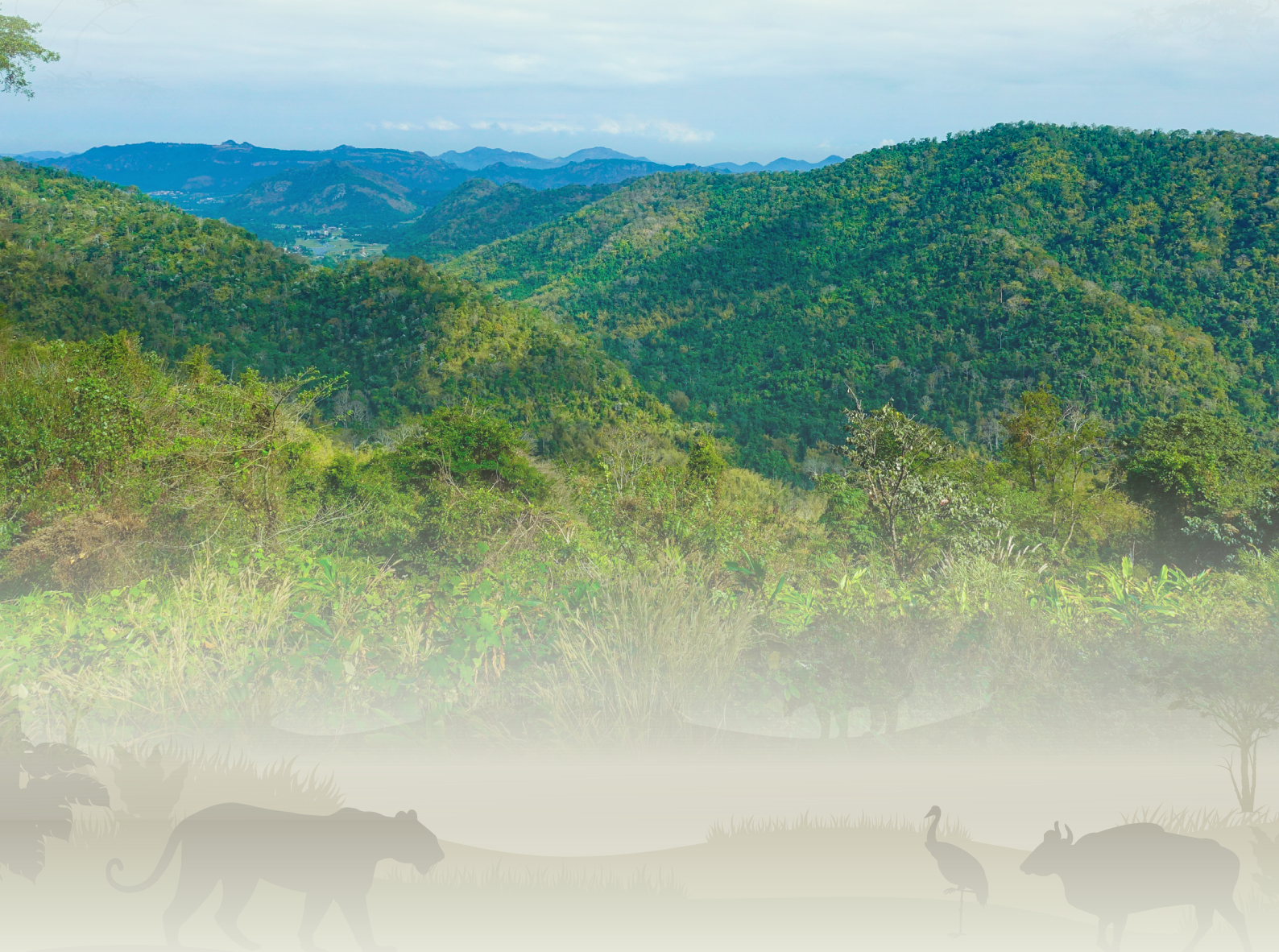
The 4th Thailand International Symposium on Natural History Museums:

Era of Ecosystem Restoration



21–22 December 2023

Rama 9 Museum, National Science Museum Thailand

Pathum Thani, Thailand

Schedule and Abstracts

The 4th Thailand International Symposium on Natural History Museums:

Era of Ecosystem Restoration

21–22 December 2023

Rama 9 Museum

National Science Museum Thailand

39, Moo 3, Khlong 5, Khlong Luang, Pathum Thani, Thailand

Message from the NSM President

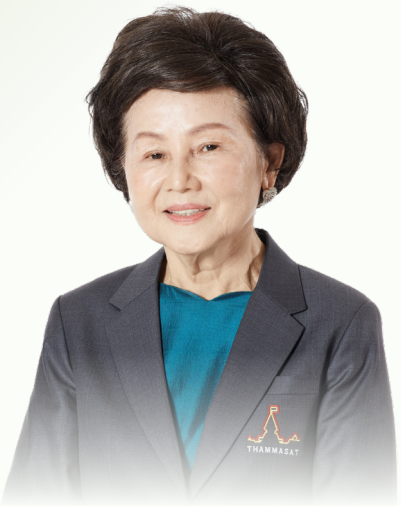
On behalf of the National Science Museum, Thailand, I would like to thank all participants attending the 4th Thailand International Symposium on Natural History Museums: Era of Ecosystem Restoration, held during 21–22 December 2023 at the Rama 9 Museum, Thailand.

This symposium will encourage interdisciplinary collaborations associated with taxonomy, biodiversity, museum collections, specimen conservation, museum education, public programs, young scientist inspiration, and utilization of natural resources. We hope that the presentations and sharing will contribute valuable insight for all of you, as well as inspire young people towards conservation of nature and sustainable development.

I wish you all enjoy the symposium and, once again, welcome to Thailand

Rawin Raviwongse, Ph.D.

President National Science Museum, Thailand



Message from the Rector

Nestled in the heart of our biodiverse nation, this symposium beckons us to a journey of exploration and collaboration. As we convene to delve into the intricacies of Taxonomy, Biodiversity, Museum Collection, Specimen Conservation, Environmental Earth Sciences, Museum Education, Public Programs, and Utilization of Natural Resources, we embark on a collective endeavor to understand, utilize, and sustain the precious resources bestowed upon us. Thailand, endowed with rich ecosystems, presents not just challenges but incredible opportunities. Our biological resources are not mere commodities; they are wellsprings of innovation. In the discussions on utilizing these resources, let's reflect on how we can extract value while embracing sustainability—a delicate dance with nature.

The symposium provides a platform to explore not only the scientific aspects of our natural heritage but also the responsible utilization of biological resources. Let us seize this opportunity to exchange ideas, foster collaborations, and inspire one another to contribute to the preservation of biodiversity and the advancement of sustainable practices.

May the discussions over the next two days be a catalyst for change, grounded in a shared commitment to understanding, utilizing, and preserving our natural world. Welcome to a symposium that goes beyond knowledge dissemination—it's a call to action for a sustainable future.

G. Wit.

Assoc. Prof. Gasinee Witoonchart
Rector
Thammasat University, Thailand

Message from the Executive Director

Biodiversity and taxonomy stand as fundamental pillars in our comprehension of life on the planet. They not only contribute to our well-being and offer potential solutions to a myriad of challenges but also illuminate the interconnectedness among all living beings. Preserving biodiversity and comprehending taxonomy are crucial for the prosperity of both current and future generations on our planet. Understanding the foundational principles of biodiversity studies is important, but equal emphasis should be placed on the prudent utilization of natural resources. The utilization of these resources plays a pivotal role across diverse fields such as agriculture, food, medicine, and healthcare.

Thailand boasts an abundant biodiversity, granting the country competitive advantages by offering a wide array of foundational materials for various high-value products. This abundance drives the development of the bioeconomy, leveraging the richness of our natural resources to propel innovation and economic growth.

BIOTEC is delighted to be one of the organizing committee of the 4th Thailand International Symposium on Natural History Museums (TISNHM): "Era of Ecosystem Restoration". I am certain that the symposium serves as a vital platform for disseminating published information and knowledge among participants from diverse origins, fostering an exchange that enriches the understanding of natural sciences. The symposium also encourages collaboration among practitioners, and facilitates the establishment of alliances for effective knowledge management and communication within and between individuals and organizations.

Wonnop Visessanguan, Ph.D.
Executive Director
National Center for Genetic Engineering and Biotechnology
Acting for President of National Science and Technology Development Agency

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21st December 2023

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Oral Presentation

Oral Presentation
Session 1: *Taxonomy and Biodiversity (Botany)*

The National Biobank of Thailand's (NBT) Seed Bank: Long-term Conservation of Wild Plants in Thailand

Pramote Triboun* and Sissades Tongsima

The National Biobank of Thailand (NBT) maintains long-term biobanking infrastructure for Thailand's conservation of the biological resources. Lacking knowledge of long-term conservation for tropical plants, NBT researchers routinely conduct many experiments to tailor seed banking protocols for effectively conserving these plants. Due to various threats from both human and harmful effects of the global warming, preservation of specimens stored at our biobank is vital for maintaining the current and future bioeconomy in Thailand. Among several plant conservation programs, the NBT Seed Bank aims to support the national long-term conservation of native threatened species. The standard seed banking service is practiced along with other operational procedures that ensure the achievement of long-term conservation of the specimens. Over the five-year period, NBT researchers have curated and maintained orthodox seeds of wild plant species (collected from nature) of over 1,000 accessions. Our researchers are collaborating with many plant conservation organizations, both national and international, to prevent the risk of plant-extinction, and hopefully if needed, the collected seeds can be reintroduced back to nature to maintain the balance of plant genetic biodiversity.

Keywords: Seed Bank, Thailand, wild plants, conservation

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Species Diversity of the Green Macroalgal Genus *Caulerpa* (Caulerpaceae, Chlorophyta) in the Area of Ko Kut, Ko Chang, and Nearby Islands, Trat Province

Suttikarn Sutti*, Sirikanya Chungthanawong and Ratchaneewan Sumitrakij

The preliminary survey of the Project "Species diversity and genetic resources assessment of the genus *Caulerpa* (Caulerpaceae, Chlorophyta) in Thailand for the principal conservation and sustainable utilization" was kicked off at Trat Province as the representative of the upper part of the Gulf of Thailand. *Caulerpa*, some other seaweeds and seagrasses were sampled mainly by scuba diving in the area of Ko Kut, Ko Chang, and nearby islands, totalling ten sampling sites, during 19–23 December 2022. Unfortunately, it seems like December is not the right season for *Caulerpa* sampling, hence, not many *Caulerpa* were found. Ko Kradad, Ko Khai Hua Ro and Ko Mak were the only three sites that *Caulerpa* could be collected. Based on morphological characters solely, at least five *Caulerpa* species were identified. Besides, for better precision of species diversity in the genus *Caulerpa* in these areas, twenty *Caulerpa* voucher specimens were prepared and twelve of them were sent for DNA extraction and molecular analysis. The molecular result is pending.

Keywords: species diversity, *Caulerpa*, Trat, preliminary, Thailand

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The Species Diversity of Plants in the Satun Geopark

Bhanumas Chantarasuwan* and Wisoot Supong

The species diversity of plants in the Satun Geopark was a result of the plant diversity survey project in the Satun Geopark. The project began in October 2019 and will end in September 2024. The objective is to record plant species in the geopark. After four years (2019–2023) of work, 337 plant species have been recorded. They are comprised of 157 species of trees, 93 species of shrubs, 30 species of herbs, four species of palms, two species of grasses, and 29 species of exotic plants. Moraceae had the highest species number (32 species), the second was Fabaceae (25 species), and the third was Malvaceae (23 species).

Keywords: land plant, plant diversity, Satun Geopark

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Mushroom Collection for Education, Research, and Exhibition from the Natural Medicinal Mushroom Museum

Khwanyuruan Naksuwankul[1,2*], Areerat Saisong[1] and Orathai Sertsri[1]

The Natural Medicinal Mushroom Museum, Faculty of Science, Mahasarakham University, Thailand, is where the mushroom collection is deposited. The specimens are edible, poisonous, medicinal, and saprophyte mushrooms, most of which were investigated in the dry dipterocarp forests and local forests in Northeastern Thailand. All mushroom specimens have been preserved in a vacuum bag for dry specimens and in bottles with 95% ethanol for edible and poisonous mushrooms. A database has been created with Excel for geographic data, identification data, and photography. The mushroom collection is provided for study, research, and reference collection from Thailand.

Keywords: collection, education, mushroom, exhibition, research

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Ferns and Lycophytes of Gerenai-long Mekaba, Sarawak: with Medicinal and Ornamental Use Potential

Avelinah Julius[1*] and Andi Maryani A. Mustapeng[2]

The ferns and lycophytes survey, led by the second author in Gerenai-Long Mekaba, yielded a total of 128 taxa from 55 genera, belonging to 23 families. A literature review revealed that 104 of these taxa (approximately 81% of the total collection) were reported to possess medicinal properties, while medicinal properties for the remaining 24 taxa are yet to explored. Limited research exists regarding the traditional uses of fern and lycophytes in Borneo. However, 19 out of the 104 taxa, which were previously identified as medicinal plants in Sabah for treating various conditions such as skin diseases, malaria, and diarrhea, were also found in Gerenai-Long Mekaba. Besides that, *Selaginella sarawakensis*, the hyperendemic species of Sarawak has been reported to be used traditionally as a diuretic, antipyretic, and for treating liver ailments. Some taxa, including *Davallia cummingii*, *Diplazium cordifolium*, *Lindsaea doryphora*, *Selaginella wallichii*, *Phlegmariurus nummulariifolius*, *P. phlegmaria*, and *P. squarrosus*, not only serve medicinal purposes but are also cultivated for their ornamental leaf shapes. This study aims to expand the knowledge and value of fern and lycophyte collections from Gerenai-Long Mekaba, providing researchers with valuable information to explore and develop novel phytochemical compounds for therapeutic use.

Keywords: anti-inflammatory, antioxidant, Borneo, horticulture, therapeutic

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Oral Presentation

Session 2: *Taxonomy and Biodiversity (Invertebrate Zoology I)*

Two Decades of Terrestrial Microsnail Family Diplommatinidae and Hypselostomatidae (Gastropoda: Prosobranchia: Pulmonata) Studies in Thailand: An Updated List and Geographical Distribution

Pongrat Dumrongrojwattana*

The contribution of Thai microsnails was the great work of Prof. Dr. Somsak Panha from Chulalongkorn University, started in 1995. This has been the first extended survey of Thailand's land snails and contributed significantly to understanding the terrestrial Thai microsnail diversity as it led to the description of 90 species new to science. Following these pioneering works, the investigation of Thai terrestrial microsnails continued and many new taxonomic studies were published. Based on the voucher specimens from field surveys in limestone areas in Thailand gathered together with a review of the literature. A total of two genera and 15 species were added to the list, of which five are diplommatind species from the East, two are *Opithostoma*, and three are diplommatind species from the South, increasing the number of diplommatinid species from 29 species to 44 species. In hypselostomatid snails, a total of three genera and six species were added to the list increasing the number of species from 74 species to 80 species. Several unnamed cave-dweller snails were recorded from caves in Thailand. Further taxonomic study of this group is needed.

Keywords: Diplommatinidae, diversity, Hypselostomatindae, microsnails, Thailand

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Highly Diversified Population Structure of *Lycosa ishikariana* Inhabiting Sandy Beach Habitat

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The burrowing wolf spider, *Lycosa ishikariana*, is endemic to sandy beaches and is classified as vulnerable (VU) in the Red List of Japan, due to the drastic decline in the total shoreline length of Japanese sandy beaches. This study examines whether restoring sandy beaches alone could facilitate the re-establishment of spider populations through natural immigration in the event of local extinction due to habitat loss. The ability of these spider populations to re-establish is contingent upon their dispersal capability. Using mitochondrial CO1 sequencing data and microsatellite data, we analysed the population structure of *L. ishikariana* to infer their dispersal ability. The analysis revealed a highly diversified population structure, leading to the conclusion that *Lycosa ishikariana* are poor dispersers. Consequently, in the event of local extinction, merely restoring sandy beaches would not suffice to re-establish *L. ishikariana* populations through immigration from distant habitats.

Keywords: conservation, dispersal ability, rescue effect

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Species Diversity of Gammarid Amphipods Associated with Macro-Algae at Samae San Islands, Chon Buri Province, Thailand

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Ratchaneewarn Sumitrakij and Koraon Wongkamhaeng

The Gammarid amphipod community is one of the major important invertebrate communities associated with macro-algae in the coastal area. This work aimed to study the species diversity of gammarid amphipods which inhabited macro-algae hosts at Samae San Islands, Chon Buri Province, in February and August 2023. A total of seven species from six families were identified. *Elasmopus nanshaensis* is a new record for Thai Waters. Illustrations and descriptions of each species are provided.

Keywords: Amphipoda, diversity, eastern Gulf of Thailand

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Preliminary Study of the Zooplankton Community in Mae Klong Estuary, Samut Songkram

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The Zooplankton community in Mae Klong Estuary, Samut Songkram, was investigated with a 330-micrometer plankton net from 14 stations on 27 April 2023. A total of three Phyla of zooplankton were identified, composed of Phylum Annelida, Phylum Arthropoda, and Phylum Chordata. The density of zooplankton was highest at station 12.1 (225 individual/m^3) and lowest at station 10 (0 individual/m^3). The dominant group were calanoid copepod and crab zoea, and fish larvae found at almost every station. The major environmental parameters that affect zooplankton communities in Mae Klong Estuary include salinity, TDS and pH.

Keywords: zooplankton, diversity, eastern Gulf of Thailand

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Private Mollusca Systematic Collection

Chorchat Gra-tes*

The experience of continuous sample collecting, preserving, and conserving mollusk for over five decades has made the private collection grows dramatically. With a dream of owning a museum or donating this complete collection to an institution, all specimens should be well organized and arranged in systematical order with full information provided.

After studying the cabinet design of various museums, a room was dedicated and designed for storing mollusk specimens. This room was filled with cabinets containing about 800 drawers to store specimens in systematic order.

Now, the collection comprises of over 6,500 species, over 30,000 specimens (not including micro specimens of size <0.5cm.), and it is growing. This collection is not only focused on variety of species, but also specimens of the same species that were collected from various localities and biogeographical provinces. The formulation of the collection is dedicated for the future, for researchers and scientists to track their changes in size, morphology, variations, distribution, environmental, pollution effects, etc.

To organize vast numbers of species in the collection, a database was self-created to record all species and specimens in the collection with complete details of each specimen that a complete museum collection should have. This database also contains a listing of living Mollusca in every Class of about 50,000 species. The Mollusca Classification in this database is based on “A Classification of the Living Mollusca” by Kay Cunningham Vaugh. Newly described species are also added to this database frequently and continuously.

Mollusk specimen preservation is not that easy to deal with. From my experience and observation in collecting molluscan specimens, there are many measures to comply with to keep the specimens as they were in their original condition. Importantly, incorrect preservation will destroy specimens. Also specimens with incorrect data or no complete data are useless to science.

Keywords: collecting, systematic, database, preservation, measures

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An Updated Checklist of Hypselostomatid Snails from Southern Thailand

Tawan Subanjui and Pongrat Dumrongrojwattana*

Hypselostomatidae Zilch, 1959 (= Pupillidae Torton, 1831) is one of the most diversified groups of microsnails in Thailand. Based on the literature reviews and voucher specimens from field surveys in the limestone areas in southern Thailand since 2005, a total of five genera and, 13 named species, were known. In the study, seven unnamed species of *Gyliotrachela* Tomlin, 1930 were collected. *Gyliotrachela khaochongensis* is widely distributed, while others are endemic to Southern Thailand.

Keywords: southern Thailand, microsnail, Pupillidae

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Oral Presentation

Session 3: *Taxonomy and Biodiversity (Vertebrate Zoology I)*

Diversity Review of Jacks and Trevallies (Pisces: Carangiformes: Carangidae) in Thai Waters

Chavalit Vidthayanon*

The jacks and trevallies are popular economic fishes, commonly found in local supermarkets, but only the pilotfish *Naucrates ductor* is very rare. These fishes inhabit marine habitats ranging from estuaries, reefs, coasts, and oceans, but it is rarely a freshwater visitor. In Thai waters, at least 60 species from 28 genera of four subfamilies; Caranginae, Naucratinae, Scomberoidinae and Trachinotinae, occur. Most of the genera consist of single species, but *Caranx* and *Decapterus* are numerous, including seven species. *Carangoides* is previously most diverse genus, but 14 species were placed into several genera, namely: *Carangichthys, Craterognathus, Ferdauia, Flavocaranx, Platycaranx, Atropus* and *Turrum*, leaving only *Carangoides praeustus*. *Scyris indica* was moved from *Alectis,* with only *A. ciliaris* remaining. Body and fin shapes, head profile, patterns of naked patch and lateral line, and scute numbers are major diagnostic characters for identification. *Caranx ignobilis* is the largest and *Alepes kleinii* is the smallest. No species are in a threatened status, both in IUCN and Thai Red Lists.

Keywords: Carangidae, taxonomic review, Thai waters

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Intraspecific Variations of Dwarf Whipray *Brevitrygon heterura* (Chondrichthyes: Dasyatidae) in the Gulf of Thailand

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Dwarf whipray (*Brevitrygon heterura*) is a common species found in local markets around the Gulf of Thailand. However, like many other species of stingrays, it is threatened by overfishing and habitat destruction. Therefore, an accurate species identification is crucial because conservation efforts may vary depending on the species. This study aimed to understand morphological variations of *B. heterura* in the Gulf of Thailand by morphometric study and genetic analysis. During October 2022 and February 2023, we obtained 49 samples from research vessels, fish landing ports, and local fish markets. We observed two distinct groups based on 43 morphological variables/ratios. *B. heterura* samples from Chanthaburi, Rayong, Chon Buri, Samut Sakhon, Nakhon Si Thammarat, and Songkhla Provinces, called "group A," typically have a longer snout length than those from Prachuap Khiri Khan Province, called "group B" according to external morphological characters for species identification. Three morphological variables/ratios were significantly different between groups A and B. Main characters to explain intraspecific variations between group A and group B are further discussed. DNA barcoding based on a fragment of the cytochrome c oxidase subunit I (COI) gene were obtained from eight samples of group A and eight samples from group B. Pairwise percent sequence divergence (p-distance) for COI between group A and group B were 0.0–2.5. This study contributes to the understanding of *B. heterura* variations of morphology and genetics in the Gulf of Thailand.

Keywords: stingrays, threatened species, morphometrics

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Composition of Fishes Associated with Willow-leaved Water Croton (*Homonoia riparia* Lour.) in Wangtakrai, Nakhon Nayok Province

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Wangtrakrai is a famous place for Eco-tourism which is located in Nakhon Nayok Province, eastern Thailand. In this place, there are two streams, Khlong Takhian and Khlong Maduea, as main tourist attractions that flow and later joint together before draining into Khlong Wang, a branch of the Nakhon Nayok River. Along the streams, they are distinctly vegetated by *Homonoia riparia*, a particular shrub which roots in sand dunes or banks to form a special microhabitat resisting fast currents. Although *H. riparia* has been reported as a significant indicator for stream ecosystems, its mechanisms serving other aquatic organisms are poorly known. To elucidate this matter, fish considered a major animal associated with this plant are selected as the studied topic. During field surveys in Khlong Takhian in March and July 2023, fish specimens were collected from two defined areas, including waters surrounding *H. riparia* and waters outside of that. The results reveal 13 species in total found in Khlong Takhian. By comparing percentage of individuals, the former areas were composed of *Poropuntius normani* 57.0%, *Channa gachua* 16.5%, *Xenentodon* sp. 8.9%, *Monopterus albus* 7.6% and the remaining four species 10%; whereas, the latter areas consisted of *P. normani* 49.0%, *Channa gachua* 21.0%, *Crossocheilus stigmaeus* 9.0%, *Barbodes rhombeus* 5.0% and the remaining seven species 16.0%. As a result of the data obtained, discussion on the relationship between *H. riparia* and trophic behavior of fish is provided.

Keywords: composition, fishes, *Homonoia riparia*, streams, Wangtrakrai

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An Undescribed Rheophilic Cyprinid Species of the Genus *Poropuntius* (Actinopterygii: Cypriniformes) from the Khek River, Chao Phraya River System, North-central Thailand, With Notes on Its Biogeography

Prachya Musikasinthorn[1*] and Veera Vilasri[2]

The southern Asian cyprinid fish genus *Poropuntius* Smith, 1931 is characterized by distinct large tubercles on the snout and lacrimal bones; the rostral cap is separated from the first infraorbital or lacrimal bone by a deep groove; blackish streaks along the leading edges of caudal-fin lobes in most species; and an accessory pore on a ventral branch of the lateral-line canal on scale. The genus comprises medium-sized species (mostly 10–20 cm in standard length as adult) which inhabit mainly mountainous streams at moderate elevations (typically less than 1,000 m) of tropical and subtropical Asia. Presently, some 38 species of the genus are recognized as valid. During ichthyological surveys in the Khek River (a lower tributary of the Nan River, Chao Phraya River system) in Phitsanulok Province, north-central Thailand, during 27–30 January 2023, we collected individuals of an undescribed species of *Poropuntius*. This species morphologically most resembles *P. carinatus* previously reported from the Mekong River Basin of Laos and China in having a pointed head, a relatively slender body (28.6–32.9% in standard length [SL]), and a high dorsal fin (69.0–88.5% in body depth at dorsal-fin origin), but differs in having a longer head (head length 26.3–27.9% SL vs. 24.8–26.6), a less slender snout (snout width at mid-nostrils 8.2–9.6% SL vs. 6.8–7.6), a wider interorbital space (interorbital width 7.4–9.3% SL vs. 6.9–7.7), a shorter caudal peduncle (caudal peduncle length 17.1–20.0% SL vs. 21.4–23.7), fewer caudal vertebrae and epineurals (15 or 16 and 7 vs. 17 or 18 and 8, respectively), and the absence of a large distinct black blotch at the tip of dorsal fin. The biogeographical implications of the distributional pattern of the undescribed species in relation to that of *P. carinatus*, its putative sister species, are also provided.

Keywords: Chao Phraya River system, Khek River, *Poropuntius*, *Poropuntius carinatus*, undescribed species

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A Preliminary Result on Image Classification of Fourteen Species of Sharks in Thailand

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Certain species of sharks are designated as protected wildlife. In order to aid legal authorities and conservationists in the identification of these shark species using digital photographs, deep learning models based on convolutional neural networks were developed and trained using a collection of photographs encompassing 14 distinct shark species. Each photograph used in this initial trial captured a complete view of a shark specimen, either from the lateral or dorsal perspective. Currently, the quantity of available images for each individual shark species was limited, ranging from 5–24 photographs. The original color images were resized to dimensions of 256 x 512 pixels. Due to the small dataset size, overfitting the training dataset was expected to occur. To tackle the overfitting problem, both image augmentation and a dropout regularization were used. Three random image transformations of horizontal flipping, rotation, and zooming were utilized in image augmentation to create new training examples from the existing images. Various hyperparameters were also varied in a trial-and-error fashion to combat the overfitting problem. Even with all these efforts, the overfitting problem still persisted, i.e., the training accuracies of the models increased steadily during the training while the validation accuracies did not. As a result, these models will have low accuracies when applied to test images which were not used during the training. To reduce the severity of the overfitting problem, more digital photographs of shark specimens will be acquired in the future to increase the dataset size. In addition, we also plan to utilize a systematic approach to hyperparameter tuning and to investigate the effectiveness of transfer learning when applied to this image classification problem.

Keywords: shark, image classification, deep learning, convolutional neural network, hyperparameter tuning

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Oral Presentation
Session 4: *Museum Collection and Specimen Conservation*

The Central Storage of National Museums: Sustainable Management and Collections Care

Kannasamon Bhutham*

The Museum's Storage started from a small room which was originally located in the Bangkok National Museum for storing many antiques that could not all be displayed. The Museum's Storage is roughly divided into groups like stone sculptures, Buddha images, and textiles. In 1999, the Fine Arts Department relocated more than 30,000 items of antiquities from the storage inside the National Museum Bangkok to be preserved at the Kanchanaphisek National Museum in Khlong Ha Sub-district, Khlong Luang District, Pathum Thani Province. The Fine Arts Department aims to make the Central Storage become another innovative knowledge center for studying, researching, analyzing, and learning about antiques and artifacts in order to be able to connect with other institutions, local and international museums. So far, the Central Storage has been modernized into visible storage in accordance with museum science standards, providing education and research services of antiques (Study Collection), and serving as educational storage. The first central storage of the Fine Arts Department had been in operation for more than 16 years. The number of antiques delivered to be kept there had increased to more than 90,000 items. The Fine Arts Department constructed the new central storage under designed to be a storage warehouse for antiques and artifacts. Heat control, humidity from outside, and installation of an indoor environment control system have been taken into great consideration to protect and preserve antiques and keep art objects in a more sustainable and safer manner, in conformity with the standards of international museum storage. These include the storage systems of antiques and art objects by material types, temperature and humidity monitoring and control systems, air conditioning systems, fire protection systems, and theft protection systems. In addition, it is planned to be a learning center providing educational and research services in the form of "The Central Storage for Education".

Keywords: Central Storage, Study Collection, educational storage, collection care

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The National Science Museum's RE-ORG Project of the Dry Collection Storage Room (Bones, Antlers, Horns, Tusks and Fossils)

Wachara Sanguansombat* and Cholawit Thongcharoenchaikit

Here we report our mini-projects after participating in the online International Course on the Reorganization of Collections Storage in Museums of Southeast Asia organized by ICCROM and the National Discovery Museum Institute (Museum Siam) in Bangkok, Thailand, in collaboration with the Canadian Conservation Institute (CCI), Canada, Royal Institute for Cultural Heritage (KIK-IRPA), Belgium, National Museum in Belgrade, Serbia, Islamic Arts Museum of Malaysia (IAMM), Malaysia, and with the support of CHA-Korean Cultural Heritage Administration from 13 September 2021–30 April 2022. The aims of our mini projects were to regroup and reorganize the dry specimens, namely horns, antlers, tusks, rocks, minerals, and fossils in our collection storage room by applying the REORG principals. These were achieved via removal all non-collections from our storage room, providing new furniture to store the specimens that were currently placed on the floor, grouping the different types of those specimens by categories of preparation, size, and weight and relate those categories to the types of new furniture, rearranging the furniture along with assigning a new location system. We found out this not only helped to provide more area and unit spaces with easy access, but also to optimize the floor space, as well as unit space in order to increase the capacity of storing the specimens efficiently and effectively. It also enhanced the full functioning of the collection storage room. Furthermore, specimens could be easily accessed at their designated location within three minutes and without moving more than two others, according to the new location system. Moreover, the RE-ORG principles and methods that were used in these mini projects can be further applied to other storage rooms within our museum, such as herbarium, modern taxidermy collection, as well as the archive and library.

Keywords: reorganizing of collections storage, dry collections, RE-ORG principals, Natural History Museum Collections

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Oddy Test of Storage Materials for Natural History Specimens

Wanwisa Woraward*

The materials for exhibition and storage of the natural history collection should be appropriate to the specimens stored near them. This would help to avoid the risk of deterioration due to the emission of volatile organic compounds (VOCs) from materials used that directly affect the specimens. The most commonly used materials, such as adhesives and paper are potentially harmful since they may emit gas into stored specimens over time. The National Discovery Museum Institute's Collection Storage and Laboratory section conducted the Oddy Test in order to detect the VOCs presumed to be emitted from materials used for exhibition and storage at the National Science Museum's Natural History Museum. The material samples were enclosed in the sealed containers with three suspended metal coupons; silver, copper, and lead and then held at 60 degrees Celsius in 24 hours for 28 days after that the metal coupons are assessed for changes that may indicate their exposure to various compounds. Based on test results, it was suggested that some adhesives were suitable for temporary use; whereas some were not recommended at all. As for paper, it is suitable for temporary use only. Therefore, it is recommended that materials should have been tested to determine if they are safe to use for the Natural History collection along with applying other tests to help evaluate the suitability of particular materials for use in displays and in the storage of museum specimens.

Keywords: preventive conservation, Oddy Test, VOCs

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The Preparation of Readiness for Natural History Archives, References, and Information Management of the Natural History Museum, National Science

Wisan Trakoolrangsi* and Pattrapron Pimlor

It should be noted that although the Natural History Museum of National Science Museum, Thailand has long been established, for almost 20 years now, the references and information of important Thai Naturalists such as Dr. Boonsong Lekagul as well as others from the Thailand Institute of Scientific and Technological Research (TISTR) has not yet been properly systematically organized and stored, and the number of tasks have been increasing over time. Therefore, we have been unable to accomplish all tasks, including deterioration inspections, and ineffective use reviews. There has been an initiative to improve the structure of the archival system, reference documents, and the collection of natural information resources, by preparing to create a resource storage management system. Starting by surveying and classifying all resource groups within the archival storage room, it was found that these resources can be classified as hard copy information (books, journals, meeting and training reports), documents, and related materials (audiovisual materials, sculptures, and antiques) for a total number of 37,439 records that must be processed. Due to the space limitation of the archival storage room, it was necessary to manage the area as efficiently as possible along with organizing the system, managing storage, and conserving materials. This was to create a standard and stable system format going forward in storing information resources, providing services, and supporting resources for the future.

Keywords: information resources, archives management, Natural History Museum, National Science Museum

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Suggestions for the Improvement of Displaying the Natural History Specimens in the Temporary Exhibition Room at the Natural History Museum of National Science

Puangporn Srisomboon*

The temporary exhibition room at the Natural History Museum of the National Science Museum, Thailand provides a space for displaying specimens-based exhibition that connect visitors to the evidence and processes of field research in natural history and biodiversity. The two-story building of the museum was constructed with brick and mortar and consists of two areas of exhibition space: the permanent and temporary galleries located inside the building, and an outdoor area located in front of the entrance to the museum. Most of the exhibits are organic matter whose main chemical composition is Carbon. The exhibits include dry specimens such as plants, fossils, bones, pinned insects, and fluid-preserved specimens. These types of museum specimens are at risk of deterioration by temperature fluctuation, relative humidity, radiation, air pollution, and are infested by insects, fungi, and rodents. In addition, damage can easily occur by improper handling and displaying methods.

After inspection of the surrounding area of exhibition, it was found that the greatest risk identified was infrared radiation (heat) and visible light from LED bulbs. These cause a reaction called photochemical degradation, and especially affect the exhibits located in the outdoor area that are exposed to the sunlight for a long period of time. Other identified risks include air pollution coming from the outside, pollution can also come from materials used for constructing exhibits display showcases, and improper exhibits displaying methods currently used.

To improve the displaying of natural history specimens, actions should be taken by lowering the risk with two concepts: avoidance and prevention. These can be achieved by avoiding direct exposure to the bright light of the specimens and preventing sunlight from damaging the exhibit in the outdoor area. Apart from this, it is also recommended avoiding using the plywood for making exhibit showcases and avoiding displaying the specimens by vertical hanging them. Lastly, collaboration from different sectors is required in order to develop plans for proper displaying of the natural nistory specimens. The main goal should be prolonging the life of the specimens, while putting them on display, and to achieve an aesthetic displaying method that draws attention from the visitors.

Keywords: natural history specimens, collection risk assessment, photochemical degradation

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Oral Presentation

Session 5: *Taxonomy and Biodiversity (Invertebrate Zoology II)*

Unravelling the Ants of Singapore: Museum Collections Reveal Unexpected Diversity

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Despite its small (ca. 720 km^2) size and long history of relentless deforestation and urbanization, the city state of Singapore still supports myriad flora and fauna. In order to inform conservation decisions in the wake of global insect declines, we urgently need to document present insect diversities at stake. Numerous species of ants (Hymenoptera: Formicidae) have been recorded or described from Singapore since its founding as a British colony in 1819. However, it has been more than a century since the last checklist of ant species found in Singapore was published. Based on examinations of museum collections material, verified records from overseas repositories and primary literature sources, we compiled a comprehensive checklist of all named species and subspecies of ants in Singapore. We also annotated records with useful notes on taxonomy, and ecology of each species in the local context. We documented a total of 409 nominal species and subspecies from ten subfamilies and 100 genera, making Singapore the city with the highest known ant diversity in the world (at the time of writing). These include new records for 121 species and ten genera. Another 96 species and subspecies have types originally designated from Singapore. Most species are considered native to Indomalaya, including 13 cosmopolitan tramps; ten other species are presumed exotic to this region. We further raise nine subspecies to species and synonymize two species. This list remains incomplete, with substantial material impossible to identify to extant species. Museum collections are, and will continue to be, invaluable resources towards biodiversity discovery and resolution.

Keywords: biodiversity, natural history museums, Southeast Asia

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Behavioral Investigation of Virgin Dealate Queens of *Harpegnathos venator*

Sunittra Aupanun[1*], Mizuno Riou[2] and Fuminori Ito[3]

In the field, colonies of *Harpegnathos venator* show monogynous, polygynous (queenright condition) and gamergates colonies (queenless condition). In both conditions, we found numerous virgin dealate queens. After collecting the colonies from the field, we maintained the colonies of *H. venator* in artificial nests in the laboratory for observation. In the laboratory, 128 newly alate queens emerged in 13 colonies then we observed their behavior. We observed the only wings condition of 55 alate queens, 33 individuals shed their wings (average duration until dealation, 58.44±52.52 days). With the remaining 73 alate queens, we carefully observed their behavior. All of the 73 alate queens were attacked by workers in mother colonies. Only 48 individuals showed remarkable behavior during observation. They escaped from attacking workers by dispersing to artificial foraging areas (outside the nest) then coming back to the colonies again. Finally, attacked alate queens shed their wings (average was 18.45±11.80 days) and become virgin dealate queens in mother colonies. These virgin dealate queens were not attacked by workers anymore, and they played the role as workers. We dissected 18 alate queens who escaped from the colonies and dispersed at the outside, there were 16 alate queens that had developed oocytes in their ovaries without spermatheca and yellow bodies (2.58±1.5 oocytes).

Keywords: *Harpegnathos venator*, behavior, dispersal, alate queens, polygynous

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Range Extensions of Endemic Butterflies in Western Mindanao, Philippines

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A recent assessment on the butterflies of Mount Gutom, Zamboanga del Norte, Mindanao, Philippines. The study was conducted on 12–23 April 2022 and 7–20 December 2022. The samples were collected using a sweep net. A total of 235 individuals were recorded which consists of forty-one species belonging to five families and classified into 36 genera. Also, it resulted in range extensions of Mindanao endemic nymphalid butterflies such as *Zethera hestioides* and *Zethera musa*.

Keywords: endemic, Mount Gutom, Zamboanga del Norte

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Preliminary Study of Crab Larvae in the Maeklong Estuary, Samut Songkram

Kittikhun Suksamai*, Tanatorn Tienpothong and Koraon Wongkamhaeng

A study of crab larvae diversity in Maeklong Estuary, Samut Songkram, was investigated from March to April 2023. Crab larvae were taken from 14 stations using a plankton net (330μm) with a horizontal haul technique along the estuary. The study area covers all of the Maeklong Estuary, which is divided into three types: freshwater, brackish water, and marine water. Infraorder Brachyura, Order Decapoda was the dominant group of total crab larvae density. The highest density of crab larvae was found in station 14, near the Don Hoi Lot mud flat, adjacent to the Gulf of Thailand. A total of four morphotypes from four families were found. Illustrations of and a dichotomous key for crab larvae in this area are provided.

Keywords: crab larva, Brachyura, plankton, Meaklong estuary, Samut Songkram

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Distribution, Ecology, and Conservation Status of Aquatic Fireflies in Thailand

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Aquatic fireflies are currently utilized as an interesting commercial insect for ecotourism. Firefly habitats are transformed into firefly tour sites for nocturnal activities and to assist the local economy. Due to the effects of urbanization factors and land use change on urban wetlands, firefly populations are declining or disappearing in many regions across the world. To encourage Thai firefly conservation, this study focuses on aquatic fireflies distributed across Thailand, including a list of species, habitats, feeding behaviors, and their conservation status. There are several genera including *Abscondita, Luciola*, *Pteroptyx*, *Pygoluciola*, *Sclerotia*, and *Triangulara* that occur in the semi-aquatic and aquatic habitats throughout the country. Their habitats include running and standing water ecosystems, i.e., ponds, ditches, paddy fields, streams and their riparian zones, and estuaries. The conservation status of Thai fireflies is discussed. This study was supported by Magnolia Quality Development Corporation Limited (MQDC) through the Firefly Conservation for Sustainable Ecosystem Management Indicator Project (R000026588).

Keywords: firefly, conservation, aquatic habitat, urban wetland, urbanization

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Oral Presentation
Session 6: *Taxonomy and Biodiversity (Vertebrate Zoology II)*

Spatial Ecology and Density of the Indochinese Leopard (*Panthera pardus delacouri*) and its Prey in Kaeng Krachan Forest Complex, Thailand

Manoon Pliosungnoen*

Kaeng Krachan Forest Complex (KKFC) is a World Natural Heritage Site located in Thailand's Tenasserim Mountain Range, a top global priority landscape for large carnivore conservation and one of the last strongholds for Indochinese leopards (*Panthera pardus delacouri*), a wild felid that has lost over 90% of its historical range. The current study identified key areas in KKFC where leopards occurred in relation to environmental features and human pressures via a landscape-scale species occupancy survey. Density estimates confirmed that a key leopard population in the core area of KKFC has remained stable at 2.8–3.8 leopards/100 km^2 over the last two decades with a proportion of melanistic individuals estimated via spatial capture-recapture and spatial mark-resight analyses at ca. 30%. Prey densities estimated by camera trap distance sampling and converted to biomass suggested that the KKFC core area contained adequate prey to support the current leopard population, but large prey outside the core area occurred at much lower abundance and reduced biomass. This study revealed that human activities negatively influenced space use by both leopards and their prey. To safeguard and ensure the persistence of the Indochinese leopard population in the KKFC, all protected areas must be managed under the same strategic plan following an ecosystem-based approach. Effective law enforcement must be a priority in the core area of KKFC, and the livelihoods of people who live inside and along the border of the protected areas must be improved to reduce their dependency on wild meat. In addition, the government should invest in long-term monitoring to evaluate the effectiveness of all interventions and generate reliable information required for adaptive management of this Indochinese leopard population.

Keywords: indochinese leopard, habitat occupancy, spatial capture-recapture, Kaeng Krachan Forest Complex, Thailand

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Species Diversity and Abundance of Birds in Different Habitats at Kasetsart University, Bang Khen Campus

Pattida Uwichain* and Patchara Danaisawadi

All habitats around the world have birds. Birds are good indicators of biodiversity because they are relatively sensitive to environmental change. Each bird species might prefer different habitats. Therefore, this research aims to study species diversity and abundance of birds from four different areas at Kasetsart University, Bang Khen Campus. Diversity data were recorded from February to May 2023 with the line transect method. As a result, a total of 3,982 individuals, 63 species belonging to 33 families, and 13 orders have been provided. The Shannon-Wiener Index of Diversity (*H'*) of the campus was at 3.06. The dominant bird species are *Passer montanus*, *Columba livia* and *Geopelia striata*. In terms of habitat usage, the Agricultural Museum provided the highest species diversity index (*H'* = 3.00), followed by Rice School (*H'* = 2.91) and the Faculty of Fisheries (*H'* = 2.82), respectively. While the Thai Commemorative Garden shows the lowest index of diversity (*H'* = 2.78). Although either the Agricultural Museum or the Thai Commemorative Garden are the arboretums that provide the necessary resources for birds, the degree of disturbance by humans is significantly different. It is possible that human activity and area management are important factors that affect bird diversity at Kasetsart University.

Keywords: birds, human activity, urban area

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Fishes and Fisheries in the Flood Plain of the Mun-Chi Sub-basin

Jarungjit Grudpan* and Chaiwut Grudpan*

The Lower Mekong Basin (LMB) is the most extensive region of aquatic environment to support the highest biodiversity of fishes in the tropical Asian country. The total number of species in this region is 800–1,200 species, and the total annual wild caught fisheries including aquaculture approaches three million tons.

The Mun-Chi watershed is the largest sub-basin of the LMB. 300 fish species have been reported belonging to intensive observation field surveys, where it is significant to the region in the relation between various types of fish natural habituation with the human land use, such as agricultures factories, including urban sites. The lower part of The Mun-Chi Sub-basin in Sisaket and Ubon Ratchathani Provinces, northeastern Thailand are significant alluvial flood plains in the middle part of LMB. This place has the most biological richness and is typically supported by the most productive inland fisheries, strongly related to the supply chain of the regional economy.

This is preliminary report found distribution patterns of the threaten economic species group clariid catfishes significantly abundant in the lower part of the Mun-Chi Sub-basin, which included species composition of fish in this region separately divided two main groups for regional flood plain and short distance migration species.

Keywords: fishes, fisheries, flood plain, lower Mun-Chi Sub-basin, Thailand

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The First Preliminary Observational Field Survey on the Diversity and Ecology of Fishes in the Ma Basin, Laos PDR

Somphanh Philavong[1*], Jarungjit Grudpan[2] and Chaiwut Grudpan[2]

The Mekong Basin is 90% watershed area consisting of 183,000 km^2 with other two basins, Ma and Ka sharing 10% watershed area consisting of 13,000 km^2 expanded in Houaphan and Xieng Khuang Provinces in northeast. The Ma River Basin is the transboundary basin shared between 35% in Laos PDR and 65% in Vietnam. The elevation above sea level is between 125–336 meters. There are three seasons of the year which are summer, rainy and winter, with temperatures varying from 21.61 °C and -3.78 °C and precipitation of 112.81 mm. The first preliminary observational field survey on the diversity and ecology of fishes in Ma Basin in Laos PDR conducted six sampling sites in the area of confluence between Ma River and its tributary Ed River, during the rainy season from 28–31 May 2023 at Ed District, Houaphanh Province. The sampling method used were mainly experimental gillnet surveys (GNS) for biological parameters which included participation with local fishing methods to include independent data. Samples were taken in six sampling sites: four sampling sites on the Ed River (tributary sites), and two sampling sites on the Ma River (mainstream sites). Five orders, 13 families, and 28 fish species were found. Twenty-three species are endemic to this river, three species are exotic species, and two species are shared with the Mekong fish fauna of Laos PDR.

Keywords. diversity, ecology, fishes, Ma Basin, Laos PDR

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Oral Presentation

Session 7: *Taxonomy and Biodiversity (Invertebrate Zoology III)*

Quantification and Mapping of Invasive Alien Ants using the GIS/GPS Approach at the Songkhram River Basin

Puvadol Doydee[1*], Weeyawat Jaitrong[2] and Tadsanai Jeenthong[2]

Invasive alien ants (IAAs) can compete with native faunae in Thailand, thereby affecting the balance of ecosystems. Ecological restoration aims to mitigate the impact of invasive alien ant species and restore ecological communities and ecosystem functioning. However, the knowledge and management of IAAs in the wetland ecosystem is limited. In this context, spatial information on IAAs is essential for reducing the impacts of their invasion. The integration of Geographic Information Systems (GIS) and the Global Positioning System (GPS) shows an opportunity to collect, create mapping, and conduct analyses of spatial IAAs issues. There were two objectives of this paper. The first was to identify the species composition of IAAs and their habitat types in Songkhram River Basin (SRB). The second objective was to provide thematic map associated with geo-referenced information on the frequency and spatial distribution of IAAs produced in SRB and conduct analyses of how the impacts of IAAs have disturbed the native faunae throughout the SRB landscape. The results showed that *Anoplolepis gracilipes* (Smith, 1857) was the top dominant IAA, being recorded 100% of the time at the 43 sampling data collection sites within the SRB boundary during 31 July–4 August 2023 from actual field data gathering, with an average frequency of 23.02%. Following, we had *Paratrechina longicornis* (Latreille, 1802), and *Tapinoma melanocephalum* (Fabricius, 1793) occupying the second and third place with average frequency of 19.05% and 14.96%, respectively. According to the thematic maps, the urban area had the highest density with high invasion potential zones. These zones were neighborhoods with along Songkhram River, agricultural areas, and forest communities, with an elevation of 120–400 MSL. Most of the IAAs living in the SRB pose the possibility of disturbing nature and anthropogenic livelihoods.

Keywords: invasive alien ants, GIS/GPS, spatial mapping, Songkhram River Basin

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Darkling Beetle (Tenebrionidae Latreille, 1802) Infestation and Susceptibility of *Falcataria falcata* in Barangay Rogongon, Iligan City, Philippines

Dcery Joy G. Quiban* and Eddie P. Mondejar

The family of darkling beetles inhabits mostly arid areas where direct sunlight radiates among the trees and other plants. They can be found in dried trees, and decaying wood, where they inhabit the barks of the trees, and some species can be agricultural pests. This study investigates the distribution, abundance, and host plants of darkling beetles in Barangay Rogongon, Iligan City, Philippines. Opportunistic sampling was conducted from 1 July until 30 September 2023, in three sampling areas located in the agroecosystem at Sitio Sta. Cruz, Sitio Lawlawon, and Sitio Libandayan in Barangay Rogongon, Iligan City, Philippines. The inventory documented four morphospecies: *Amarygmus* sp., *Ceropria* sp., *Derosphaerus* sp., and *Phaedis* sp. In addition, *Derosphaerus* sp. was the most abundant morphospecies, with 24 individuals. Moreover, *Falcataria falcata* was the most susceptible to infestation of darkling beetles, with 79.71% frequency of occurrence. In addition, the infestation in *F. falcata* was consistently high at Sitio Lawlawon (R.A = 74.42%) than in Sitio Sta. Cruz (R.A = 91.67%) and Sitio Libandayan (R.A = 85.71%). The result implies that *Falcataria falcata* was the most susceptible to infestation of Tenebrionidae species, and knowledge of their distribution and hostplants is vital in formulating mitigation measures so that they cannot cause massive destruction to the agroecosystem.

Keywords: agroecosystem, *Falcataria falcata*, hostplant, libandayan, opportunistic

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Species Composition and Distribution of Tetrigidae in Brgy. Rogongon, Iligan City, Philippines

Aiko Tabig* and Eddie Mondejar

The family Tetrigidae, commonly known as groundhoppers, is one of the understudied taxa and constitute a diverse group with diverse ecological functions. This study investigates the species composition and distribution of Tetrigidae at Sitio Sumagaysay and Sitio Libandayan, Barangay Rogongon, Iligan City, Philippines. An opportunistic sampling was employed to capture Tetrigidae in Sitio Sumagaysay (an agroecosystem) and in Sitio Libandayan (a secondary forest). Field sampling was conducted 24–29 July 2023 in Sitio Sumagaysay and on 27–30 September 2023 in Sitio Libandayan. The study recorded 66 individuals of Tetrigidae in two sampling sites representing five species, namely *Hymenotes triangularis*, *Hymenotes* sp. 1, *Hymenotes* sp. 2, *Tetrix* sp. 1 and *Tetrix* sp. 2. The most prevalent species was *Hymenotes triangularis* in Sitio Sumagaysay, accounting for 16.16% of the total individuals, followed by *Tetrix* sp. 1 (15.15%), *Tetrix* sp. 2 (7.58%), *Hymenotes* sp. 1 (4.54%) and *Hymenotes* sp. 2 (1.52%). In Libandayan, *Tetrix* sp. 1 was the most abundant (18.18%), followed by *Hymenotes triangularis* (13.64%), *Tetrix* sp. 2 (10.61%), *Hymenotes* sp. 1 (7.58%) and *Hymenotes* sp. 2 (4.54%). These highlighted differences in species composition between the two locations, with *Tetrix* sp. 1 and *Hymenotes triagularis* as the dominant species in both sampling sites, albeit more prominently in Libandayan due to its higher elevation and the presence of piled leaf litter on the ground. This study's findings emphasize the importance of conservation and ecosystem management in the distinct ecological landscapes of Sitio Sumagaysay and Sitio Libandayan, with implications for safeguarding known species and identifying potentially new species.

Keywords: agroecosystem, groundhopper, *Hymenotes*, *Tetrix*

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Taxonomy of the Ant Genus *Meranoplus* Smith, 1853 in Thailand (Hymenoptera: Formicidae: Myrmicinae)

Kuntima Yodprasit[1*], Weeyawat Jaitrong[2] and Wattanachai Tasen[1]

Taxonomic study of the ants has only been seriously started recently in Thailand. The main purpose of this study was to clarify the ant genus *Meranoplus* Smith, 1853 in Thailand mainly based on the worker caste. Ant specimens used in this research were mainly based on the specimens deposited in the collection at the Natural History Museum of the National Science Museum, Pathum Thani Province, Thailand and the Ant Museum, Kasetsart University, Thailand. Type specimens or images of type specimens from AntWeb and AntWiki were examined and identified correctly. Currently, a total of eight species are recognized among the *Meranoplus* fauna of Thailand including three new species: *Meranoplus isanensis* **sp. nov.,** *M. siamensis* **sp. nov.**, and *M. tanomtongi* **sp. nov.** The new species are described based on worker caste. Four species (*Meranoplus bicolor* [Guérin-Méneville, 1844]; *M. castaneus* Smith, 1857; *M. laeviventris* Emery, 1889; and *M. mucronatus* Smith, 1857) were previously recorded from Thailand. A small species, *Meranoplus malaysianus* Schödl, 1998 is recorded for the first time in the country. Most species of the genus nest in the soil. Only one species, *M. castaneus* is an arboreal ant, nesting in dead branches of trees. A key to the Thai species of the genus based on the worker caste is provided. The distribution pattern and bionomic information for each species are also discussed.

Keywords: distribution, *Meranoplus*, Myrmicinae, taxonomy, Thailand

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Species Diversity of Caddisfly (Order Trichoptera Kirby, 1813) Adults in a Stream Contaminated by Mine Acid Drainage in Northeast Thailand

Kittisak Kumtanom[1], Narin Chomphuphuang[2], Weeyawat Jaitrong[3]
and Kanyakorn Piraonapicha[2*]

Abstract. Diversity of caddisfly adults is reported here for the first time from a degraded lotic system in northeast Thailand. Caddisfly (family Trichoptera) adults were carried out from four sites of a stream that were contaminated with mine acid drainage from a gold mine in Loei Province, Thailand. The samples were collected using an ultraviolet light trap in November 2023. A total of twelve species, seven genera in five families of caddisfly adults were found. *Cheumatopsyche dhanikari* Malicky 1979 and *Chimarra akkaorum* Chantaramongkol & Malicky, 1989 were found in upstream to downstream sites. The most abundant species was *Cheumatopsyche carmentis* Malicky & Chantaramongkol, 1997 (28%) followed by *Chimarra akkaorum* (22%) and *Cheumatopsyche dhanikari* (21%), respectively. The present study is a preliminary survey of species diversity of aquatic insects in streams that are contaminated by mine acid drainage six years after the closing of the gold mine.

Keywords: ecology, aquatic insect, EPT, habits, water pollution, gold mining

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Oral Presentation
Session 8: *Museum Education and Public Programs*

Photo Contest: A Platform where Scientists and Citizens Meet Nature

Kaewnapha Phothi*

Photographs are a familiar and widely popular form of media due to being conveniently produced, disseminated, or shared online within society. It can be utilized for creative purposes in various fields, including science communication. Communicating science via photography requires a proper combination of the understanding of scientific content, the craft of communication, and artistic views. This kind of activity is not yet widely prevalent in Thailand. Most of them tend to emphasize entertainment, though we can always incorporate scientific narratives into photographs since science is around us. The National Science Museum Thailand has been arranging the yearly photo competition for nine years, encouraging both scientists and the public to observe, capture, and share the science they encountered through a photograph and accompanying text. From all submissions, we found that photographs can represent nature in various perspectives, not only depicting living things, habitats, or ecosystem, but also capable of resonating messages about environmental issues and conservation. A selection of photographs from the contest is also publicly displayed, providing a further chance for people to engage with science and nature. As a result, the mechanism of the photo contest and its relating activities may serve as a tool to stimulate interest and promote the appreciation and understanding of science, leading to a better quality of life and sustainable coexistence with the environment.

Keywords: photo contest, scientists, citizen platform

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How Natural History Museums Benefit from Virtual Reality (VR) Technology to Make Learning Media More Memorable

Pornphan Phichai*

This paper aims to discuss designing content for a VR exhibit that enhances episodic memory from analysis results of a study to investigate how a participant remembers the story of a VR exhibit. The design was considered the dominant feature of Head-Mounted Displays VR (HMD VR) that delivers a full immersive experience, an embodiment with the virtual body (VB) that induces sensory-motor function. The researcher conducted an empirical study which created a VR exhibit to deliver scientific knowledge about the camouflage of animals in a Tundra environment. The study used a mixed-method approach, quantitative and qualitative, to collect data for analyzing three factors: memory, emotion, and immersion, which focused on discussion in this paper. Fifteen subjects participated in the study. The results showed that the memory two weeks after the experiment did not significantly decrease from the memory after the experiment. It indicates that learners can recall the story of the Camouflage VR Exhibit at a high level. The results show learners' emotions have high levels of pleasantness and arousal, and the exhibit offers a sense of immersion to the participants with 2.90 from 5.00. The analysis of the qualitative data found nine design features that support learners to remember the Camouflage VR Exhibit's story, for example, game mission, objects in virtual environments, changing of the environment, critical situations, etc. This study suggests that natural history museums (NHM) should design the content of VR exhibits with experiential learning by creating experiences that allow learners to move their bodies to interact with a virtual environment rather than text explanations. This will aid to design experiences more actively by applying game mechanics, which the VR full immersive technology benefits from design content for NHM.

Keywords: VR exhibit, immersive technology, museum learning, user experience, camouflage

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Public Engagement with Flood Risk Management in Bangkok: A Case of Thai Public Visitors to a Large Science Museum in Thailand

Supa Tanprasertkun*

Due to the increasing flood risks in Thailand, the education sector has been called on to promote public engagement in flood risk management (FRM). Nevertheless, there is still limited support in terms of how the sector, especially non-formal education, can achieve this task effectively. To address this gap of support, this thesis qualitatively explored the scenario of public engagement in FRM in Thailand from the perspectives of 56 Thai public visitors to a large science museum (18 children and 38 adults) and ten FRM key actors in Thailand.

By accepting that laypeople have the potential and are important to act in both the private and public spheres to reduce their own and collective flood risks, the study provides empirical evidence that, through their lived experiences, the Thai public visitors possess several sorts of capital that are essential for improving FRM (i.e. flood experiences, a strong/moderate belief that severe flood will occur in the future, and knowledge of personal flood impacts). This affirms that the public is a potential contributor to dealing with flooding issues in Thai society. However, the study revealed that the Thai public visitors' engagement with FRM remained limited to taking no action or taking private actions to lessen personal or household flood risks. By analysing the empirical data through a holistic lens, the study underlines that the limited engagement was a result of several personal and situational constraints. Based on these constraints, the study suggests two significant roles that museums and other similar non-formal education organisations in Thailand can adopt to support the promotion of public engagement in FRM: (1) being a source of reliable and updated knowledge about flooding issues and FRM for the public to access, and (2) being a safe space for the public to exercise their participation in conversations, deliberations, and collective actions toward improving FRM. Possibilities and challenges in integrating these roles into science museum practices in Thailand are discussed.

Keywords: public engagement, flood risk management, climate change, science museum, flood education

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The Results of Implementing the "Plant Rangers" Educational Resource Set in Schools across Thailand

Siraprapah Srisupan*, Napat Malathum* and Jittikan Intamong

The National Science Museum of Thailand (NSM Thailand) had developed an educational resource set titled "Plant Rangers," which is intended as a mini curriculum for students to learn about plants. We distributed them to schools in every region in Thailand for teachers to implement them. This study aimed to investigate the results of their implementation and survey the students' knowledge of plant ecology and environmental awareness after learning with the resource set. Both quantitative and qualitative data were collected, the former with a test about agricultural plant ecology for the students and the latter with in-depth interviews of the teachers. The quantitative data were analyzed with descriptive statistics; whereas, the qualitative data were analyzed with content analysis. We found that in total, the teachers from the 22 selected schools used the Plant Rangers set with 519 uppers primary (Grades 4–6) and lower secondary (Grades 7–9) students. The set was used in six different formats: 1) science camps; 2) science classes; 3) school clubs; 4) student development classes; 5) the schools' science week; and 6) sharing the resources with other schools in their network. Student evaluation results on the knowledge test yielded a mean score of 7.30 out of a total score of 12.00 (SD = 2.72). The environmental awareness questionnaire showed a high level of awareness (M = 4.17, SD = 0.50). In the teacher interviews, they thought that the content of the Plant Rangers set could easily be adapted to native plants of their respective regions, which makes the curriculum highly relevant to the students' daily lives. Furthermore, the hands-on nature of the activities encouraged the students to explore the local flora in their area with enthusiasm. Overall, the distribution of the Plant Rangers educational resource set has been greatly successful.

Keywords: educational resources, integrated learning management, plant ecology, environmental awareness

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National Science Museum (NSM) Augmented Reality (AR): Adventure in the Science Museum; New Application Developed Through Concepts Combining Science and Scientific Communication

Apichaya Nuchino, Chanin Sarigaputi, Pawita Likitdacharoj, Nuchjarim Yensuong, Anupap Sakulgnam and Umaporn Kruekamwang*

The National Science Museum has recently launched a new application for learning about and visiting a science museum called “NSM AR: Adventure in the Science Museum”. Via augmented reality (AR) technology, visitors are provided with the opportunity to learn science with a more concrete and clear understanding of the scientific contents. The application represents scientific subjects exhibited in the Science Museum that have been methodically interpreted, structured, and integrated into the three specific story trails, including Amazing Living Creatures, Ever-Changing Energy, and Up and Beyond. On each route, players will gain basic research skills through missions by learning step-by-step with distinct goals connecting the core idea of each mission with logic. To provide visitors with fun activities and scientific cognition through a particular subject, creators have developed educational media by combining the concepts of science communication and scientific communication. Emphasising accuracy, precision, and obviousness in details was realized; on the other hand, it presents simply by conveying and demonstrating interesting displays in the form of ARs, games, animations, and 3-dimensional objects to make science communication as effective as possible.

Keywords: augmented reality, science museum, museum education, science communication, educational media

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Oral Presentation

Session 9: *Taxonomy and Biodiversity (Vertebrate Zoology III)*

The *Varanus* Merrem, 1823 (Monitor Lizard) Species of Thailand

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Thailand is home to four species of the genus *Varanus* (Monitor Lizards). These are *Varanus bengalensis* (Daudin, 1802); *V. dumerilii* Schlegel, 1839; *V. rudicollis* (Gray, 1845); and *V. salvator* (Lauprasert and Thirakupt, 2001). The taxonomic problems of *Varanus bengalensis* as to a mistaken belief of isolated sympatry are discussed. Other taxonomic information presented is on the subgenera of these four *Varanus* species occurring in Thailand, as well as the subspecies of Water Monitor, *Varanus salvator macromaculatus* and the synonymized *V. s. komaini*. The report of *Varanus flavescens* occurring in Thailand is also discussed. Red Listing and CITES information of the four *Varanus* species are presented. Ranges, habitat, diets, size, and how sympatric overlap of ranges occur through unique ecological niches are also reported, showing how all four species occur in some overlapping areas. Species that prey on *Varanus* species, few as they may be, are also discussed. The Thai people's attitude and some myths about the *Varanus* species are discussed.

Keywords: distribution, diversity, taxonomy, Thailand

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Diversity and Habitat Utilization of Reptiles at Taksin Maharat National Park, Tak Province

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The current study presents reptiles' diversity and habitat utilization at Taksin Maharat National Park, Tak Province. The data were collected during October 2022 to April 2023, through a visual encounter survey method. With a total of six routes, covering the main habitats types as follow: 1) evergreen hill forest, 2) mixed deciduous forest, 3) deciduous dipterocarp forest and 4) teak plantation. A total of 82 reptiles from two orders, nine families, 15 genera and 19 species were recorded in this study, three of which are the first records from the study site: *Sphenomorphus maculatus*, *Lycodon davisonii*, and *Hebius khasiensis*. The most common reptile species was *Sphenomorphus maculatus*, found from all habitat types. The diversity index (H') of the study area is 2.48, exhibiting the highest diversity index and teak plantation had the lowest diversity index of 2.40 and 1.28, respectively. In conclusion, heterogeneity of habitats and level of disturbance by humans are the main factors that affect the diversity of reptiles in the study area.

Keywords: heterogeneity of habitats, reptiles, species diversity, visual encounter survey method

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Species Diversity and Habitat Utilization of Anurans at Taksin Maharat National Park, Tak Province

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The present study on species diversity and habitat utilization of anuran was surveyed at Taksin Maharat National Park. The study was surveyed between October 2022 to April 2023, with visual encounter survey method. Five families, belonging to 15 genera and 23 species were discovered in four different types of forest, namely evergreen hill forest, mixed deciduous forest, deciduous dipterocarp forest, and teak plantation. The most common species was *Leptobrachium smithi*. Three anuran species have been recorded in this area for the first time: *Limnonectes taylori* Matsui *et al.*, 2010, *Odorrana chloronota* (Günther, 1876), and *Brachytarsophrys carinense* (Boulenger, 1889). In terms of habitat utilization, mixed deciduous forest had the highest values for the Shannon diversity index (2.76), followed by deciduous forest (2.31), evergreen hill forest (2.22), and teak forest (0.60), respectively.

Keywords: anurans diversity, Taksin Maharat National Park, diversity index

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Distribution Modeling of Spotted Forest Skinks (*Sphenomorphus maculatus* complex) Inferred from Morphological and Genetic Data

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Forest skinks of the genus *Sphenomorphus* Fitzinger, 1843 are cryptic and secretive lizards. Their habitats can be vary including lowland and montane forests. Spotted forest skink (*Sphenomorphus maculatus)* is a common skink broadly distributed in Thailand. It is a diurnal small terrestrial skink. There are two subspecies including *S. maculatus maculatus* (Blyth, 1854) found in northern Thailand and *S. maculatus mitanensis* (Annandale, 1905) found in western and eastern Thailand. However, the distribution range of these two subspecies is unclear. Therefore, this study evaluated the distribution range of the two subspecies by performing species distribution modeling. Field surveys were conducted by visual encounter surveys and line transects during 2020–2022. Then, we used mitochondrial DNA (16S rRNA and ND2) and nuclear DNA (R35 and NGFB) for species confirmation. We also used morphological confirmation in case genetic material were not available. We used MaxEnt software for predicting the potential distribution areas and suitable habitats. We also compiled occurrence data from the voucher specimens in Chulalongkorn University. The coordinators used species distribution modeling which was analyzed with 19 climatic variables from WorldClim by using MaxEnt. The model had a high area under the curve (AUC) (*S. maculatus maculatus* = 0.949 and *S. maculatus mitanensis* = 0.992). Temperature annual range, temperature seasonality, and precipitation of the wettest month made an important contribution to *S. maculatus maculatus*. Mean diurnal range, temperature annual range, precipitation of driest month, and annual precipitation were most of the environmental variables showing the distribution of *S. maculatus mitanensis*. The potential distribution of *S. maculatus maculatus* range was in the northern regions, and the potential distribution of *S. maculatus mitanensis* in the southwest and southeast regions. We also found that there was no distribution-overlap between these two subspecies. Data on species distribution is essential for the correct conservation management of the species and their habitat.

Keywords: cryptic species, distribution range, highland species, lizard, MaxEnt

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Diversity and Habitat Selection of Amphibians in the Central Panay Mountain Range, Antique, Philippines

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The Central Panay Mountain Range (CPMR) in the Philippines, representing the largest contiguous forest on Panay Island, was investigated to elucidate the diversity and habitat selection of amphibians. This study notably fills the knowledge gap on the linkage between amphibian composition and environmental determinants. Employing opportunistic, visual encounter, and acoustic encounter surveys within strip transects across varying habitats—lowland forest, lower montane forest, streams, and grasslands—244 individuals from eleven amphibian species (*Rhinella marina*, *Platymantis corrugatus*, *Platymantis dorsalis*, *Platymantis* cf. *dorsalis*, *Platymantis panayensis*, *Occidozyga laevis*, *Kaloula conjuncta negrosensis, Kaloula* sp., *Hylarana erythraea*, *Polypedates leucomystax*, and *Rhacophorus pardalis*), spanning six families were recorded. Notably, five species are endemic to the Philippines, with one under threat, and two being introduced and invasive. *Platymantis dorsalis* emerged as the most abundant, exhibiting adaptability across diverse habitats. A pronounced concentration of species and individual abundance was observed in the lowland forests at elevations of 850–990 m asl. Canonical correspondence analysis (CCA) revealed a positive correlation between amphibian habitat preference and physicochemical parameters of each habitat, influencing their distribution and abundance. As initiatives are underway to designate CPMR as a nationally protected area, this study bolsters that endeavor, underscoring amphibians' role as ecological indicators.

Keywords: amphibian diversity, habitat selection, Central Panay Mountain Range, physicochemical parameters, ecosystem indicators

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Oral Presentation
Session 10: *Young Scientists*

The Morphological Study of the Stone Loach, *Schistura* cf. *nicholsi* (Cypriniformes: Nemacheilidae) from Salad-Dai Waterfall

Salawin Thepsupornkul[1] and Salinee Khachonpisitsak[2*]

A stone loach, *Schistura* cf. *nicholsi* morphological characters were studied. Thirty specimens of the stone loach fish were collected by scoop nets from Salad-Dai Waterfall, Nakon Nayok Province, Bangpakong River Basin, Thailand. Some morphological characters such as a black spot at the base of the dorsal fin, the lateral line is complete, lips thick, and the lower lip with a median sulcus were observed and measured then compared with morphological characters of *Schistura nicholsi* (Smith, 1933), a closely related species. The results show that the specimens collected from Salad-Dai Waterfall agreed well with *Schistura nicholsi* (Smith, 1933) but only a few variations have been found. The important character to distinguish *S. nicholsi* from other species in the genus is the presence of the median incision on the upper lip. This character was found in all specimens examined. However, the character was not documented in the original description of *S. nicholsi*. For the moment, we roughly identify these specimens as *S. nicholsi.* Moreover, this stone loach fish is recorded for the first time in the Bangpakong River Basin.

Keywords: Salad-Dai Waterfall, morphology, Nemacheilidae, *Schistura* cf. *nicholsi*, Bangpakong Basin system

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Identifying Dinosaur-like Creatures in the Mural Paintings of the Temple of the Emerald Buddha: An Implication to Study Paleontological Knowledge in Thailand

Saranpat Ouilapan[1*] and Cholawit Thongcharoenchaikit[2]

In the murals of Thailand's centuries-old "Temple of the Emerald Buddha", a depiction of two dinosaur-like creatures is present within a Ramakien scene: "Pali lifting Mount Kailash". Thus, to provide insights into the depiction, this research was conducted to find out why prehistoric creatures are depicted, what could be their hypothetical species, and how the artist knows of them. This is done first by identifying the components of the painting to find out what the creatures might represent. Then, comparison results with extant, extinct, and mythical creatures were combined with analysis by experts to find the hypothetical species. Lastly, in order to learn how the artist knew about them, prehistoric publications that entered Thailand during the period in which the mural was painted were compiled. Results revealed that the creatures represent mythical "Himmavanta" creatures, which isn't unusual as these representations often occur with mysterious/rare animals. Next, the two creatures' hypothetical species were concluded, with one of the creatures baring quadrupedal characteristics and rows of triangular and tail spikes was concluded to be a stegosaur dinosaur. The other with bipedal characteristics, and short forelimbs was concluded to be a theropod dinosaur, after combining experts' analysis and comparison with creatures, including otters, kangaroos, iguanodon dinosaur, and Himmavanta creatures. Finally, after determining that the mural was repainted in 1911 and restored in 1987, it is likely that the artist knew about dinosaurs from publications that entered Thailand with the first evidence of dinosaur exhibits, TV shows, and media articles being seen in 1965, 1967 and 1976, respectively. Whilst the possibility of dinosaur fossils near the actual Mount Kailash, influencing dinosaur depiction was ruled out as the area yielded no dinosaur fossils. In summary, these results provide useful context and identification of a dinosaur depiction in Thailand's centuries-old temple and the background of early paleontological knowledge in Thailand.

Keywords: dinosaurs, paleontology, paleoart, mural painting

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External Morphological Study of *Carebara diversa* (Jerdon, 1851) (Hymenoptera: Formicidae: Myrmecinae) from Thailand and Laos

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and Salinee Khachonpisitsak[2*]

Carebara diversa (Jerdon, 1851) is an ant species belonging to the subfamily Myrmicinae in the family Formicidae. This species is distributed from India, Southern China, Taiwan to Southeast Asia. It prefers to nest in soil or rotting logs in open or disturbed areas. This species is characterized by a black to reddish brown body; the small to large body size from 2–16 mm (polymorphism); small eyes, especially in minor worker; sharp and curved down propodeal spine; and an ocellus presence in some major workers. The external morphological characters of *C. diversa* specimens from Thailand and Laos were studied. This study is mainly based on materials deposited in the Thailand Natural History Museum of the National Science Museum Thailand. Measurements of head length (HL), head width (HW), scape length (SL), mandible length (ML) and eye length (EL) were made using an ocular micrometer, recorded to the nearest 0.01 mm. Other characters, such as mandibular dentition, number of ommatidia, shape of head and number of teeth were observed and compared among castes. The result show that this ant is strongly polymorphic in worker caste. Workers can be divided into five groups (HW vs SL): 1) the largest head width of 4–4.9 mm; 2) head width of 3.1–3.75 mm; 3) head width of 2.1–2.7 mm; 4) head width of 1.2–1.75 mm; and 5) the smallest body size 0.55–0.7 mm. The head of queen is slightly smaller than in the largest worker, but its mesosoma and gaster are distinctly larger. The large workers have a large and strong mandible that is reduced in the number of teeth on the masticatory margin. The small workers have a subtriangular mandible that has teeth on the masticatory margin.

Keywords: ant, polymorphism, morphology, stereoscopy, ocular micrometer

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Diversity of the Mayfly Nymphs in Ton Ya Plong Waterfall, Songkhla Province

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The mayfly nymph is a group of insects which are commonly used as an indicators of water quality in the lotic ecosystems. There is a few information on the diversity of mayfly nymphs in the Southern Thailand. This study aimed to investigate the diversity of mayfly nymphs in the lower and upper areas of Khlong Khok Chang Weir at Ton Ya Plong Waterfall, Songkhla Province. The survey was conducted between June 5th and 24th, 2023. Samples of the mayfly nymphs were randomly collected from both areas by using hand-piking method. These samples were classified in the level of families and species based on the external morphological characteristics. The results showed a total of five families and 26 species of mayfly nymphs. Four families of the mayfly nymphs were found in each area. At the same time, the number of species was higher in the upper area (19 species), compared to the lower area (nine species). Moreover, the Jaccard similarity index to measure the similarity between the mayfly nymph species in the lower and upper areas, revealed a relatively low similarity between these two areas (8% similarity). Additionally, two species of mayfly nymphs were found in both the lower and upper areas.

Keywords: diversity, mayfly nymphs, Ton Ya Plong Waterfall, Songkhla Province

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Diversity of Signal Flies at Ton Ya Plong Waterfall, Songkhla Province

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Signal flies are insects belonging to the order Diptera, family Platystomatidae. Although these flies are very abundant in the tropical forest, there are few reports of the diversity in southern Thailand. This study aimed to investigate the diversity of signal flies in the mixed plantations at Ton Ya Plong Waterfall, Songkhla Province. The survey was conducted from May 2023–July 2023. Four line transects were set up, and two fruit-bait traps were used in each line transect. The specimens were preserved in 95% alcohol and identified to species level based on the external morphology of the mature flies. The data were analyzed and compared with the list of signal flies from previous reports at Ton Ya Plong Waterfall from November 2022–January 2023. The results showed that the signal fly species which were found in fruit-bait traps were *Scholastes cinctus* (Guérin, 1831) and *Valonia* sp. The study also indicated that *S. cinctus* (Guérin, 1831) was the dominant species, as it had a higher frequency of occurrence than *Valonia* sp.

Keywords: Diptera, southern Thailand, tropical forest, the frequency of the occurrence

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Oral Presentation
Session 11: *Utilization of Natural Resources*

Spider-Parasitic Fungi: The Diversity of Their Morphologies, Bioactive Compounds and Potential Applications

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Spider-parasitic (araneogenous) fungi are fungi occurring on spiders found in diverse habitats including the underside of leaves, tree trunks, or buried in the ground. Many of these fungi occur on juvenile spiders in the family Araneidae (orb spinners), Clubionidae (sac spider), Pholcidae (daddy long-legs), Salticidae (jumping spider), and Theridiidae (tangle web spiders or cobweb spiders). Most species are found in the Cordycipitaceae and are members of the genera *Akanthomyces*, *Beauveria*, *Cordyceps*, *Engyodontium*, *Gibellula*, *Hevansia*, *Jenniferia*, *Parahevansia*, *Polystromomyces*, and *Samsoniella*. Only few species are reported from the Ophiocordycipitaceae (*Ophiocordyceps*, *Hirsutella*, *Hymenostilbe*) and Clavicipitaceae (*Neoaraneomyces*, *Pseudometarhizium*).

Fungal pathogens of invertebrates are known to be prolific producers of structurally interesting molecules with many biological activities. Secondary metabolites have long been known to act as virulence factors in pathogenesis and are also used to cope with other competing microorganisms. This explains why many of the secondary metabolites of invertebrate-pathogenic fungi have capacities to inhibit the growth of a wide variety of microorganisms. For araneogenous fungi, only in the last decade was attention given to them and their metabolites. For example, *Hevansia novoguineensis* turned out to be a rich source of novel compounds including akanthols and akanthopyrones. *Gibellula* was reported to produce pigmentosins (in *G. pigmentosinum*) and gibellamins (in *G. gamsii*) that showed inhibition of the biofilm formation in *Staphylococcus aureus*.

Keywords: spider-parasitic fungi, secondary metabolites, taxonomy, diversity

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Potential Drylands Restoration: An Investigation of Biocrust Microbial Dynamics Changes after Water Activation

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Up to 40% of global terrestrial land surface consists of desert environments (dryland region, semi-arid, and arid lands). Desert ecosystems are sparsely covered with vegetation and any occurring vascular plants are normally found associated with important microbial communities in the plant interspaces called “biological soil crusts (biocrust)”. Moreover, biocrusts play an important role in soil stabilization for interspaces between plants. However, we have very limited knowledge about how water activation affects biocrust microbial communities and their metabolites. As a result, this project aims to explore the composition of microbial (archaea, bacteria, and fungi) communities using high throughput amplicon sequencing and capture the biocrust exometabolites profiles after biocrust water incubation using metabolomic technique. Two dominant crust types of biocrusts including Cyanobacteria lichen crust (CLC) and Light algal crust (LAC) were collected. Biocrust metabolites incubation solutions were collected at five different time points (3 minutes, 1 hour, 24 hours, 48 hours, and 96 hours) for metabolites profiling. Our results indicated that (i) after water incubation, microbial exometabolites in CLC were significantly different from LAC, (ii) similar to exometabolite, microbial composition is crust-type specific so that shared and unique signatures of microorganism were observed for each crust type, (iii) water activation and incubation time affect both biocrust microbial composition and exometabolites. However, this metabolite profile was different from previous reports from Moab, UT suggesting biocrust geographical differentiation. Understanding how microbes interact to form crust layers requires detailed accounting of their microbial diversity, community structure, and measurable functions. Deep understanding about water activation processes will provide insights into biocrust restoration and management in dryland ecosystems to prepare for future desertification.

Keywords: biocrust, dryland, restoration, microorganisms, water activation

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Microbial Resources: Bridging Discovery, Engineering, and Sustainable Applications

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Thailand owns a vast microbial biodiversity, which includes potent producers of versatile bioactive compounds. Research at the National Center for Genetic Engineering and Biotechnology (BIOTEC) is focused on the search for novel natural products from filamentous fungi, Actinomycetota bacteria, and Gram-negative bacteria. We employ a dereplication strategy combining genome mining with metabolomic-based molecular networking analysis. This approach enhances the traditional bioassay-guided discovery method, significantly accelerating natural product identification. Over the past twenty years, our endeavors have resulted in the discovery of over 800 natural products. Notably, strains prolific in producing known compounds have been licensed to the chemical company for various applications. A myriad of these bioactive compounds, both novel and known, are now undergoing evaluation and development for agricultural biocontrol and non-pharmaceutical applications. Exploring microbial genome data, biosynthetic gene clusters responsible for compound biosynthesis have been annotated. This information can be used to guide genetic engineering of microbes to improve the production of industrial compounds. These insights promise to unlock the expansive potential of microbial resources, catalyzing the innovation of products, processes, and services across a multitude of sectors.

Keywords: microbial biodiversity, bioactive compounds, genome mining, metabolomic analysis, industrial application

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Diversity, Ecology and Evolution of Entomopathogenic Fungi and Their Potential as Biopesticides and Biostimulants

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Entomopathogenic fungi are fungi that are pathogenic to insects/arthropods. There are more than 1,000 species of organisms from the phylum of Fungi but the widely used as biocontrol agents and/or biostimulants to plants are from the order Hypocreales (Sordariomycetes, Ascomycota). The diversity of this fungal group is underestimated as many cryptic species cannot be discovered with classical taxonomy. Their utilization is limited partly by fundamental knowledge of factors underlying the virulence and various potentials for using as biostimulants. In this talk, I will present our recent and on-going advances in the taxonomy of *Beauveria* and *Metarhizium* fungi, the two mostly predominant Hypocrealean genera of entomopathogenic fungi, as well as some insights gained from the knowledge of genomics.

Keywords. entomopathogenic fungi, taxonomy, genomics, virulence, evolution

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Evaluation of *Launaea sarmentosa* (Willd.) Sch. Bip. ex Kuntze Crude Extracts for Wound Healing Patch Development

Wanwisa Ramangthong[1], Nattapong Chanchula[2] and Pariya Na Nakorn[1*]

Antioxidant agents play a pivotal role in the treatment of diseases and wound healing. The biennial plant, *Launaea sarmentosa* (Willd.) Sch. Bip. ex Kuntze, from the Asteraceae, possesses essential phenolic compounds such as flavonoids and polyphenols. Historically, this plant has demonstrated significant healing properties for various wounds, including those caused by itching, infection, blisters, and conditions like herpes zoster. Given its potential therapeutic benefits, this study sought to evaluate the crude extracts of *L. sarmentosa* for their antioxidant, antibacterial, and anti-inflammatory properties. Leaves harvested during both rainy and summer seasons from Phuket Province, Thailand, were subjected to extraction using five solvents: hexane, ethyl acetate, ethanol, methanol, and distilled water. Total phenolics analysis indicated that the distilled water solvent yielded the highest concentrations, with values of 55.491 mg GAE/g and 95.740 mg GAE/g dry weight for the rainy and summer samples, respectively. Similarly, total flavonoid contents were highest in these extracts, with values of 205.566 mg QUE/g and 266.550 mg QUE/g dry weight. Antioxidant activities were evaluated using the DPPH scavenging test, with the methanol extracts displaying the most potent activity, possessing IC_{50} values of 0.050 mg/ml (rainy season) and 0.029 mg/ml (summer season). These results underscore the potential of *L. sarmentosa* as a key ingredient for the formulation of hydrogel wound healing patches.

Keywords. antioxidant, antibacterial, hydrogel patches, wound healing

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Poster Presentation

Color Enhancement of Gemstones with Nuclear Radiation Technology for the Addition of Value in the Gems and Jewelry Industry

Waratchanok Suwanmanee*

Nowadays, the irradiation technique is being interested and has become a more popular technique to improve the color of gemstones. Radiation could change the color of gemstones and produce intense color. As a result, gemstones become more beautiful in color, and it also increases the value of gemstones. In addition, Thailand has a specialized organization, the Thailand Institute of Nuclear Technology (public organization), with techniques and tools that can provide gemstone irradiation integrated services. It is well known that irradiation to increase the value can improve the color in some gemstones, for instance, topaz and tourmaline. There are three kinds of radiation that are commonly used to improve the color of gems, e.g., gamma rays, high energy electron radiation, and neutron radiation. Gemstone irradiation is still being continuously developed by researchers and some entrepreneurs to irradiate other gemstones, and to irradiate with other techniques (i.e., heat treatment). Development of irradiation techniques to create more beautiful colors of gemstone that are required for consumers of the gems and jewelry industry can greatly increase the value of the gems. Furthermore, it also helps to increase the potential of trade opportunities, and the ability to export more Thai gems and jewelry.

Keywords: color enhancement, irradiation, gemstones, gamma rays, high energy electron radiation, neutron radiation

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Cyatheaceae Study in Malaysian Borneo: Herbarium and Field Collections

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The Malesian archipelago is considered the main centre of diversity of scaly tree ferns in the Asian region, with many of the 250 species, out of 600 species worldwide, being single island endemics. Currently, the complex taxonomy of the tree ferns, fragmentary collections, inadequate descriptions, and special descriptive vocabulary all contribute to the poor taxonomic knowledge of this group. Many specimen identifications in herbaria are doubtful or erroneous, specifically in Malaysian Borneo: Sabah and Sarawak. A revision of Cyatheaceae in Malaysian Borneo is conducted, and still continuing. One of the aims of this study is to assess the species and analyse the distribution patterns of Cyatheaceae within Malaysian Borneo. In this study, herbarium specimens were referred, while the fresh living materials were collected and further provides the information of occurrence, as well as its cytology. The details of geographic distribution, species occurrences were digitised and mapped by using geographic information systems (GIS). The description (morphological and molecular) of novel lineages, from understudied geographic areas in this study, will contribute to cover some of the gaps present in botanical diversity knowledge.

Keywords: Borneo, distribution, diversity, endemic, tree ferns

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Nutrition and Antioxidant Activities of Some Edible Mushrooms, Genus *Russula* Extracts

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The objective of the study was to investigate the nutrition and antioxidant properties of *Russula adusta*, *Russula delica*, and *Russula emetica*, which were collected in local forests in Maha Sarakham Province. The nutrition was analyzed to determine moisture, fiber, protein, and fat. Antioxidant properties were determined by DPPH, ABTS, and FRAP assays. The results show the highest protein is in *Russula delica* (31.74%) followed by *Russula emetica* (27.44%) and *Russula adusta* (26.77%). Antioxidants of edible mushroom was shown in a higher value with IC_{50} in the DPPH assay with *Russula adusta* (5.79±0.21), ABTS assay is *Russula delica* (1.88±0.08), while the FRAP assay was presented in *Russula adusta* = 13.44±0.25 mg Fe/g extract.

Keywords: antioxidant, nutrition, edible mushroom

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Preliminary Study on Lichen Diversity at the Sakaerat Environmental Research Station

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Species diversity of lichens at the Sakaerat Environmental Research Station was investigated. The objective of the study was to survey and collect lichens on bark and rocks in the dry evergreen and dry dipterocarp forests at Sakaerat Environmental Research Station. The samples of lichens were random collected from habitat on the natural trail, about one kilometer in each forest type. All samples were identified to the species level by morphological, anatomical and lichen substances by using the HPTLC technique. A total of species in 17 taxa in 14 genera were found: *Chapsa indica* A. Massal, *Dirinaria picta* (Sw.) Clem. & Shear, *Dyplolabia afzelii* (Ach.) A. Massal, *Glyphis scyphulifera* (Ach.) Staiger, *Graphis* sp. 1, *Graphis* sp. 2, *Marcelaria benguelensis* (Müll. Arg.) Aptroot, Nelsen & Parnmen, *Nigrovothelium tropicum* (Ach.) Lücking, M.P. Nelsen & Aptroot, *Ocellularia* sp. 1, *Porina conspersa* Malme, *Porina mastoidea* Fée, *Porina* sp. 1, *Pyrenula aspistea* (Afzel. ex Ach.) Ach, *Pyxine cocoes* (Sw.) Nyl, *Stegobolus* sp. 1, *Thelotrema triseptatum* Mangold and *Trypethelium eluteriae* Spreng.

Keywords: diversity, lichen, Sakaerat

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Host Plants of Bark Beetle Species Occuring in Barangay Rogongon, Iligan City, Philippines: Insights to Understand Taxa (Coleoptera: Curculionidae: Scolytinae)

Kristyl Elaine S. Obguia* and Eddie P. Mondejar

The bark beetle is one of the most destructive insects affecting forest ecosystems. This study investigates the host plants of bark beetles in three sampling sites located in the agroecosystem at Sitio Lawlawon, Sikyop, in Barangay Rogongon, Iligan City, Mindanao, Philippines. Samples were collected weekly with a duration of two months, from August 2–October 2, 2023. The collection of samples was done using a bottle trap baited with vinegar and 95% ethyl alcohol. A total of 140 individuals of bark beetles were collected at three sampling sites. The relative abundance of bark beetles was found highest in sampling site 1 (a secondary forest) with 46.27%, followed by near Pagangon Falls (a secondary forest) with 32.37%, and in Kaylise (an agroecosystem) with 21.36%. The identified host plants were *Falcataria falcata*, *Ficus minahassae*, *Shorea negrosensis*, *Artcarpus blancoi*, *Ficus nota*, *Lagerstroemia speciosa*, *Trema orientalis*, and *Aglaia bathanica*. Moreover, *Xyleborus affinis* was the most abundant species, accounting for 39.28% of the study area. In addition, *F. falcata* was the most utilized host plant (28.57%) of bark beetles, and species distribution differs between sampling sites. The species *Xyleborus affinis* was associated with the agroecosystem, while *X. bispinatus*, *Cryphallus lipingesis*, *Ambrosiophilus atratus*, and *Cyclorhipidion superbum* in secondary forest. These results imply that vegetation plays a vital role in the distribution of bark beetles.

Keywords: bottle traps, diversity, *Falcataria falcata*, Pagangon Falls, vinegar

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Anatomy of *Succinea* (Pulmonata: Succineidae) from some locations of Thailand

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The snail genus *Succinea* from the three following locations were studied, including, Holy Basil Garden, Kanchanaburi Province; Lung Thong Garden, Nakhon Pathom Province; and Suan Chuen Lada Orchid, Chonburi Province. The outcomes of this study found penis sheath, penis of moderate length and without an appendix that are anatomical characters of *Succinea.* However, it requires more research on taxonomic indication.

Keywords: Succineidae, *Succinea*, taxonomy

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Crab Community under Habitats Changes due to Human Impact on Sandy and Rocky Beaches around Mu Ko Tao, Surat Thani Province

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Sandy and rocky beaches are important habitats for crabs, which are most likely utilized by humans. Characteristics of the crab community depend on shape of beaches, environmental factors, pollution, and habitat loss caused by human threats and climate change. The structure of crab community on sandy and rocky beaches of Ko Tao and Ko Nang Yuan, a total of 20 stations with different levels of human threats were studied. The species richness of crabs on sandy beaches were seven families, five genera, and eleven species while eight families, 14 genera, and 17 species of crabs were found on rocky beaches. Ao Chalok had the highest Shannon-diversity index on sandy and rocky beaches at 1.922 and 1.561, respectively due to its habitat diversity. It has been found that human threats affect the crab community on sandy beach especially the prevalence of ghost crab. The crab community in each station on rocky beaches were separately depending on characteristics of crab habitats.

Keywords: crab community, human impact, beach, Ko Tao, Gulf of Thailand

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Morphological Identity of three Rice-field Crabs Species in Northern Thailand

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The three species of rice-field crabs: *Esanthelphusa chiangmai* (Ng & Naiyanetr, 1993), *E. denchaii* (Naiyanetr, 1984) and *E. nani* (Naiyanetr, 1984) are endemic to the northern region of Thailand. In the present study, morphological characters of the three rice-field crab species are reviewed and compared. Three species are differentiated by the characters of male abdomen and the structures of male gonopods. The colour of living creatures varies according to their size and habitat. Variation of colour and habitat preferences are discussed to provide better understanding of the rice-field crabs taxonomy as well as to ascertain their ecological habitats and distribution.

Keywords: morphology, rice-field crab, *Esanthelphusa*, Northern of Thailand

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Study of Alien Ant Species (Hymenoptera: Formicidae) in the Western Forest Complex, Thailand

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Alien ant species were investigated in western forest complex from November 2021–July 2023. Pitfall traps were used to collected alien ant species from five protected areas (Khlong Lan National Park, Khlong Wang Chao National Park, Mae Wong National Park, Taksin Maharat National Park and Umphang Wildlife Sanctuary) and in three different kinds of habitats: guesthouse areas, nature trails, and natural forest areas. The alien ants were mostly found in guesthouse areas followed by nature trails and natural forest areas. Ten species of alien ant species were found including *Anoplolepis gracilipes* (Smith, 1857); *Monomorium floricola* (Jerdon, 1851); *Monomorium pharaonis* (Linnaeus, 1758); *Paratrechina longicornis* (Latreille, 1802); *Solenopsis geminata* (Fabricius, 1804); *Tapinoma melanocephalum* (Fabricius, 1793); *Technomyrmex albipes* (Smith, 1861); *Technomyrmex difficilis* (Forel, 1892); *Tetramorium kheperra* (Bolton, 1976); and *Trichomyrmex destructor* (Jerdon, 1851), and they colonized these forest ecosystems. The most dangerous ant was *A. gracilipes* that is an invasive alien species.

Keywords: alien species, national park, Western Forest Complex

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Rearing Method of *Sclerotia aquatilis* (Coleoptera, Lampyridae) in the Laboratory for Its Conservation Approach in Urban Ecosystems

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Due to the effect of urbanization factors and land use change on urban wetlands, this research focused on the rearing method of *Sclerotia aquatilis* for the conservation of their population. According to our observation during 2020–2023 in Central Thailand, i.e., wetlands in Bangkok and Samut Prakan, the habitats of this species are declining. For the conservation plan, the rearing method should be studied in order to prepare for the reintroduction of populations in urban ecosystems. *Sclerotia aquatilis* were collected from their natural habitats, i.e., ponds, wetlands, and ditches around Bangkok and Samut Prakan sampling sites. One female and three males were kept for reproduction in insect cages (7 × 7 × 10 cm, water depth 5–10 cm, total n = 16), and floating plants, i.e., *Lemna perpusilla* or *Salvinia cucullata*, were put inside the cages. After laying eggs, the eggs with plants were transferred to a glass aquarium (20 × 60 × 28 cm), where an oxygen pump, floating plants, soil, and early immature stages of golden apple snails (*Pomacea canaliculata*) and Ramshorn Snail (*Gyraulus* sp.) as prey were prepared. Based on this rearing system under laboratory conditions, *S. aquatilis* eggs, larvae, pupa, and adults required 10–14, 57–69, 12–14, and 14–20 days, respectively, for their developmental time at each stage, and their life cycle required approximately 93–117 days. From our preliminary rearing study, nine *S. aquatilis*' pupa successfully emerged to be adults, i.e., six males and three females from 95 first instars, and these adults were fertile. This rearing system study was supported by Magnolia Quality Development Corporation Limited (MQDC) through the Firefly Conservation for Sustainable Ecosystem Management Indicator Project (R000026588).

Keywords: *Sclerotia aquatilis*, rearing method, conservation, firefly, urban ecosystems

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Species Diversity of *Pachyrhynchini weevils* (Coleoptera: Curculionidae: Entiminae) in Selected Areas of Northern and Western Mindanao, Philippines

Princess Mae Ebal* and Eddie Mondejar

Pachyrhynchini weevils are one of the most distinct and well-known beetle taxa due to their intricate and stunning iridescent markings. However, some are considered pests. Hence, assessment of this understudied taxa is very important. Field sampling was conducted 22 June–2 July 2022 at Claveria and Gingoog City (Misamis Oriental Province), 14–25 November 2022 at Mt. Tuminungan (Bukidnon Province), and 12–23 April 2022 and 7–20 December 2022 at Mt. Gutom (Zamboanga del Norte Province). An opportunistic sampling was employed to sample weevils in different sampling sites, with an elevation ranging from 1,000–1,300 masl (Claveria and Gingoog), 1,500–1,800 masl (Mt. Tuminungan), and 600–850 masl (Mt. Gutom). A total of 61 species including morphospecies was recorded, with a total of 680 individuals in three study areas. In addition, the genus *Metapocyrtus* was the most recorded in all sampling sites, with 41 species (R.A = 67.21%). Species relative abundance was found highest in the secondary forest of Mt. Gutom and in Claveria, with 48.12% and 47.41%, respectively; and the lowest was in the agroecosystem near the buffer zone of Mt. Tuminungan, with 43.243%. Moreover, eight vulnerable species were also documented in the sampling sites. This includes: *Pachyrhynchus erichsoni*, *P. corpulentus*, *P. speciosus*, *P. sulphureomaculatus*, *Metapocyrtus* (*Metapocyrtus*) *lindabonus*, *M. (Metapocyrtus) elegans*, *M.* (*Trachycyrtus*) *smaragdinus,* and *M.* (*Trachycyrtus*) *apoensis.* In addition, one Philippine endemic species was recorded, *M.* (*Trachycyrtus*) *adspersus.* Despite several threats in the study areas, a high species richness and abundance of *Pachyrhynchini weevils* was still recorded. Thus, immediate action is needed to mitigate the impact of anthropogenic activities in undisturbed areas.

Keywords: anthropogenic, endemic, Mt. Gutom, *Metapocyrtus*, vulnerable

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Direct Chromosomal Preparation Technique from Southeast Asia Tarantula (Araneae, Theraphosidae)

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Theraphosidae Thorell, 1869, is the most prevalent family within the infraorder Mygalomorpae. However, there is a lack of knowledge regarding their cytogenetics, and the chromosomes of old-world tarantulas have not been thoroughly studied. The objective of this study was to provide a streamlined procedure for the harvesting of chromosomal samples from tarantulas. This involved directly collecting chromosomes from the internal organs of spiders after subjecting them to *in vivo* colchicine treatment. This study demonstrates the efficacy of the technique in the successful production of chromosomes from three genera of Southeast Asian tarantulas. The employed methodology demonstrates efficacy in the extraction of chromosomes from both subfamilies of tarantulas which include Selenocosminae Simon, 1889 and Ornithoctoninae Pocock, 1895. The methodology employed demonstrates efficacy in extracting chromosomes from both subfamilies of tarantulas, including Selenocosminae Simon, 1889, and Ornithoctoninae Pocock, 1895. The data obtained indicate that Southeast Asian tarantulas likely possess bi-armed chromosomes and a high diploid number (2n). It is noteworthy that this study will contribute to advancing our understanding of cytogenetics in tarantulas. The application of this approach can contribute to more insight into the evolutionary processes in tarantulas.

Keywords: chromosome, Selenocosminae, Ornithoctoninae, old-world tarantulas

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Species Diversity of Butterflies in Wang Takrai Park, Central Thailand

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Species diversity of butterflies at Wang Takrai Park, Nakhon Nayok Province was investigated. A kilometer of line transects were set in several habitats of the park. Field surveys were done three times in the cold season (November 2022), hot season (March 2023), and rainy season (July 2023). A total of 142 butterfly species, 93 genera in five families (Hesperiidae, Lycaenidae, Nymphalidae, Papilionidae, and Pieridae) were found at Wang Takrai Park. The highest number of genera and species was found in the family Nymphalidae (32 genera 58 species, 40.56% of all species found in this study) and the lowest number of genera and species was found in family Pailionidae (six genera 13 species, 9.09%). The species abundance can be divided into three groups: 1) very common contains 104 species (72.73%); 2) common, 26 species (18.18%); and 3) rare, 13 species (9.09%). A protected species, *Troides helena* (Linnaeus, 1758) under the Wild Animal Conservation and Protection act, B.E. 2562 (2019) and an alien species, *Acraea terpsicore* (Linnaeus, 1758) were found in the park. Data Information on the diversity of butterflies obtained in this study will be used as basic information in the management program of butterfly conservation at Wang Takrai Park. It will also be of importance to use the data of butterflies' diversity and their life cycles to provide academic teaching and use it as an important tool for ecotourism programs.

Keywords: butterfly, species diversity, Wang Takrai Park

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Fishes and Fisheries in the Flood Plain of the Mun-Chi Sub-basin

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The Lower Mekong Basin (LMB) is the most extensive region of aquatic environment to support the highest biodiversity of fishes in the tropical Asian country. The total number of species in this region is 800–1,200 species, and the total annual wild caught fisheries including aquaculture approaches three million tons.

The Mun-Chi watershed is the largest sub-basin of the LMB. 300 fish species have been reported belonging to intensive observation field surveys, where it is significant to the region in the relation between various types of fish natural habituation with the human land use, such as agricultures factories, including urban sites. The lower part of The Mun-Chi Sub-basin in Sisaket and Ubon Ratchathani Provinces, northeastern Thailand are significant alluvial flood plains in the middle part of LMB. This place has the most biological richness and is typically supported by the most productive inland fisheries, strongly related to the supply chain of the regional economy.

This is preliminary report found distribution patterns of the threaten economic species group clariid catfishes significantly abundant in the lower part of the Mun-Chi Sub-basin, which included species composition of fish in this region separately divided two main groups for regional flood plain and short distance migration species.

Keywords: fishes, fisheries, flood plain, lower Mun-Chi Sub-basin, Thailand

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The First Preliminary Observational Field Survey on the Diversity and Ecology of Fishes in the Ma Basin, Laos PDR

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The Mekong Basin is 90% watershed area consisting of 183,000 km^2 with other two basins, Ma and Ka sharing 10% watershed area consisting of 13,000 km^2 expanded in Houaphan and Xieng Khuang Provinces in northeast. The Ma River Basin is the transboundary basin shared between 35% in Laos PDR and 65% in Vietnam. The elevation above sea level is between 125–336 meters. There are three seasons of the year which are summer, rainy and winter, with temperatures varying from 21.61 °C and -3.78 °C and precipitation of 112.81 mm. The first preliminary observational field survey on the diversity and ecology of fishes in Ma Basin in Laos PDR conducted six sampling sites in the area of confluence between Ma River and its tributary Ed River, during the rainy season from 28–31 May 2023 at Ed District, Houaphanh Province. The sampling method used were mainly experimental gillnet surveys (GNS) for biological parameters which included participation with local fishing methods to include independent data. Samples were taken in six sampling sites: four sampling sites on the Ed River (tributary sites), and two sampling sites on the Ma River (mainstream sites). Five orders, 13 families, and 28 fish species were found. Twenty-three species are endemic to this river, three species are exotic species, and two species are shared with the Mekong fish fauna of Laos PDR.

Keywords. diversity, ecology, fishes, Ma Basin, Laos PDR

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Bat Species Diversity in Wangtakrai Park, Nakhon Nayok Province

Dome Pratumthong* and Amonpong Khlaipet

The study on diversity of bats in Wang Takrai Park, Nakhon Nayok Province was conducted by using bat traps and a bat detector during November 2022–July 2023. Through 20 trap nights, a total of 13 species in nine genera and five families were found, predominantly Pteropodidae (five species: *Rousettus leschenaultia*, *Eonycteris spelaea*, *Pteropus lylei*, *Cynopterus brachyotis*, and *Cynopterus sphinx*), Vespertilionidae (three species: *Tylonycteris pachypus*, *Scotophilus kuhlii*, and *Pipistrellus javanicus*); Rhinolophidae (three species: *Rhinolophus affinis*, *Rhinolophus shameli* and *Rhinolophus malayanus*); Hipposideridae (*Hipposideros larvatus*) and Emballonuridae (*Taphozous melanopogon*).

Keywords: diversity, bat, Wang Takrai Park

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Genetic Diversity of Captive Serows in Phang-Nga Wildlife Breeding Center

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Serow, *Capricornis sumatraensis*, a species of wildlife in the Bovidae Family and one of nineteen conserved animals according to Wild Animal Conservation and Protection Act, B.E. 2562 (2019). Due to population decrease, the Department of National Parks, Wildlife and Plant Conservation have contributed through population restoration programs, increasing the serow population in Phang-nga Wildlife Breeding Center and released them into the wild annually. However, a lack of breeding program and limited initial numbers of serows in captivity, genetic diversity, and especially the inbreeding level of these captive serows were of concern. To assess genetic diversity, twelve microsatellite markers, one of the powerful molecular techniques, were applied to 22 blood samples of captive serows in Phang-nga Wildlife Breeding Center. According to the study, the average number of alleles (N_a) was 4.08 which ranged from 2–7 alleles per locus. The observed (H_o) and expected (H_e) heterozygosity were 0.5104 and 0.5162, respectively. From these results, the serow population in Phang-nga Wildlife Breeding Center tended to show low genetic diversity. In conclusion, these results provided useful knowledge of the genetic diversity of captive serows, which will be very useful for the breeding management of wildlife.

Keywords: genetic diversity, serow, Phang-nga Wildlife Breeding Center

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Hematologic Reference Interval of Captive Serows in Phang-nga Wildlife Breeding Center

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Serow, *Capricornis sumatraensis*, is one of nineteen conserved animals according to the Wild Animal Conservation and Protection Act, B.E. 2562 (2019). Department of National Parks, Wildlife and Plant Conservation contributed to population restoration programs by breeding captive serows in Phang-nga Wildlife Breeding Center and releasing them annually. A health assessment is essential to ensure that the freed serows are in good health before the captive serows are reintroduced. Although hematologic reference range data of serows are needed to diagnose the health of serows, those data are still lacking. In this study, hematologic reference intervals were conducted in 23 blood samples of captive adult serows (> 2 years old) in Phang-nga Wildlife Breeding Center. An Automated Hematology Analyzer was applied to generate and analyze hematologic parameter data. The result showed the average range of each hematology parameter as follows: Hemoglobin = 11.717 g/dl, PCV = 29.83%, RCB = 12.742 x10^6/ul, MCH = 8.635 pg/dl, MCV = 26.643 fL, MCHC = 33.557 g/dl, WBC = 5.037 x 10^3/ul, Neutrophils = 56.552%, Lymphocytes = 35.635%, Monocytes = 3.739%, Eosinophils = 3.626%, RDW-CV = 3.878% and PLT = 243.869 x 10^3/ul. In conclusion, these hematologic reference interval data of serows were established. This data are necessary for health assessments including health examinations, diagnosis, and prognosis of serows.

Keywords. hematologic reference interval, captive serows, Phang-nga Wildlife Breeding Center

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Species with Data-Deficient Status: The Survey of Herpetological Collection at Natural History Museum of Thailand

Pattarapon Promnun[1,2*], Kanokporn Panpong[3], Parinya Pawangkhanant[4], Veera Vilasri[1] and Jenjit Khudamrongsawat[3]

As part of Thailand's National Science Museum (NSM), the Natural History Museum has played a vital role in preserving a diverse range of herpetofauna specimens sourced from within the country and nearby areas. These specimens stand as invaluable resources for both research and educational purposes. The taxonomy of these species has been updated in accordance with references from the American Museum of Natural History and the Reptile Database. These revised scientific names have subsequently been employed in the evaluation of the conservation status of these species on the IUCN Red List. Our findings have unveiled a substantial number of species within the collection that currently hold an IUCN status of "data-deficient" (DD). Specifically, this category encompasses seven amphibian species and 23 reptile species. Notably, among these species, three reptiles, *Cyrtodactylus variegatus* (Blyth, 1859), *Varanus dumerilii* Schlegel, 1839 and *Varanus rudicollis* (Gray, 1845) are listed as protected under the Wild Animal Preservation and Protection Act (WARPA), B.E. 2535 (1992) (amended to B.E. 2562 [2019]). Despite their protected status, these creatures remain inadequately studied, presenting a significant challenge to conservation efforts.

Keywords: conservation, data-deficient, herpetofauna, museum collection, Thailand

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Ichthyological Collection of the Kagoshima University Museum: Establishment, Development, and Utilization

Hiroyuki Motomura*

The Ichthyological collection was established in 2006 at the Kagoshima University Museum (KAUM), located in southern Kyushu, Japan. About 10,000 fish specimens were transferred to KAUM from Faculty of Fisheries, Kagoshima University in 2006. Subsequently, we have collected fishes mainly from southern Japan and Southeast Asian countries and more recently we received about 60,000 fish specimens from the University of Miyazaki, Japan, resulting in a rapid growth of the collection. We now have in excess of 250,000 specimens, including 1,100 type specimens, representing 5,600 species. Most specimens were photographed before preservation and tissue samples for DNA analysis were taken from recently collected specimens. Thus, in addition to the voucher specimens, 250,000 color photographs and tissue samples of 82,000 specimens are deposited at KAUM. The scale of the combined voucher specimens, tissue samples, and photographs is one of largest ichthyological collections in Asia. About 5,000 specimens, tissue samples, and/or photographs have been sent to domestic and international institutions for their research every year. Based on specimens at KAUM, 1,000 scientific articles, including descriptions of 180 new species and proposing 160 new standard Japanese names, and 100 semi-popular and technical books were published. Recently, a new major biogeographical boundary line, the Osumi Line, for fishes in southern Japan was discovered from examination and analysis of the specimens deposited mainly at KAUM. In addition to research on fishes, the specimens have been used in museum events and education, including exhibitions, hands-on learning, and curator training. KAUM has also provided many kinds of local fish posters (usually A1 size) to each local area, including remote islands in Kagoshima. This presentation will introduce our collection management procedures and the extensive utilization of the collection.

Keywords: Ichthyology, fishes, specimens, taxonomy, biogeography

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Potential Use of Insect Frass as a Fertilizer: Impact on Germination and Growth of Chili pepper (*Capsicum frutescens*)

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Contemporary agriculture heavily depends on expensive and environmentally detrimental synthetic fertilizers, contributing to soil degradation and reduced crop yields. Our research focuses on exploring the utilization of insect-derived frass, sourced from mealworms, silkworms, crickets, and sago beetles in Thailand, to enhance chili seed growth and germination. The study design included five treatment groups, each with ten replicates, alongside a control group. Results indicate that sago beetle frass exhibited the highest seed germination rate at 97.2%, closely followed by silkworm and cricket frass, with germination rates of 95.6% and 94%, respectively. Additionally, assessments of root length revealed that cricket, silkworm, and sago beetle frass yielded average root lengths of 9.78 cm, 9.06 cm, and 8.72 cm, respectively. Notably, cricket and sago beetle frass showed the broadest roots, measuring 0.77 cm and 0.72 cm. These outcomes emphasize the significant potential of insect frass as a well-established, research-supported alternative to synthetic fertilizers. This opens up promising pathways to not only enhance crop productivity but also to advance agricultural sustainability and environmental well-being.

Keywords: fertilizer, yield, insect, germination rates, seed germination

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Recycling Spent Mushroom Substrate into Animal Feed via Black Soldier Fly Larvae

Aroonsiri Khuanlay, Pornpawee Truatnok and Papitchaya Teawkul*

Spent mushroom substrate, a byproduct of mushroom harvesting, was investigated for its suitability as a feed source for black soldier fly larvae. Our study examined three types of edible fungi substrates, both fermented and non-fermented, cultivated in Khon kaen Province, Thailand. Our findings revealed the robust thriving of young larvae when exposed to all fermented mushroom substrate variations. However, when subjected to unfermented mushroom substrate, larvae experienced a significant weight reduction, surpassing 50%. Moreover, middle-aged larvae fed on both a conventional control diet and fermented substrate exhibited notable increases in size compared to their counterparts consuming diets enriched with desiccated spent substrate. Importantly, larvae fed with unfermented spent mushroom substrate encountered delayed development and failed to progress to the pupal stage.

Collectively, these empirical results underscore the substantial potential inherent in spent substrate, positioning it as a credible candidate for partial substitution within the realm of conventional black soldier fly feed. This not only underscores the ecological advantages but also underscores the circular economy potential, wherein spent mushroom substrate waste may be judiciously repurposed as a valuable resource in the form of insect feed material.

Keywords: animal feed, black soldier fly, fermentation, mushroom, Khon kaen Province

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Antibacterial and Anti-inflammatory Properties of Crude Extracts from White and Yellow Chrysanthemums

Yayoi Shindo[1], Nattapong Chanchula[2], Worawat Surarit[1] and Pariya Na Nakorn[1*]

Herbal medicines have historically been pivotal in health care, offering therapeutic benefits without the risks associated with synthetic chemicals. This study focused on the characterization of white and yellow chrysanthemum extracts derived from leaves, flowers, and branches using ethanol, methanol, and hexane as solvents. Yellow chrysanthemum leaf extracts, when extracted with methanol, displayed the highest yield (11.73%) and the highest concentrations of flavonoids and phenolic compounds (43.354±0.005 mg GAE/g and 132.882±0.001 mg GAE/g dry weight, respectively). Furthermore, this extract exhibited potent antioxidant activity, as indicated by a DPPH IC_{50} value of 0.078 mg/mL. Antibacterial analysis revealed MIC of 4 mg/mL against both *Escherichia coli* and *Staphylococcus aureus*, with MBC values of 32 mg/mL and 16 mg/mL, respectively. Anti-inflammatory assessments showed that the yellow chrysanthemum leaf methanol extract inhibited nitric oxide production in LPS-stimulated RAW 264.7 macrophages with an IC_{50} of 25.972±1.186 mg/mL. Importantly, none of the extracts demonstrated cytotoxicity, highlighting their potential for pharmaceutical applications.

Keywords: chrysanthemum extract, antioxidant activity, antibacterial activity, anti-inflammatory

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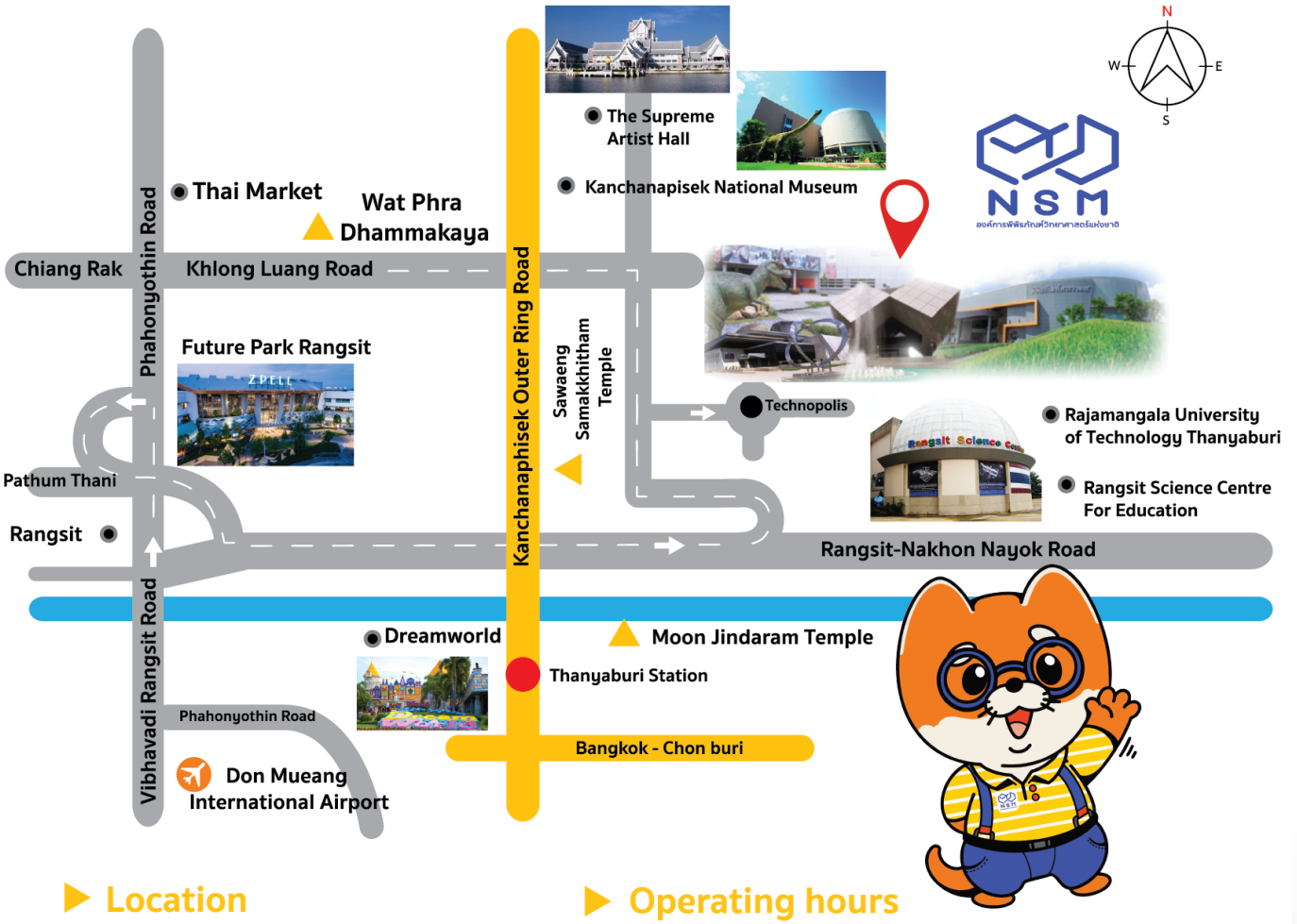
Maps



Location

39 Moo 3, Technopolis, Khlong 5,
Khlong Luang, Pathum Thani 12120

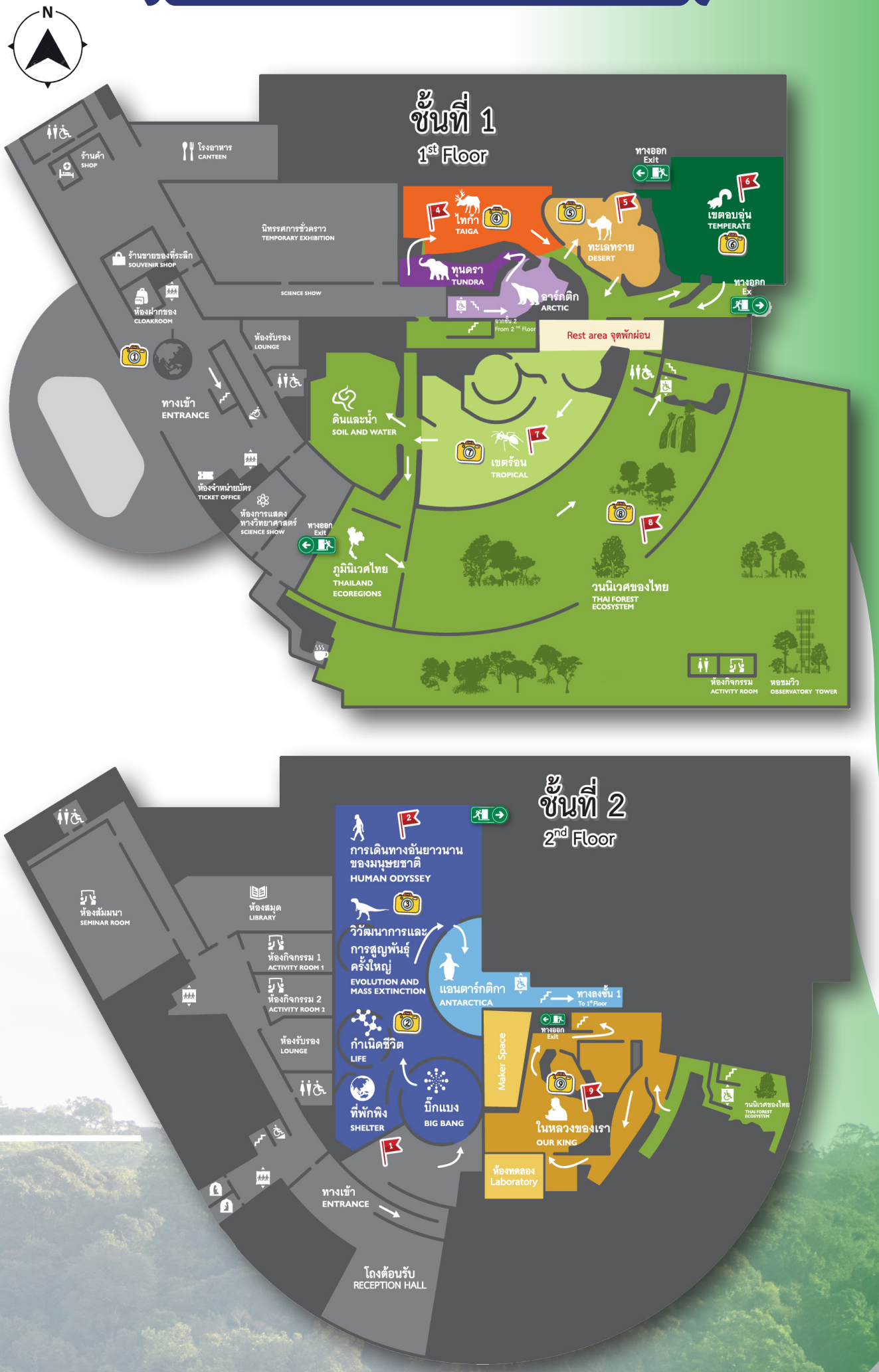
Operating hours

Tuesday – Friday: 09.30 – 16.00 hrs.

Saturday – Sunday and holidays: 09.30 – 17.00 hrs.

Closed on Monday

Guide Map of Rama 9 Museum



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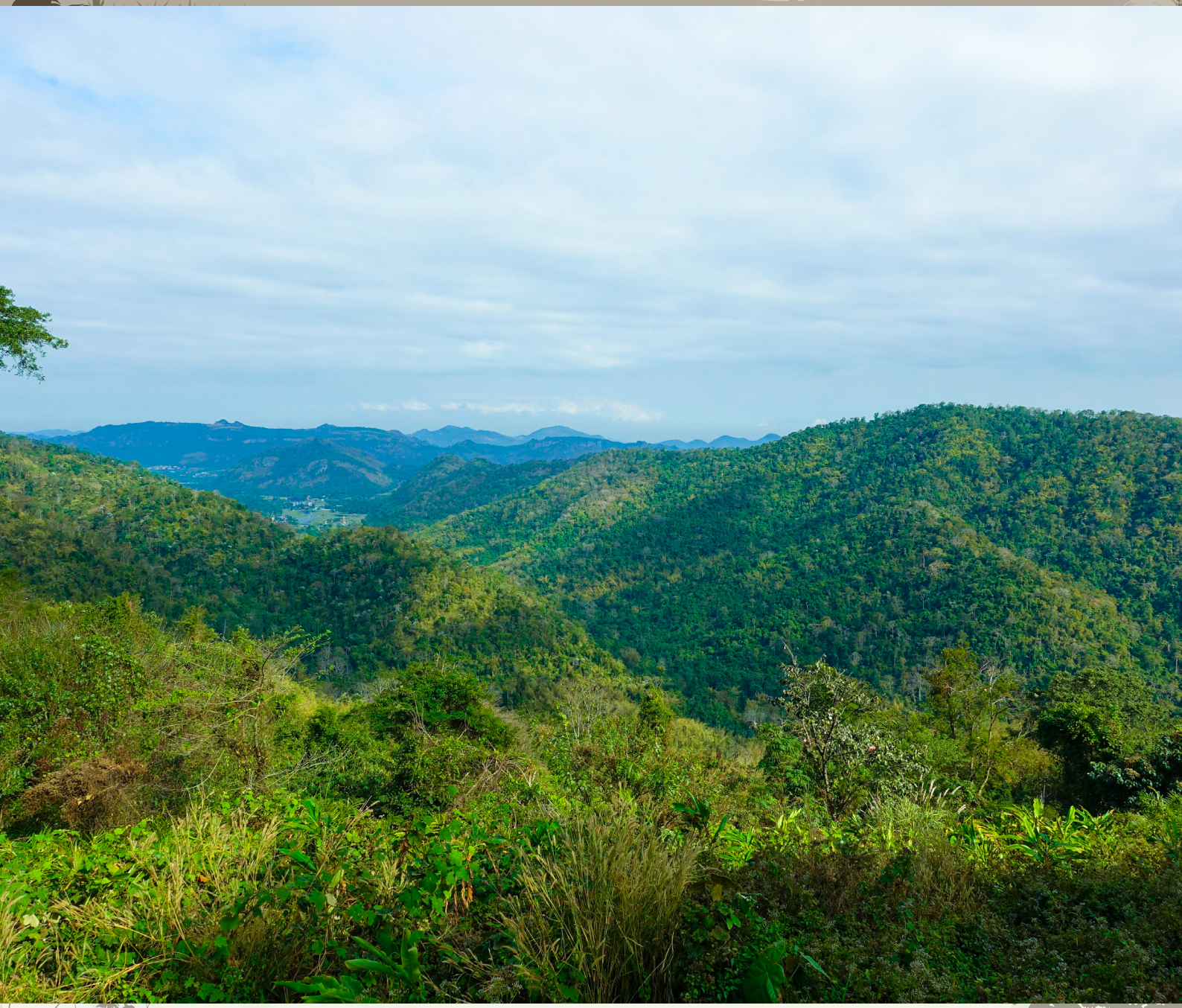

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