental literacy and ecological awareness. Through sharing sessions and experiential learning during a tour of USM’s Eco Hub, the initiative contributed to creating a culture of integrative and inclusive learning for all parts of the university community, emphasizing the global importance of biodiversity conservation.

b) SDG15 Life on Land:
By actively engaging in biodiversity monitoring, the USM Campus Nature Challenge directly contributed to the understanding and preservation of terrestrial ecosystems. The initiative aided in the collection of valuable data on local flora and fauna, supporting broader efforts to monitor and protect biodiversity.

c) SDG13 Climate Action:
Biodiversity conservation is integral to climate action. The Campus Nature Challenge, by promoting the understanding of the importance of the preservation of ecosystems, indirectly contributed to mitigating the impacts of climate change.

d) SDG17 Partnerships for the Goals:
The collaborative nature of the USM Campus Nature Challenge exemplifies the importance of partnerships. By involving students, faculty, and the local community, the initiative builds a network of diverse stakeholders committed to a common goal—biodiversity conservation.

e) SDG11 Sustainable Cities and Communities:
Given that the USM Campus Nature Challenge was conducted within the USM main campus of
Penang Island, one of Malaysia’s most urbanized and industrialized areas, it directly contributed to creating a more ecologically aware urban community.

f) SDG14 Life Below Water:
While the primary focus of this program was on terrestrial ecosystems, activities that promote biodiversity conservation on land can indirectly contribute to the health of adjacent marine ecosystems of the island and the willingness of participants to conserve life below water as much as on land.

In essence, the USM Campus Nature Challenge facilitated the interconnectedness of environmental, educational, and community-focused initiatives in addressing the broader sustainability goals of the university. By integrating these efforts, the project contributed to building consciousness about a more sustainable and resilient future through public awareness, which is in line with the United Nations’ SDGs.

4. CONCLUSION

The USM Library spearheaded the USM Campus Nature Challenge as its inaugural citizen science project in collaboration with SBS and CGSS. Indeed, the success of this project relied on the collaboration of multiple departments. Showcasing the success and active participation of students, faculty, and staff as a campus community. Through this project, the USM Library was able to provide support to USM researchers, particularly in the aspect of data collection and community engagement within the campus. Simultaneously, the librarians gained valuable insights into ongoing research endeavours. Hence, the USM Library’s commitment to participating in future citizen science projects is unwavering, given the successful collaboration with SBS and CGSS. This collaboration has proven effective in promoting the involvement of non-researchers in scientific research initiatives and will lead to more involvement in the future.

The other successful component of this project was the exploration of a novel open-science tool used throughout this project. The iNaturalist application serves as a valuable tool, aiding both citizen scientists and researchers around the globe in data collection through biodiversity observation and identification. Therefore, it demonstrates that the process of collecting biodiversity data, showcasing the abundant biodiversity on the USM campus, becomes more accessible and enjoyable for citizen scientists. Indeed, this application has been used by the USM campus community since 2017 to opportunistically record biodiversity in the ongoing iNaturalist Project “BioDiv Universiti Sains Malaysia” (https://www.inaturalist.org/projects/biodiv-universiti-sains-malaysia) gathering more than 6,700 uncurated observations of more than 1,100 different species since then. All data are available for open access in the iNaturalist app and can be used for SDG reporting and monitoring. It also could achieve the objectives of the university in fulfilling activities and programs concerning several criteria for the SDGs. Naturally, some challenges faced by the USM Library during the organization and conduct of the citizen science project included the overall awareness of citizen science and the promotion of participation in this project to a broad audience. As the first-ever citizen science project organized by USM Library, there are numerous lessons learned to enhance the success and efficiency of future citizen science projects. The success of this initiative will likely prompt the USM Library to organize more citizen science projects and foster collaboration with USM researchers and others.

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