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Thailand Spider Data Retrieval System for geographical occurrence and pictorial identification

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Abstract

Background

Data of Thai spiders were extracted from the World Spider Catalog. The geographical occurrence data of spider species in Thailand and pictures of species were compiled. It was based on the internet platform “spiderthailand.info” which allows professional arachnologists and amateur spider lovers to visit for checking geographical distribution of spiders and to quickly access pictures for comparative pictorial identification.

New information

The picture dataset contributed a pictorial identification tool for spiders in Thailand. The online platform facilitated quick comparison between voucher specimens identifying and the online pictures. It filled the gap of taking time to check paper by paper after long searching for possible species of Thai spiders from any possible paper pool. Geographical occurrences of Thai spiders were 1419 records belonging to 670 species of 228 genera and 50 families. Among those, 461 species from 133 genera of 41 familie distributed only in Thailand. Around the country of Thailand, 756 geographical positions were reported for spider occurrence. From 76 provinces and one additional special administrative area (Bangkok), 58 provinces showed occurrence records of spiders and 18 provinces showed nonoccurrence records. Those provinces of nonoccurrence records of spiders were Amnat Charoen, Ang Thong, Bueng Kan, Chai Nat, Maha Sarakham, Mukdahan, Nakhon Phanom, Nong Bua Lam Phu, Nonthaburi, Phayao, Phichit, Phra Nakhon Si Ayutthaya,

Samut Prakan, Samut Sakhon, Si Sa Ket, Sing Buri, Uthai Thani, and Yasothon. Most spiders were reported from Chiang Mai province.

Keywords

Arthropod, Arachnid, website, online platform, spider distribution, lists of species, Southeast Asia

Introduction

Spiders are a group of animals which is highly diverse in several aspects among terrestrial invertebrates (Coddington and Levi 1991, Kotze et al. 2022). They are a prominent predator among invertebrate communities with a large number of species, more than 50,000 species in the world at present and with an enormous quantity of individuals (De Smedt et al. 2019, Agnarsson 2023, World Spider Catalog 2023). They mainly consume insects which have various roles including herbivores, carnivores, detritivores (Sunderland 1999, Radermacher et al. 2020). Moreover, as they are foraged by vertebrates such as birds and lizards (Spiller and Schoener 1998, Gunnarsson 2007), they are important in ecosystems for nutritional linkage between invertebrates and vertebrates. They live in almost all types of habitats ranging from man-made environments to pristine forest or even from dry habitats to riparian zones (Marc et al. 1999, Graham et al. 2003, Buddle et al. 2004, Pearce et al. 2004, Petcharad et al. 2016, Laborda et al. 2018, Lubin et al. 2020, Szinetár et al. 2020). They have various types of silk threads which possess different properties (Blackledge 2012, Römer and Scheibel 2014, Wolff et al. 2017, Greco et al. 2020). Among their diversity within the group, some characteristics are common while others are very unique (Pekár et al. 2012, Jackson and Cross 2015, Mammola et al. 2017, Kuntner and Agnarsson 2018, Goté et al. 2019, Chamberland et al. 2022, Propistsova et al. 2023). Thus, they are a group of organisms which affects all levels of diversity including genetics, species, and ecosystems. They are very interesting for understanding evolution and using them and their web as an animal model-inspired innovation (Seymour and Hetz 2011, Miniaci et al. 2016, Blamires et al. 2017, Alfaro et al. 2018, Blamires et al. 2019, Wolff et al. 2019, Craig et al. 2020, Su and Buehler 2020, Belbéoch et al. 2021, Li et al. 2021, Ng et al. 2021, Su et al. 2021). Thailand is situated in a biodiversity hotspot where several groups of organisms are of high species richness. However, a spider group has been ignored to study and survey causing their slow growth of taxonomic databases in comparison to other groups like plants, mammals, birds, reptiles, amphibians, butterflies, ants, beetles, snails in Thailand (Tovaranonte et al. 2013, Tantipisanuh and Gale 2018, Trisurat et al. 2019, Singh et al. 2021, Pomoim et al. 2022). For a spider group in Thailand, a small taxonomic data set among their diverse appearance is a big gap of difficulty to build an identification key of Thai spiders. Such lack of the identification key causes the difficulty of spider study and obstruction of Thai spider database growing. Tools for identifying organisms such as dichotomous keys are accurate and useful in case of constructing such keys based on a complete database of each taxon from a specific area. Otherwise the dichotomous keys are risky to provide a wrong result after identifying.

However, as a reflection of going forward and backward, dichotomous keys can be done after reaching a complete database whereas obtaining a complete database is supported by a part of dichotomous keys or certain identification tools. For Thai spiders, it has been a challenge to identify them even at genus level because of few identification keys and it seems far a way to have a complete database for obtaining such keys. World Spider Catalog (2023) is a website of spiders that allows users to visit and identify spider specimens from world list species. The identification protocol to indicate species is to check family, genus, and species from a large amount of literature and all taxa at global scale, checking paper by paper and comparing each picture from those papers with a specimen being identified under a microscope. Consequently, it is time consuming for spider identification even experienced arachnologists. To fill this gap, literature of Thai spiders was extracted from the World Spider Catalog (2023) and pictures of Thai species were compiled in this study to facilitate any users who would like to identify spiders by comparing voucher specimens with spider pictures from taxonomic literature. A pictorial identification tool via an online platform was served to identify Thai spiders. Geographical occurrences of spider data were uploaded in the platform for not only supporting identification but also helping further study and collection plan decisions. The website “Spiderthailand.info” was deployed as an online platform with non-commercial purpose. Hopefully, this website will contribute to the growth of academic knowledge in arachnology, especially in Thailand.

Project description

Study area description: Our study aims to aggregate occurrences of spider in Thailand that were mainly reported in scientific resources.

Data resources and integrations: In the first step, the daily updated csv file storing worldwide spider records was downloaded from World Spider Catalog: WSC (https://wsc.nmbe.ch/dataresources) on September 9th, 2020 which contains spiders’ information almost 50,000 species (World Spider Catalog 2020). Then, data stored in a “distribution” field were filtered using some specific keywords related to spiders found in Thailand. Those keywords are as follows: Thailand, Asia and Pacific islands, Tropical Asia, Temperate Asia, Southeast Asia, Asia, as well as some countries such as China, Nepal, India, Myanmar, Laos, Vietnam, Malaysia (peninsula), and Indonesia (Bali, Java). All records associated with these keywords were pulled, and data in some related fields, i.e. species, genus, family, author, and year, were focused in order to prepare a Thailand spider list. In the second step, each spider information in the Thailand spider list was used as keywords for retrieving additional information from various data resources including articles in academic journals and websites. These data from such documents were not only manually skimmed and verified by us, but also roughly gathered for our manual verification with the help of Artificial Intelligence (AI) technology tools like SciSpace (https://typeset.io) and ChatDox (https://www.chatdox.com) to speed-up spider data integration process. After finishing this step, Thailand spider data table in the form of an excel file storing spider species appearances in Thailand as the following properties: author, publish year, province, district,

locality, location, latitude, longitude, altitude (if any), sampling method (if any), habitat (if any), microhabitat (if any), and designate (if any). Finally, a python code blocks were created in Google's Colaboratory tool to convert this excel file into a json file as the NoSQL (Not Only SQL) database file ready for developing our website to display information about species of spiders found in Thailand including a Thailand's province and district map.

Design description: The infrastructure of spiderthailand.info is based on a MongoDB database which is a NoSQL database. It does not use the traditional relational database model. But, MongoDB stores data in documents similar to JSON objects. By this way, it makes MongoDB very flexible and scalable, because documents can contain any type of data and can be nested to any depth. The website of spiderthailand.info does not provide standardized APIs. Instead, it offers a web application written in JavaScript language using NextJs for experts' data submission and a web portal for everyone's read-only data public access. Additionally, the website of spiderthailand.info contains geospatial features. This allows us to not only query each spider species, i.e. based on their names in Thailand but also search a specific district or province for spatial data visualization.

Funding: This work was supported by the Thailand Science Research and Innovation Fundamental Fund fiscal year 2023.

Web location (URIs)

Homepage: https://spiderthailand.info

Technical specification

Programming language: Back-end programming language: Go

Operational system: Linux

Interface language: Front-end platform: NextJs (JavaScript)

Service endpoint: https://spiderthailand.info

Repository

Type: Git

Browse URI: https://github.com/tuscb/spider-th-public

Usage licence

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Implementation

Implements specification

Data attribute description:

Each spider species' occurrence information was stored in one record. Explanation of every stored data field, type, and description is shown in Table 1. In addition, one record gathering data of one spider in its fields is depicted in Fig. 1 as an example.

Audience

Two main purposes of this study are to gather data of Thai spiders from literature and to present the data via an online platform in order to serve as a pictorial identification tool and geographical occurrence in Thailand. Main target groups of this online platform are students and researchers.

Additional information

Usage description:

Users can always see the current total numbers of spider species found in Thailand on the main page (Fig. 2). The database of spiderthailand.info will be regularly updated by registered experts and annually main updated by the system maintainer. There is a register page for only sign-in accounts to fill-in new data (Fig. 3). In the FEATURE TOUR section of the main page, spiders and places can be searched by three main features. First, 'Search in Map' feature allows users to select a province and the district to find out if there exists any spider species that have been reported. The list of records as well as geographical locations on the map are shown, and each spider record's details including pictures can be viewed after clicking 'SEE MORE' as illustrated in Fig. 4. These pictures were provided for easy comparison with voucher specimens. Second, 'Filter' feature was provided for users to find each spider record via selecting family, genus, and species as an example in Fig. 5. Third, occurrences of spiders in Thailand according to their family name were also summarized in the 'Family Lists' feature. Each family can be explored by clicking 'Species' (Fig. 2).

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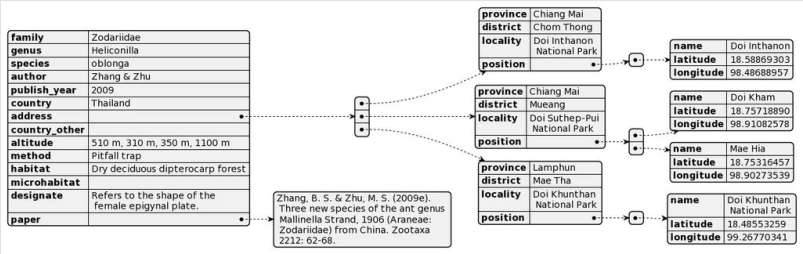

Figure 1.

Example of one spider species, *Heliconilla oblonga*, and its data stored in the spiderthailand.info database. Diagramn was created by using https://plantuml.com.

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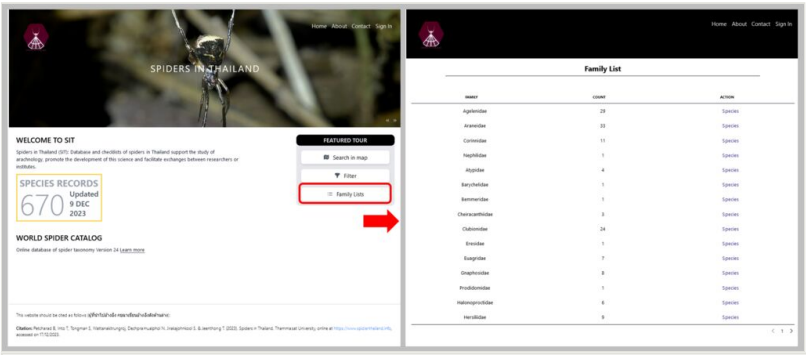

Figure 2.

Front page of https://spiderthailand.info (on the left) and family list page (on the right).

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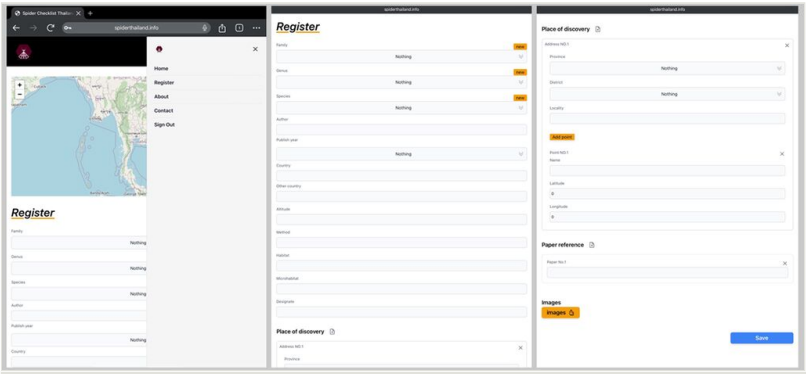

Figure 3.

Register page accessed by an expert member from a browser of mobile device in order to submit new updated data.

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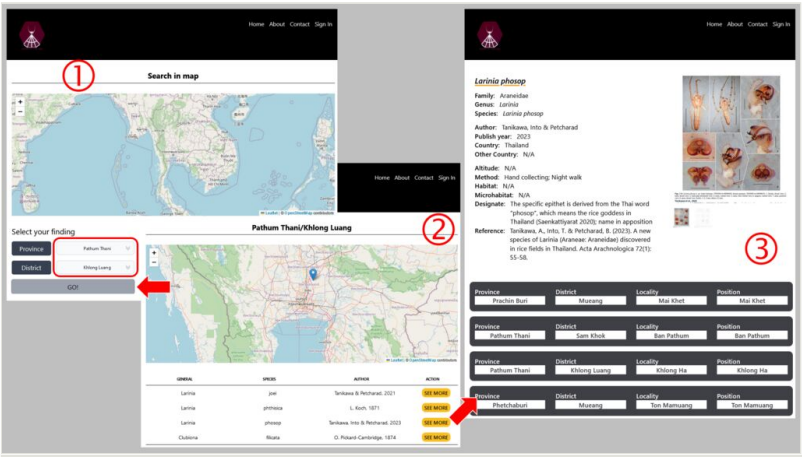

Figure 4.

An example of querying spider's data in Thailand by choosing a province and a district.

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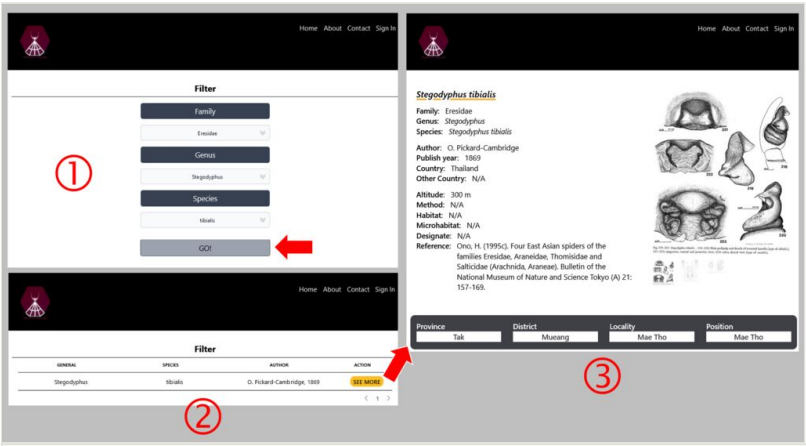

Figure 5.

An example of querying spider's data in Thailand by indicating spider's taxonomic information such as family, genus, and species, respectively.

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Table 1.

Field properies to store one data record.

Field Name	Data Type	Description
_id	object Id	ID of the Spider.
spider_uuid	string	Unique ID of the spider.
family	string	Family of the spider.
genus	string	Genus of the spider.
species	string	Name of the spider.
author	string	Author of publications who firstly discovered the species.
publish_year	string	Year of publications about the species for the first time.
country	string	Thailand, as the first country to report spider's occurrences.
country_other	string	Other countries reported spider's occurrences.
altitude	string	The vertical distance of spider's occurrences reported.
method	string	Procedure of spider's occurrences reported.
habitat	string	Living areas of spider's occurrences reported.
microhabitat	string	Sub-living areas of spider's occurrences reported.
designate	string	Origin of spider's species name?
status	string	State of data completion?
address[]	array of object	Nested data array stored area positions and names of spider's occurrences reported.
address[].province	string	Province Name.
address[].district	string	District Name.
address[].locality	string	Location name of spider's occurrences reported.
address[].position[]	array of object	Position of spider's occurrences reported.
address[].position[].name	string	Name of each position.
address[].position[].latitude	float64	Latitude of a position.
address[].position[].longitude	float64	Longitude of a position.
image_file[]	array of string	Image file names.
paper[]	array of string	References to papers related to the Occurrences.
create_at	date_time	Data and time of the firstly created record.
update_at	date_time	Data and time of the latest data modification.
created_by	string	User who submitted data.