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封面圖說／

水位因蒸發降低的七股頂山廢棄鹽灘成過境及度冬候鳥重要的覓食棲地  
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# A Newly Naturalized Plant to Taiwan: *Plantago heterophylla* Nutt. (Plantaginaceae)

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## Abstract

A newly naturalized herb species, *Plantago heterophylla* Nutt. (Plantaginaceae), is reported in this paper. It is native to the southeastern United State, but is now well-established and naturalized in northern Taiwan. In this paper, we provide its taxonomical description, line drawing, photographs, distribution map and a key to the other plantains in Taiwan to aid in its identification.

**Key words:** naturalized plant, Plantaginaceae, *Plantago heterophylla*, Taiwan.

## 臺灣車前草科新歸化植物—線葉車前

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## 摘要

本文報導一種車前草科新歸化的草本植物—線葉車前 (*Plantago heterophylla* Nutt.)，原產於美國東南部，最近於臺灣北部地區發現。本種的葉子纖細呈線狀，極易與臺灣同屬的其他種類區分。本文提供其分類特徵描述、手繪圖、生態照、在臺灣的分布地點，以及與臺灣同屬的其他種類的檢索表以供辨識。

**關鍵詞:** 歸化植物、車前草科、線葉車前、臺灣

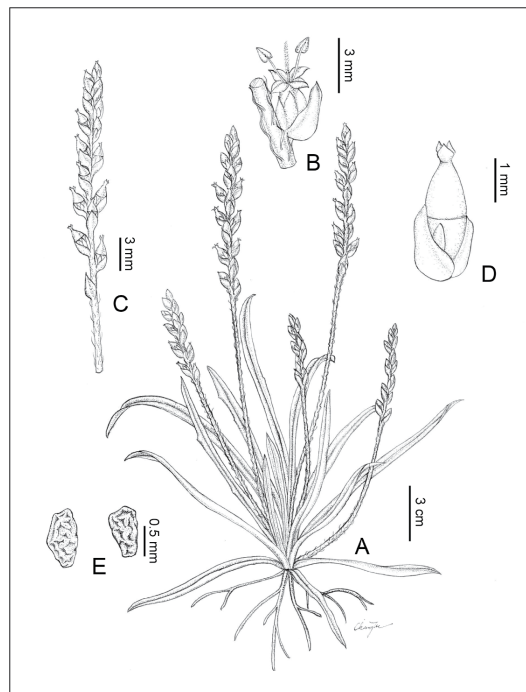
## Introduction

*Plantago* L. (Plantaginaceae) is a cosmopolitan genus comprising over 200 species concentrated in temperate and high-elevation tropical regions (Rønsted *et al.* 2002, Li *et al.* 2011, Hassemer *et al.* 2015, Hassemer 2018). Members of the *Plantago* have been known as common weeds of the native flora or naturalized plantains in Taiwan. In Flora of Taiwan, the second edition, two naturalized plants, *P. lanceolata* L., and *P. virginica* L., have been recorded (Chen and Wu 1998). Until now, the genus in Taiwan is represented by four species containing two native species (*P. asiatica* L. and *P. major* L.) and two naturalized species

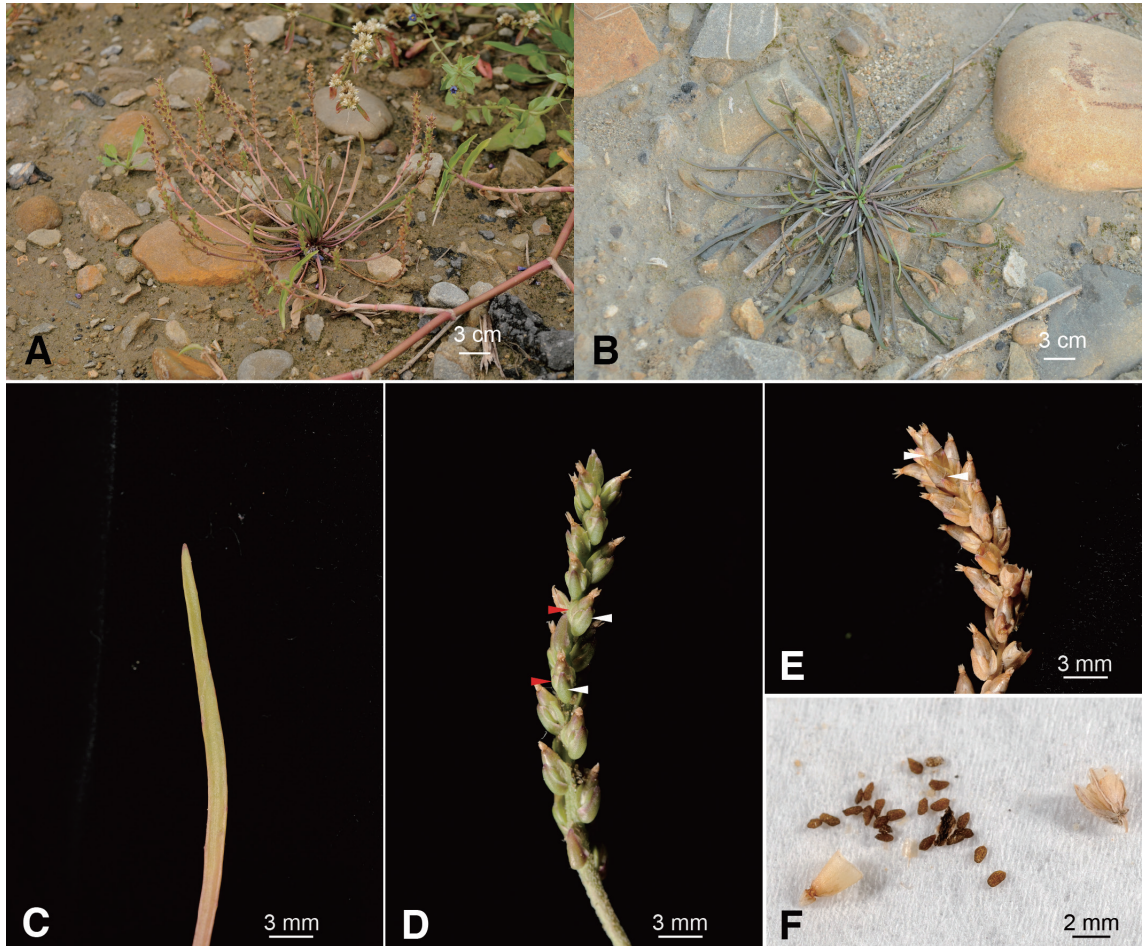
(*P. lanceolata*, and *P. virginica*) (Li *et al.* 2011). Recently, in our botanical inventory, a strange herb was found on waste fields in northern Taiwan. After examining the inflorescence and flowers, we confirm that it resembles *Plantago* sp. but differs from all known species in Taiwan by its linear leaves. Based on further compared with literatures (ex. Small 1913, Huisinga and Ayers 1999, Hassemer *et al.* 2015), it is confirmed that this strange species is *P. heterophylla* Nutt. which is native to southeast United State. Here, morphological description of this newly naturalized plantain and a taxonomic key to species of *Plantago* L. in Taiwan are provided to aid identification.

## Taxonomic Treatment

*Plantago heterophylla* Nutt. Trans. Amer. Philos. Soc., n.s. 5: 177. 1837. …線葉車前



**Fig. 1.** *Plantago heterophylla* Nutt. A, habitat; B, flower; C, inflorescence; D, mature fruit; E, seeds. Illustration by Chang-Tse Lu.



**Fig. 2.** Photographs of *Plantago heterophylla* Nutt. A, habitat; B, plant with young inflorescence; C, part of leaf; D, young fruit, white arrows show the bracts and red arrows show the sepals; E, mature fruit, white arrows show the position of fruit dehisced; F, seeds. Photographed by Wei-Yu Wang.

**TYPE:** USA: Territory of Arkansas: on the banks of the Mississippi and Arkansas (rivers), 1819, *Nuttall s.n.*

Annual herbs, slender well-developed taproot. Plants glabrous or sparingly puberulent, decumbent to erect. Leaves all basal, linear, entire or with lobed short-tooth, smooth or slightly hairy, 1–3-veined; petioles flat at base, without distinction between petiole and blade; blade linear or filiform, 5–18 cm  $\times$  1.1–2.0 mm, entire or remotely short-dentate on margins with 1 to several tiny teeth each side, acute at apex. Inflorescence few to many, axillary to basal leaf, usually pubescent with appressed hairs, spike slender, loosely flowered, 3.5–9.0 cm long. Flowers bisexual, radial, 0.6–0.7 mm in diameter, bracteate; bracts ovate, 2.7–2.9 mm long, with a wide scarious margin, slightly longer than the calyx; calyx 4-lobed, lobes cupped-ovate, ca. 2 mm long, glabrous, persistent; corolla 4-lobed, minute, scarious, less than 1 mm; stamens 2, alternate with corolla lobes, fused to midpoint of corolla tube; pistil 1, ca. 1.5 mm long; ovary superior, subspheroid to ovoid, 2 locules; style becoming exerted, ascending papillate-hairy except at base. Capsules slenderly ovoid, circumscissile just below the middle, ca. 3.4  $\times$  1.4 mm. Seeds ca. 20 (-25), dark brown, irregularly and coarsely pitted, slightly ellipsoid in outline, ca. 0.85  $\times$  0.4 mm.

#### Specimen examined:

Taoyuan City, Guanyin District, Baishatun, 12 Apr. 2018, *W.-Y. Wang* 2419 (TAIF); same locality, 26 May. 2018, *W.-Y. Wang* 2420 (TAIF).

#### Distribution and ecology:

*Plantago heterophylla* is native to the southeastern United State, and it has now been recorded introducing to Mexico, Southern American (Argentina, Paraguay, Uruguay) and Japan (GBIF 2017, The Catalogue of Life Partnership 2018). Herein, we have recorded it as naturalized in northern Taiwan (Fig. 3). This plant can be found mostly in moist sandy and silty soils, frequently weedy in cultivated, pasture, and waste fields (Bassett 1966). In Taiwan, we only found it growing in waste fields. Flowering and fruiting were observed from March to May.

#### Notes:

*Plantago heterophylla* Nutt. belongs to *Plantago* section *Micropsyllium* Decne (Pilger, 1937). All species within this section, including *P. heterophylla*, *P. polysperma* Kar., *P. pusilla* Nutt., *P. bigelovii* A. Gray, *P. elongata* Pursh, and *P. teuniflora* Waldst., are easy to distinguish from other plantains by its linear leaves. On the other hand, it is difficult to distinguish it from the other species of the same section. After consulting relative literatures (ex. Morris 1909, Small 1913, Pilger 1937, Bassett 1966, Hassemer *et al.* 2015), we concluded that the number and shape of seeds can be used to separate these species, though they are similar in appearance. *Plantago heterophylla* can be distinguished from the others by seeds 10–25, and seed shape irregular in outline.

Compared to the known plantain species in Taiwan, *P. heterophylla* is easily distinguished from them by its linear leaves. The following key is provided to aid identification of the *Plantago* species in Taiwan.

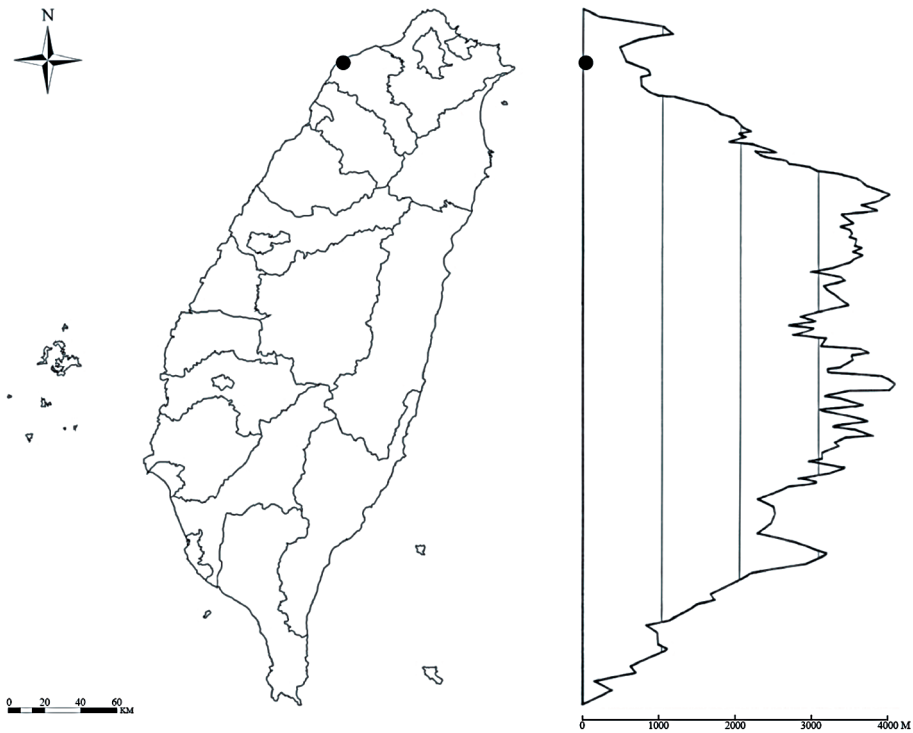


Fig. 3. Collection location of *Plantago heterophylla* Nutt. in Taiwan.

**Key to species of *Plantago* L. in Taiwan**

- 1. Leaf blade linear, 1–3-veined. .... *P. heterophylla*
- 1a. Leaf blade lanceolate, ovate, obovate, or elliptic, 3–7-veined. .... 2
- 2. Plants glabrous or pubescent; blade broadly ovate to broadly elliptic; stamens 4; seeds more than 5. .... 3
- 2a. Plants strongly villose; blade obovate, elliptic, lanceolate; stamens 2; seeds 2. .... 4
- 3. Flower shortly pedicellate; capsule circumscissile near base. .... *P. asiatica*
- 3a. Flower sessile; capsule circumscissile at middle. .... *P. major*
- 4. Spikes long-cylindric; bracts hairy; sepals 4, distinct. .... *P. virginica*
- 4a. Spikes conic or short-cylindric; bracts glabrous; sepals 3, lower sepal connate to near apex. .... *P. lanceolata*

## Acknowledgements

We thank Mr. Tian-Chuan Hsu for providing useful information to identify this species.

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## Dataset of bird communities at Budai salt pans

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### Abstract

In this data paper, a dataset is described of the bird community in the Budai salt pans of Chiayi County, Taiwan. Through monthly flock counting, bird species richness and abundance in 51 salt pans were recorded. In the survey period of 2016-2017, 1,291 sampling event records were accumulated. To date, 118 species which can be classified into 31 bird families have been recorded. Among the records, 11 are protected species of Taiwan, and 18 are in The Red List of Birds of Taiwan.

**Keywords:** sampling event, Aves, salt pan, species composition, abundance

## 布袋鹽田鳥類群集資料集

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### 摘要

本資料集為在臺灣嘉義縣布袋鹽田進行的每月鳥類調查資料。調查方式為群集計數法 (counting flocks)，記錄鹽田中的鳥種及數量。調查樣區包含 51 塊鹽田，於 2016-2017 年共累積了 1,291 筆取樣事件紀錄。目前共記錄到 31 科 118 種鳥類，其中有 11 種屬於臺灣保育類野生動物，18 種名列臺灣鳥類紅皮書名錄 (The Red List of Birds of Taiwan)。

**關鍵詞:** 取樣事件、鳥類、鹽田、物種組成、豐度

## Introduction

As the areas of natural wetlands around the world have been sharply decreasing, the conservation value of artificial wetlands for waterbirds has been increasingly emphasized. Studies have revealed that seaside salt pans can be an alternative habitat for waterbirds (Warnock *et al.* 2002; Masero 2003; Sripanomyom *et al.* 2011; Dias *et al.* 2014) and reduce the impact caused by the loss of natural wetlands. For example, the abandoned salt pans in San Francisco are a breeding site for some waterbirds (Meckstroth and Miles 2005; Demers and Robinson-Nilsen 2012). Also, some salt pans are rich with invertebrates, providing a food source for shorebirds and diving ducks (Takekawa *et al.* 2009; Band *et al.* 2014).

The Budai salt pans are located in Chiayi County, Taiwan. Since the salt pans were abandoned in 2001, they have become one of the Important Bird Areas in Taiwan and an important winter habitat for migratory waterbirds. According to the Taiwan New Year Bird Count, which is held every winter, the Budai salt pans are the sample plot with the largest number of birds in Taiwan (Lin *et al.* 2014, 2015, 2016, 2017).

However, the Budai salt pans face environmental degradation problems. After the salt pans ceased to be used for production, the lack of human management, damaged water facilities, and progressive land subsidence caused the salt pans to become unsuitable habitats for waterbirds. In addition, the Budai salt pans consist of 102 ha of land that will be developed into a ground-mounted solar photovoltaic (PV) system. The development will considerably reshape the original wetland landscape.

To assess the influence that environmental changes have had on birds and propose possible habitat improvement measures, we conducted a monthly systematic bird survey at the Budai salt pans. The survey started in January, 2016. Until December, 2017, 1,291 sampling events have been recorded, documenting 118 species of birds and 388,456 bird individuals. Months with peak bird abundance ranged from November to February, consisting of over 20,000 birds each month (Fig. 1). The survey is expected to continue until 2019.

## Project details

**Project title:** A preliminary study on enhancing waterbird habitats of Budai salt pan

**Funding:** Current funding from the Endemic Species Research Institute, Council of Agriculture, Executive Yuan, R.O.C. (Taiwan).

**Study area descriptions:** The study site of this project is Budai town, located in the southwestern coast of Taiwan (23°22'24.9"N to 23°18'39.1"N, 120°08'57.9"E to 120°11'23.4"E, Fig. 2). The Budai town is a land subsidence area (WRPI 2007), and the salt pans are below sea level (elevation -1.8 to -0.5 m, Kuo and Wang 2018). The temperature and rainfall data from 2010 to 2017 were obtained from the Chiayi weather station, located 30 km northeast of the sample plot; on average, the month with the lowest temperature is January (16.7 °C), and the month with highest temperature is July (20.1 °C). The year with the lowest recorded rainfall was 2011 with a total of 1021.7 mm of rain; the year with highest recorded rainfall was 2013, with 2580.5 mm of rain. The Budai salt pans are brackish wetlands. According to the field investigation

records of this study, the salinity was highest in May ( $30.9 \pm 7.9$  psu) and lowest in August ( $8.4 \pm 2.0$  psu).

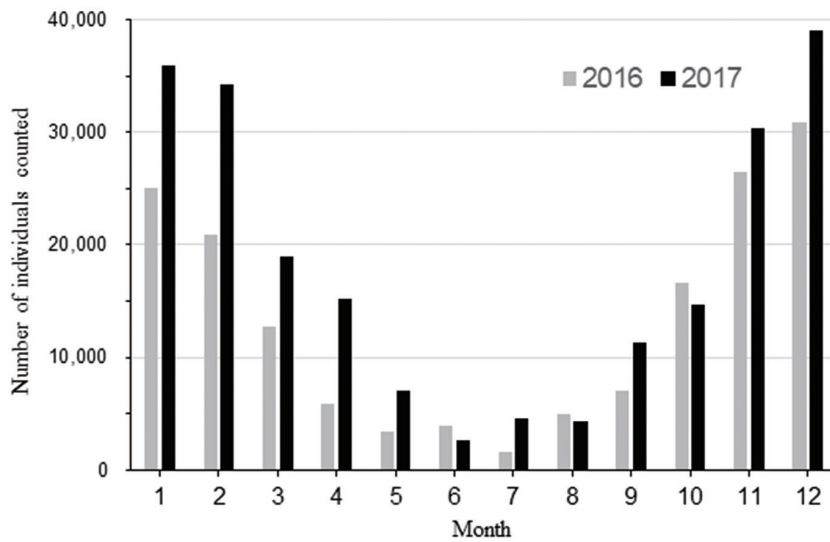


Fig. 1. Seasonal variation in total bird abundance in study salt pans from 2016 to 2017. Repeated bird surveys in five salt pans were conducted during high tide and low tide of the same day from March to May and September to December, 2017 (see Methods). To avoid double counting, only the data during high tide was used.

圖 1. 布袋鹽田的鳥類數量於 2016-2017 年間的月分變化。其中 5 個鹽田於 2017 年 3-5 月與 9-12 月在當月同 1 天漲潮及退潮各進行 1 次鳥類調查 (參見方法), 為避免重複計算, 只分析漲潮時的資料。

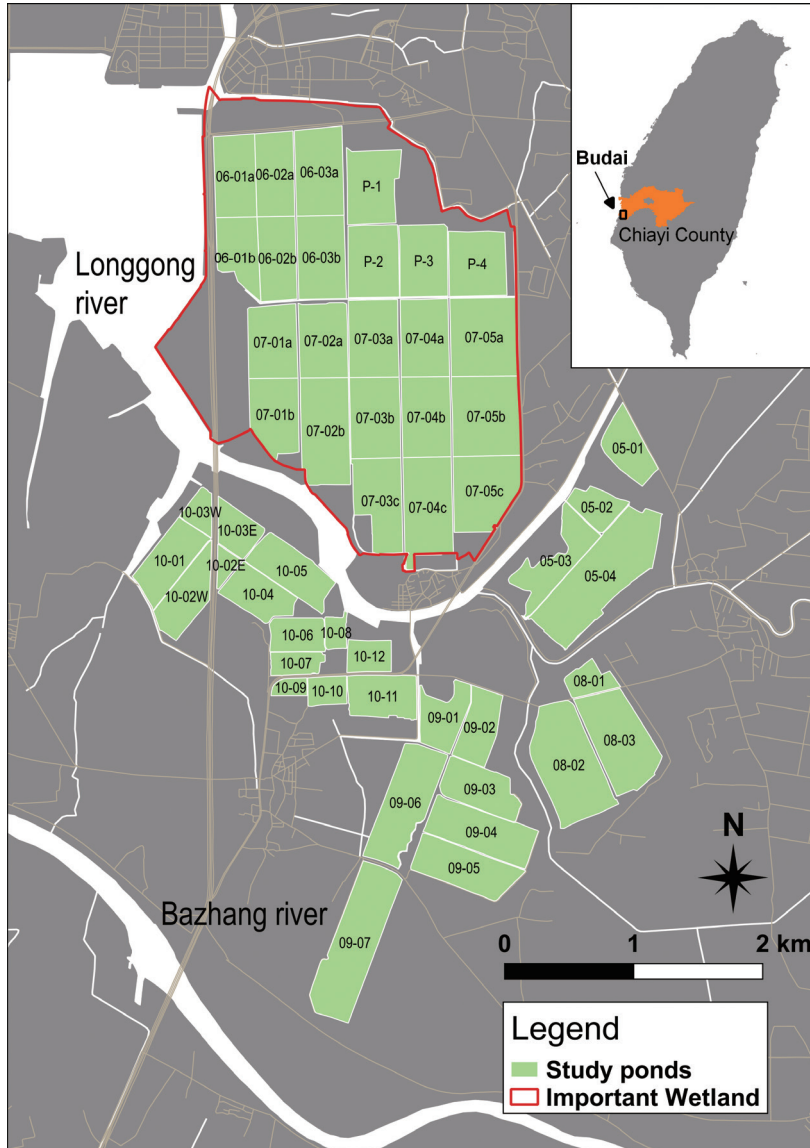


Fig. 2. Location of Budai salt pans.

圖 2. 布袋鹽田位置圖。

## Taxonomic coverage

**General taxonomic coverage description:** From 2016 of 2017, the survey recorded 118 species of Aves from a total of 31 families (Table 1). A total of 19 species had a maximum abundance of over 1,000 individuals in a single survey (Fig. 3). Species that had a maximum abundance of over 4,000 individuals in a single survey are as follows: whiskered tern (*Chlidonias hybrida*), northern shoveler (*Spatula clypeata*), Eurasian wigeon (*Mareca penelope*), and Kentish plover (*Charadrius alexandrine*). Within the records, 11 species are protected species of Taiwan: 2 were

endangered species, 6 were rare and valuable species, and 3 were other conservation-deserving species. A total of 18 species recorded are listed in The Red List of Birds of Taiwan (Lin *et al.* 2016), which consisted of 2 nationally critical species, 2 nationally endangered species, 9 nationally vulnerable species, and 5 nationally near-threatened (Table 2).

### Taxonomic ranks

Class: Aves

Common names: Bird

### Temporal Coverage

January, 2016-December, 2017.

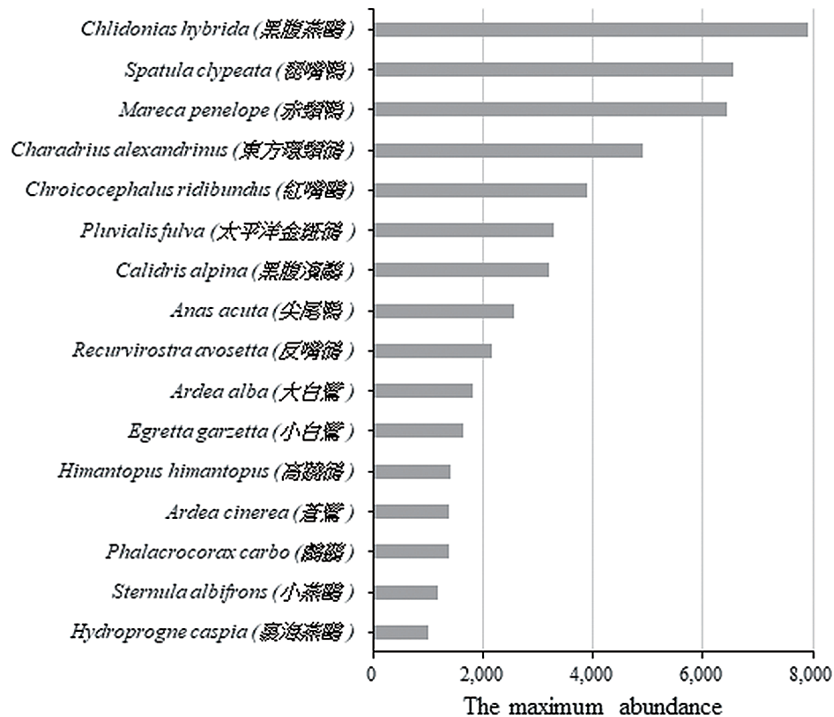


Fig. 3. The maximum abundance of dominant species in a single survey.

圖 3. 優勢鳥種在單次調查出現的最大數量

Table 1. List of bird orders and families recorded in the dataset

表 1. 資料集涵蓋的鳥類目別與科別

Order	Family	Family English Name
Anseriformes	Anatidae	Ducks, Geese, and Waterfowl
Podicipediformes	Podicipedidae	Grebes
Phoenicopteriformes	Phoenicopteridae	Flamingos
Suliformes	Phalacrocoracidae	Cormorants and Shags
Pelecaniformes	Ardeidae	Hérons, Egrets, and Bitterns
Pelecaniformes	Threskiornithidae	Ibises and Spoonbills
Accipitriformes	Pandionidae	Osprey
Accipitriformes	Accipitridae	Hawks, Eagles, and Kites
Gruiformes	Rallidae	Rails, Gallinules, and Coots
Charadriiformes	Recurvirostridae	Stilts and Avocets
Charadriiformes	Charadriidae	Plovers and Lapwings
Charadriiformes	Scolopacidae	Sandpipers and Allies
Charadriiformes	Laridae	Gulls, Terns, and Skimmers
Columbiformes	Columbidae	Pigeons and Doves
Coraciiformes	Alcedinidae	Kingfishers
Falconiformes	Falconidae	Falcons and Caracaras
Passeriformes	Laniidae	Shrikes
Passeriformes	Dicruridae	Drongos
Passeriformes	Corvidae	Crows, Jays, and Magpies
Passeriformes	Alaudidae	Larks
Passeriformes	Hirundinidae	Swallows
Passeriformes	Pycnonotidae	Bulbuls
Passeriformes	Scotocercidae	Bush Warblers and Allies
Passeriformes	Cisticolidae	Cisticolas and Allies
Passeriformes	Zosteropidae	White-eyes, Yuhinas, and Allies
Passeriformes	Muscicapidae	Old World Flycatchers
Passeriformes	Sturnidae	Starlings
Passeriformes	Motacillidae	Wagtails and Pipits
Passeriformes	Emberizidae	Old World Buntings
Passeriformes	Passeridae	Old World Sparrows
Passeriformes	Estrildidae	Waxbills and Allies

Table 2. Conservation status of the species included in this dataset

表 2. 資料集中鳥類的保育狀態

Scientific Name	Vernacular Name	Protected Species <sup>a</sup>	Red List of Taiwan <sup>b</sup>
<i>Mareca falcata</i>	羅文鴨		NVU
<i>Anas crecca</i>	小水鴨		NVU
<i>Aythya baeri</i>	青頭潛鴨		NCR
<i>Platalea leucorodia</i>	白琵鷺	II	
<i>Platalea minor</i>	黑面琵鷺	I	NNT
<i>Pandion haliaetus</i>	魚鷹	II	
<i>Elanus caeruleus</i>	黑翅鳶	II	
<i>Pluvialis squatarola</i>	灰斑鶺		NNT
<i>Charadrius leschenaultii</i>	鐵嘴鶺		NNT
<i>Numenius madagascariensis</i>	鵞鶺		NEN
<i>Numenius arquata</i>	大杓鶺	III	NVU
<i>Limosa lapponica</i>	斑尾鶺		NVU
<i>Limosa limosa</i>	黑尾鶺		NVU
<i>Calidris tenuirostris</i>	大濱鶺		NEN
<i>Calidris canutus</i>	紅腹濱鶺		NVU
<i>Calidris ruficollis</i>	紅胸濱鶺		NVU
<i>Calidris alpina</i>	黑腹濱鶺		NVU
<i>Limnodromus semipalmatus</i>	半蹼鶺	III	
<i>Tringa brevipes</i>	黃足鶺		NNT
<i>Saundersilarus saundersi</i>	黑嘴鷗	II	NCR
<i>Sternula albifrons</i>	小燕鷗	II	NNT
<i>Falco tinnunculus</i>	紅隼	II	
<i>Falco peregrinus</i>	遊隼	I	
<i>Lanius cristatus</i>	紅尾伯勞	III	
<i>Lanius schach</i>	棕背伯勞		NVU

a. Schedule of Protected Species: Council of Agriculture, Executive Yuan, Taiwan (2017 amended). I: Endangered Species; II: Rare and Valuable Species; III: Other Conservation-Deserving Species

b. The Red List of Birds of Taiwan, 2016 (Lin *et al.* 2016). NNT: Nationally Near-threatened; NVU: Nationally Vulnerable; NEN: Nationally Endangered; NCR: Nationally Critical

## Methods

**Method step description:** Monthly bird surveys were conducted between 2016 and 2017. Each survey lasted two days and employed the counting flock method. We scanned each sample plot with a monocular telescope and recorded the bird species, abundance, and behavior (foraging/non-foraging). For this dataset, waterbirds were completely inspected in each survey; complete records of landbirds were only created for January-March, 2016 and January and December, 2017 (see DwC event “samplingProtocol”). Waterbirds include shorebirds, waterfowls, wading birds (herons, egrets, storks, spoonbills and ibises), gulls, terns, cormorants, grebes, coots, moorhens and kingfishers. To understand whether the rise and fall of the tide influenced birds in salt pans, further surveys were conducted from March-May and September-December, 2017. Five salt pans (10-01, 10-02W, 10-03W, 10-11, 10-12) were selected, and bird surveys were conducted during high tide and low tide of the same day (see DwC event “eventRemarks”). High tide was defined as three hours before and after high tide, and low tide as three hours before and after low tide.

**Study extent description:** The sample plot included the seven main areas of the Budai salt pans (old area 5, area 6, area 7, area 8, area 9, area 10, and area P), consisting of a total of 51 salt pan sampling sites. Within the sample plot, area 6 and area 7 are currently listed as Important Wetlands in Taiwan by the Wetland Conservation Act (Fig. 2). The area of every salt pan is between 2.7-48.4 ha. The total sample plot is about 1,030 ha.

**Quality control description:** To maintain survey quality, two experienced investigators carried out the surveys. In January, 2016, and January and December, 2017, in accordance with the Taiwan New Year Bird Count, other volunteers took part in the survey. To reduce errors while documenting the recorded data, if the bird species was rarely observed or the quantity recorded was abnormal, we reconfirmed the details with the investigators. The classification system employed was the eBird Taxonomy (Clements *et al.* 2018), and the Chinese names of the birds were referenced from the Checklist of the Birds of Taiwan (Ding *et al.* 2017). We imported all the field name descriptions of the dataset into the metadata, for which the GBIF Integrated Publishing Toolkit was used to describe the field names for global sharing purposes. The GBIF node and portal in Taiwan is the Taiwan Biodiversity Information Facility.

## Datasets

### Dataset description

**Object name:** Darwin Core Archive Bird survey of Budai salt pans in Taiwan

**Character encoding:** UTF-8

**Format name:** Darwin Core Archive format

**Format version:** 1.0

**Distribution:** [http://ipt.taibif.tw/archive.do?r=bird\\_survey\\_of\\_budai\\_salt\\_pan\\_in\\_taiwan](http://ipt.taibif.tw/archive.do?r=bird_survey_of_budai_salt_pan_in_taiwan) (Darwin Core Archive)

<https://www.gbif.org/dataset/3f9cd7e5-6d7b-40a8-8062-a18d2f2ca599> (GBIF)

<https://doi.org/10.15468/b7om21> (DOI)

**Publication date of data:** 2018-12-25

**Language:** English

**Licences of use:** Creative Commons Attribution (CC-BY) 4.0 License

**Metadata language:** English

**Date of metadata creation:** 2018-09-17

**Hierarchy level:** Dataset

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## Dataset of long-term bird census in Cigu, 2004–2017

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### Abstract

For the conservation of the black-faced spoonbill (*Platalea minor*) and the avian community in Cigu, Tainan City, Taiwan, the Taiwan Black-faced Spoonbill Conservation Association initiated the Long-Term Bird Census in Cigu (LTBCC) project in August 2004. The censuses were conducted twice a month in ten sites which represented agricultural fields, tidal mudflats, windbreaks, fish ponds, and abandoned salt pans in Cigu. The dataset for the 13 census years from August 2004 to July 2017 consists of 2,885 sampling events and 25,974 occurrence records. A total of 522,246 individuals in 54 families and 235 species were counted and identified. Passeriformes, included 26 families and 97 species, occupied the highest percentage of the number of species, followed by Charadriiformes, with eight families and 62 species. However, the Charadriiformes was the order with the highest accumulated number of individuals (329,227), followed by the Pelecaniformes (114,779).

**Keywords:** Sampling event, Cigu, Tainan, Taiwan, Long-term Bird Census project

## 七股地區長期鳥類調查資料集 2004-2017

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## 摘要

臺灣黑面琵鷺保育學會為保育黑面琵鷺 (*Platalea minor*)，自 2004 年 8 月起，於臺南市七股區啓動「七股地區長期鳥類調查計畫 (LTBCC)」，選擇當地農墾地、感潮灘地、防風林、魚塭及廢棄鹽田等 5 類代表性棲地的 10 處地點進行每月兩次之鳥類調查。本資料集內容涵蓋 2004 年 8 月至 2017 年 7 月，共計 13 調查年度之所有調查紀錄，共計觀察事件 2,885 筆、出現紀錄 25,974 筆，記錄鳥類 54 科 235 種 522,246 隻次。種類上以雀形目 (Passeriformes) 26 科 97 種為最多，其次為鴿形目 (Charadriiformes) 8 科 62 種；數量上以鴿形目 329,227 隻次為最多，其次為鵜形目 (Pelecaniformes) 114,779 隻次。

**關鍵詞：**取樣事件、七股、臺南、臺灣、長期鳥類調查

## Introduction

The East Asian–Australasian Flyway (EAAF) supports the largest number of bird species of any flyway. A total of 471 migratory bird species are found in the EAAF (Kirby 2010), with the minimum total number of migratory shorebirds at approximately eight million (Bamford *et al.* 2008). Taiwan occupies a central position in the EAAF and contains 12 of the 397 internationally significant sites (Bamford *et al.* 2008). A total of 296 migratory bird species have been recorded in Taiwan, including 57 legally protected species such as the black-faced spoonbill (*Platalea minor*) and the Chinese crested tern (*Thalasseus bernsteini*) (Ding *et al.* 2017).

Although Taiwan is one of the major habitats in the EAAF for migratory birds, especially waterbirds, long-term bird population data and knowledge about population trends are lacking, except for certain flagship species such as the black-faced spoonbill. Therefore, the members of Taiwan Black-faced Spoonbill

Conservation Association voluntarily initiated the Long-Term Bird Census in Cigu (LTBCC) project in 2004. The aims of the LTBCC were to monitor the structure and composition of the avian community, as well as to build the population trends of the flagship and the common species to provide the necessary information for decision-making on the management of the Black-faced Spoonbill Refuge in Cigu District, Tainan City, Taiwan.

From August 2004 to July 2017, 2,885 sampling events and 25,974 occurrence records were collected. In total, 522,246 bird individuals belonged to 54 families and 235 species were counted. Passeriformes, included 26 families and 97 species, occupied the highest percentage of the number of species, followed by Charadriiformes, with eight families and 62 species. However, the Charadriiformes was the order with the highest accumulated number of individuals (329,227), followed by the Pelecaniformes (114,779) (Table 1).

Table 1. List of orders, families, and numbers of species and birds in the dataset

表 1. 資料集內涵蓋的鳥類目別、科別、鳥種數及數量

Order	Family	No. of Species	No. of Birds
Accipitriformes	Accipitridae	10	170
	Pandionidae	1	100
Anseriformes	Anatidae	15	31,357
Apodiformes	Apodidae	2	349
Bucerotiformes	Upupidae	1	1
Charadriiformes	Charadriiformes sp.	--	6,250
	Charadriidae	8	73,301
	Glareolidae	1	56
	Haematopodidae	1	1
	Laridae	15	55,049
	Recurvirostridae	2	13,227
	Rostratulidae	1	32
	Scolopacidae	33	181,309
	Turnicidae	1	2
Columbiformes	Columbidae	5	5,338
Coraciiformes	Alcedinidae	2	562
Cuculiformes	Cuculidae	6	25
Falconiformes	Falconidae	2	63
Galliformes	Phasianidae	1	5
Gruiformes	Rallidae	6	605
	Acrocephalidae	1	21
	Alaudidae	1	41
	Campephagidae	2	4
	Cettiidae	3	38
	Cisticolidae	3	3,268
	Corvidae	3	292
	Dicruridae	3	264
	Emberizidae	4	216
	Estrildidae	3	2,671
	Fringillidae	3	13
	Hirundinidae	4	<b>6,290</b>
Laniidae	3	<b>1,201</b>	

	Locustellidae	3	47
	Monarchidae	3	37
	Motacillidae	9	522
	Muscicapidae	21	680
	Oriolidae	1	1
	Passeridae	1	7,773
	Phylloscopidae	6	349
	Pittidae	1	1
	Ploceidae	1	1
	Pycnonotidae	2	6,491
	Sturnidae	6	1,072
	Timaliidae	1	1
	Turdidae	8	288
	Zosteropidae	1	5,565
Pelecaniformes	Ardeidae	14	63,136
	Fregatidae	1	1
	Phalacrocoracidae	1	379
	Threskiornithidae	3	51,263
Phoenicopteriformes	Phoenicopteridae	1	1
Piciformes	Picidae	2	133
Podicipediformes	Podicipedidae	1	2,375
Procellariiformes	Procellariidae	1	7
Strigiformes	Strigidae	1	2

## Project details

**Project title:** Long-Term Bird Census in Cigu

**Funding:** None

**Study area descriptions:** Five habitat types, namely, tidal mudflats, agricultural fields, fish ponds, abandoned salt pans, and windbreaks, in Cigu District, Tainan City, Taiwan.

**Design description:** Volunteer implementation of a long-term bird census project involving certain sites, periods, and methods, to establish baseline data of the avian community in various major bird habitats in Cigu.

## Taxonomic coverage

### **General taxonomic coverage description:**

A total of 235 species from 54 families in 18 orders were recorded. Passeriformes, included 26 families and 97 species, occupied the highest percentage of the number of species, followed by Charadriiformes, with eight families and 62 species.

### **Taxonomic ranks:**

**Class:** Aves

**Common names:** Bird

## Spatial coverage

**General spatial coverage:** Area of Cigu District, Tainan City, Taiwan

**Coordinates:** 23°2'34.8"N and 23°11'34.8"N (latitude), 120°1'51.6"E and 120°8'42"E (longitude)

## Temporal Coverage

**Temporal coverage:** August 1, 2004–July 22, 2017

## Methods

**Method description:** The survey methods and periods for each site are listed in Table 2. One or more volunteers used pairs of 8–12x binoculars and/or 32–60x spotting scopes to detect birds in the selected survey sites during a particular period. The start and finish times, weather conditions, and water coverage (ratio of the area covered by water, classified as five levels from 0/4 to 4/4) were recorded for each survey event. Each species of bird sighted or heard was recorded, with species, number, and type of movement (flyover or rest in the survey site) noted.

**Study scope description:** Seven sites in four major habitat types in Cigu were selected at the beginning of the project in August, 2004. Three sites (L0 agricultural field, E2 fish pond, E3 windbreak habitat) with one more habitat type were added in August 2005. The site code, habitat type, survey method, site size or length of line transect, duration, coordinates, survey period, and notes are given in Table 2 and Figure 1.

Table 2. Profile of survey sites

表 2. 調査點說明

Site Code	Habitat Type	Survey Method	Area/Length	Duration	Coordinate (WGS84)	Survey Period	Notes
L0	Agricultural Field	Total Count	2.6ha	20~30min	23.0903° N 120.1064° E	2005.8~	The main crop is shallot ( <i>Allium ascalonicum</i> ).
M1	Tidal Mudflat	Total Count	98ha	60min	23.0754° N 120.0487° E	2004.8~	Northern part of the Black faced Spoonbill Refuge, surrounded by embankments but water can flow in and out through the water gates.
M2	Tidal Mudflat	Total Count	83ha	20min	23.068° N 120.0513° E	2004.8~	Southern part of the Black-faced Spoonbill Refuge, the elevation is slightly higher than M1.
J2、 J2A、 J2B	Wind-break	Line Transect	150m	30min	J2 : 23.0856° N 120.0366° E J2A : 23.0817° N 120.0367° E J2B : 23.0803° N 120.0371° E	2004.8~	The area was becoming smaller because several extreme weather events occurred during observation years; therefore, the position of the line transect was moved south twice (J2A & J2B), only several trees left until July 2017.

J3、 J3A	Wind- break	Line Transect	450m, 300m after August 2017	30min	23.077° N 120.037° E	2004.8~	The area was becoming smaller for the same reason as J2. The length of the line transect was shortened by 150 m after August 2017.
E1	Fish Pond	Total Count	12ha	30~90min	23.0755° N 120.067° E	2004.8~	The 2 survey sites were nearby each other, and surveys were conducted at the same time.
E2	Fish Pond	Total Count	6ha		23.0753° N 120.069° E	2005.8~	
E3	Wind- break	Line Transect	150m	30min	23.0716° N 120.0657° E	2011.8~	The site was added in response to the lost area of J2 & J3.
D1、 D1A	Aban- doned Salt Pan	Total Count	D1 : 20ha D1A : 40ha	30min	D1 : 23.1709° N 120.1148° E D1A 23.1735° N 120.1148° E	2004.8~	<b>Because of the small population of birds, the site was scaled up to twice the size from August 2011(D1A&amp;D2A)</b>
D2、 D2A	Aban- doned Salt Pan	Total Count	D2 : 20ha D2A : 40ha	30min	D2 : 23.1706° N 120.1108° E D2A : 23.1735° N 120.1108° E	2004.8~	

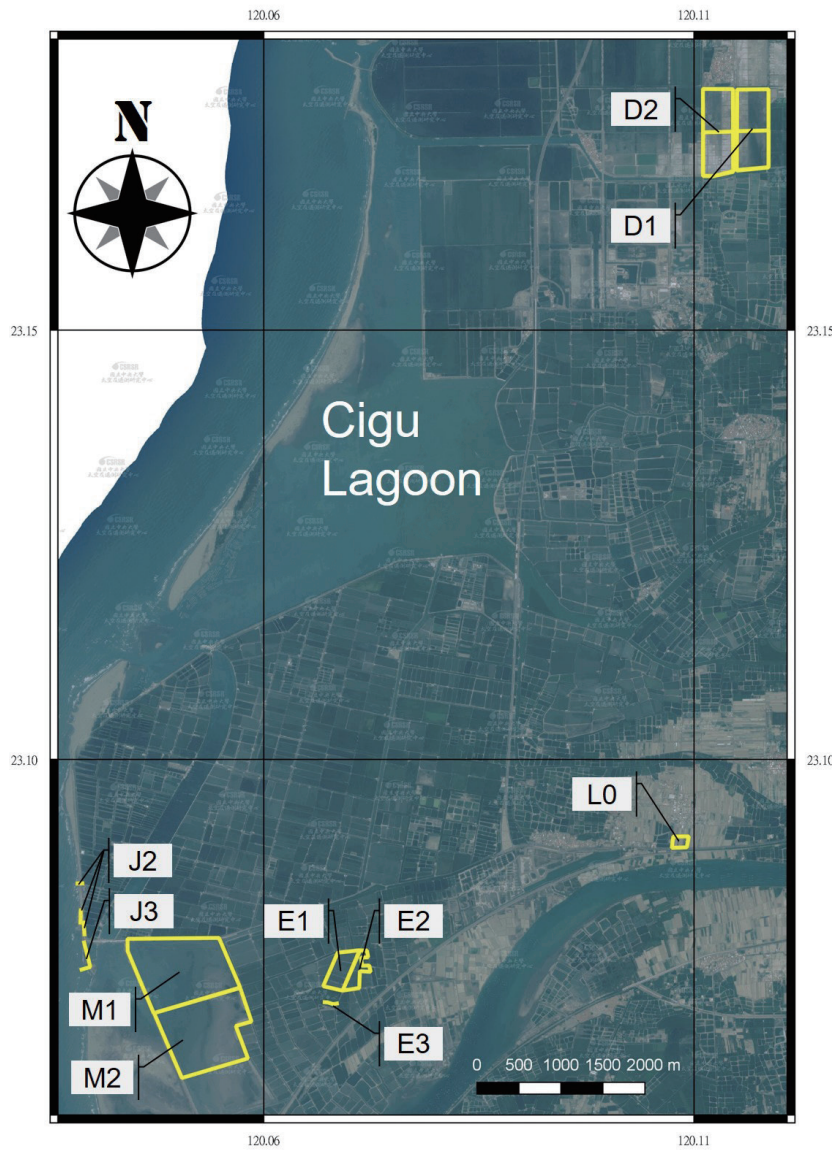


Figure 1. Distribution of LTBCC sampling sites.

圖 1. 調查點位置圖。

**Sampling description:** Ten sites representing five habitat types were selected with the aim of collecting avian community data in Cigu. Since the winter migratory birds were the main monitoring target group of LTBC, the study period was from August to July of the following year. In each survey, all of the sites were investigated by a team of volunteers led by a senior observer during the daytime. The survey frequency for each site was generally twice a month, except in August 2004 (four times) and September and October 2004 (three times each). Several surveys were not conducted because of weather conditions or other reasons.

**Quality control description:** The sampling effort equaled the number of observers times the total amount of time surveyed. For example, the sampling effort would be forty observer minutes when a survey was conducted by four observers in ten minutes. The people conducting the surveys, the number of participants, and the observational equipment varied in each survey, thus possibly resulting in quality differences. When each survey was completed, the results were sent to the secretary, who compiled the data in a digital file and then returned it to the survey team leader for verification.

## Datasets

**Dataset description:**

**Object name:** Darwin Core Archive Long-term Bird Census in Cigu 2004–2017

**Character encoding:** UTF-8

**Format name:** Darwin Core Archive

**Format version:** 1.0

**Distribution:** <https://www.gbif.org/dataset/>

b6ca9b0b-b6eb-46c5-b623-cd479a71e566; [http://ipt.taibif.tw/archive.do?r=ltccc\\_bfsa](http://ipt.taibif.tw/archive.do?r=ltccc_bfsa)

**Preferred identifier:** <https://doi.org/10.15468/u6p7vi>

**Data publication date:** 2019-01-02

**Language:** English

**License of use:** Creative Commons Attribution (CC-BY) 4.0 (<https://creativecommons.org/licenses/by/4.0/legalcode>)

**Metadata language:** Chinese

**Metadata creation date:** 2018-07-02

**Hierarchy level:** Dataset

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# 「台灣生物多樣性研究」稿約

## 壹、一般說明

- 一、《台灣生物多樣性研究》為行政院農業委員會特有生物研究保育中心出版之學術期刊，歡迎國內外學者發表有關生物多樣性或自然保育之學術論文與有關物種出現資料之資料論文，但以未曾在其他刊物發表之原創研究及資料為限。
- 二、本刊為網路期刊，隨時接受投稿，並於每年 1 月、4 月、7 月及 10 月在中心網站 ([http://tesri.tesri.gov.tw/list\\_protect.php](http://tesri.tesri.gov.tw/list_protect.php)) 刊登發行。
- 三、撰稿中、英文均可，來稿以完整微軟 WORD 格式文稿電子檔傳送至「台灣生物多樣性研究」期刊編輯委員會電子信箱(email: [tjbd@tesri.gov.tw](mailto:tjbd@tesri.gov.tw))。
- 四、經本刊接受刊登之稿件，投稿著作所有列名作者皆同意授權本刊單位以非專屬授權之方式再授權，並得為重製、公開傳輸、授權用戶下載、列印等行為。為符合資料庫之需求，並得進行格式之變更。
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