資料論文
Data paper

Point count sampling data from the Taiwan Breeding Bird Survey

臺灣繁殖鳥類大調查的定點計數數量資料

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Abstract

The Taiwan Breeding Bird Survey (BBS Taiwan) is a nationwide monitoring project with the aim of establishing a breeding bird population index for conservation. The project was initiated in 2009 as a citizen science project by a cross-organizational working group. The BBS Taiwan has obtained 358,183 records of bird sampling data from 454 sampling sites during the breeding season from 2009 to 2015. This paper provides the descriptions of sampling design, survey methods, and coverage of species of the dataset.

摘 要

臺灣繁殖鳥類大調查（簡稱BBS Taiwan）是以建立繁殖鳥類族群指標趨勢爲目標的全國性監測計畫。自2009年起，透過結合政府組織、學術機關，以及民間團體的夥伴關係持續推動。累計至2015年，BBS Taiwan已累計454個樣區，358,183筆繁殖鳥類取樣事件紀錄。本篇資料論文說明計畫的取樣設計、調查方法，以及涵蓋的鳥種範圍。

Keywords: Sampling event, Aves, distance sampling, population index, citizen science

關鍵詞：取樣事件、鳥類、距離取樣、族群指標、公民科學

Received: October 05, 2017 Accepted: November 29, 2017

收件日期：2017年10月05日 接受日期：2017年11月29日

Introduction

Information about the status of wildlife populations is vital for biodiversity conservation, especially as early warnings of emerging environmental crises and for evaluating the efficiency of implemented conservation strategies. Relevant datasets with a large spatial and temporal time scale are scarce in the Asia-Pacific region, including Taiwan. Wild bird populations are among the few taxa for which substantial data are available in Taiwan, mainly due to amateurs engaged in wildlife observation and bird counting events. Still, monitoring data collected by systematic sampling schemes are rare even for birds, possibly due to the financial and management challenges to run such programs. Although unstructured citizen-science data are data rich and powerful in many circumstances, they may not be as sensitive as structured monitoring data to detect population changes (Kamp *et al.* 2016). Implementing a monitoring program that applies a systematic sampling scheme and also recruits the energy of citizen science hence seems promising and invaluable. For these reasons, the Taiwan Breeding Bird Survey project was initiated.

The Taiwan Breeding Bird Survey (BBS Taiwan) is the very first systematic regional-scale bird monitoring scheme in Taiwan and also one of the pioneers in the Asia-Pacific region. In 2009, a joint partnership by the Chinese Wild Bird Federation, the Institute of Ecology and Evolutionary Biology of National Taiwan University, and the Endemic Species Research Institute of the Council of Agriculture, Executive

Yuan, R.O.C. (Taiwan), was formed to initiate the project. Since then, the annual BBS Taiwan has recorded an average of 231 species (range 201-254) and 104,160 bird individuals (range 58,664 to 134,789) in 257 (range 140-355) sampling sites, with an average, 228 people (range 112-330) participating (Fig. 1). Running annually without an expected end of its project time, the BBS Taiwan is expected to continue to collect and update breeding bird population distribution and abundance data.

The primary aim of the project is to produce population indices of breeding birds in Taiwan to serve as biodiversity and environmental indicators. To date, 102 breeding bird species population trends were reported (Ko *et al.* 2017). The usage of the dataset has broadened into a wide range of issues, including the Red-List of Birds of Taiwan (Lin *et al.* 2016), status and characteristics of introduced bird species in Taiwan (Su *et al.* 2014, 2015, 2016, 2017), and landscape planning (Huang 2015). Due to the standardized sampling protocol, comprehensive spatial coverage, and the increasing temporal coverage in the future, the usage of the dataset has even more potential in studying biogeography, community composition, and biodiversity indicators.

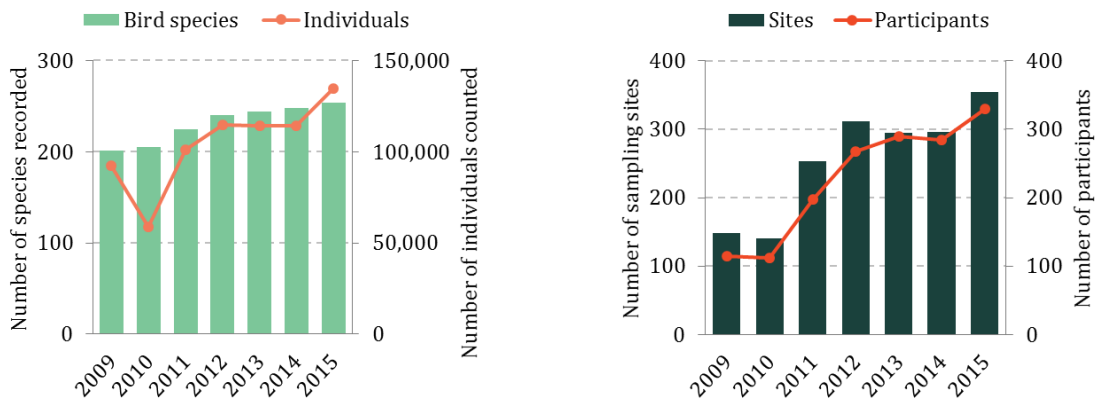

Fig. 1 Statistics of the BBS Taiwan from 2009 to 2015.
圖1. BBS Taiwan於2009至2015年的統計數據

Project details

Project title: Bird sampling dataset of the Taiwan Breeding Bird Survey (BBS Taiwan)
Funding: Current funding from the Endemic Species Research Institute, Council of Agriculture, Executive Yuan, R.O.C. (Taiwan). Initial funding was from the Forestry Bureau, Council of Agriculture, and the Biodiversity Research Center, National Taiwan University.

Study area descriptions/descriptor: As a nationwide monitoring project, the study extent is expected to cover both the Taiwan island and its main associated islands. This includes c. 36,190 square kilometers of land mass, located roughly between 21.5°N to 26.5°N and 118°E to 122°E. The climate is mainly subtropical with a mean temperature 18°C in winter and 28°C in summer, while average precipitation is 2,200 mm in the plains and over 3,000 mm in the mountains areas. Mountains compose 70% of the main island, and the elevation ranges from 0 meters to 3,952 meters a.s.l..

Taxonomic coverage

General taxonomic coverage description: A total of 313 bird species from 62 families have been recorded (Table 1), including all 27 endemic bird species of Taiwan, as well as most of the introduced bird species.

Table 1. List of bird orders and families recorded in the dataset
表1. 資料集內涵蓋的鳥類目別與科別

Order	Family	Family English Name
Anseriformes	Anatidae	Ducks, Geese, and Waterfowl
Galliformes	Phasianidae	Pheasants, Grouse, and Allies
Pelecaniformes	Pelecanidae	Pelicans
Pelecaniformes	Ardeidae	Herons, Egrets, and Bitterns
Pelecaniformes	Threskiornithidae	Ibises and Spoonbills
Accipitriformes	Pandionidae	Osprey
Accipitriformes	Accipitridae	Hawks, Eagles, and Kites
Gruiformes	Rallidae	Rails, Gallinules, and Coots
Charadriiformes	Rostratulidae	Painted-Snipes
Charadriiformes	Jacanidae	Jacanas
Charadriiformes	Scolopacidae	Sandpipers and Allies
Charadriiformes	Turnicidae	Buttonquail
Charadriiformes	Laridae	Gulls, Terns, and Skimmers
Columbiformes	Columbidae	Pigeons and Doves
Cuculiformes	Cuculidae	Cuckoos
Strigiformes	Strigidae	Owls
Caprimulgiformes	Caprimulgidae	Nightjars and Allies
Caprimulgiformes	Apodidae	Swifts
Bucerotiformes	Bucerotidae*	Hornbills

Coraciiformes	Alcedinidae	Kingfishers
Coraciiformes	Coraciidae	Rollers
Piciformes	Megalaimidae	Asian Barbets
Piciformes	Picidae	Woodpeckers
Falconiformes	Falconidae	Falcons and Caracaras
Psittaciformes	Cacatuidae*	Cockatoos
Psittaciformes	Psittacidae*	New World and African Parrots
Passeriformes	Pittidae	Pittas
Passeriformes	Campephagidae	Cuckooshrikes
Passeriformes	Laniidae	Shrikes
Passeriformes	Vireonidae	Vireos, Shrike-Babblers, and Erpornis
Passeriformes	Oriolidae	Old World Orioles
Passeriformes	Dicruridae	Drongos
Passeriformes	Monarchidae	Monarch Flycatchers
Passeriformes	Corvidae	Crows, Jays, and Magpies
Passeriformes	Alaudidae	Larks
Passeriformes	Hirundinidae	Swallows
Passeriformes	Paridae	Tits, Chickadees, and Titmice
Passeriformes	Aegithalidae	Long-tailed Tits
Passeriformes	Troglodytidae	Wrens
Passeriformes	Cinclidae	Dippers
Passeriformes	Pycnonotidae	Bulbuls
Passeriformes	Cettiidae	Bush Warblers and Allies
Passeriformes	Regulidae	Kinglets
Passeriformes	Pnoepygidae	Cupwings
Passeriformes	Phylloscopidae	Leaf Warblers
Passeriformes	Acrocephalidae	Reed Warblers and Allies
Passeriformes	Locustellidae	Grassbirds and Allies
Passeriformes	Cisticolidae	Cisticolas and Allies
Passeriformes	Paradoxornithidae	Parrotbills, Wrentit, and Allies
Passeriformes	Zosteropidae	White-eyes, Yuhinas, and Allies
Passeriformes	Timaliidae	Tree-Babblers, Scimitar-Babblers, and Allies
Passeriformes	Pellorneidae	Ground Babblers and Allies
Passeriformes	Leiothrichidae	Laughingthrushes and Allies
Passeriformes	Muscicapidae	Old World Flycatchers

Passeriformes	Turdidae	Thrushes and Allies
Passeriformes	Sturnidae	Starlings
Passeriformes	Dicaeidae	Flowerpeckers
Passeriformes	Prunellidae	Accentors
Passeriformes	Motacillidae	Wagtails and Pipits
Passeriformes	Fringillidae	Finches, Euphonias, and Allies
Passeriformes	Passeridae	Old World Sparrows
Passeriformes	Estrildidae	Waxbills and Allies

*introduced bird families

Taxonomic ranks

Class: Ave

Common names: Bird

Spatial coverage

General spatial coverage: Current records in the BBS Taiwan dataset are only from the main island of Taiwan and Lanyu Island off the east coast. The environmental gradient of the sampling locations spans an elevational range from 0–3,900m a.s.l. and across habitats from highly human-dominated urban landscapes to primary forests in remote mountain regions. Each sampling site was composed of 6–10 survey points with a 100 meter radius. Maximum distance between survey points at the same sites is 4 kilometers, and the minimum distance between survey points was 200 meters.

Coordinates: 21°48'36''N and 26°30'0''N Latitude; 118°22'48"E and 122°11'24"E Longitude

Temporal coverage: March 1, 2009 - July 31, 2015

Methods

Method step description: The BBS Taiwan applied a stratified random sampling scheme for an initial set of 450 sampling sites aimed at covering 5% of the c.f. 36,000 km^2 area of Taiwan Island. Each sampling site is viewed as representative of a c.1 km x 1 km grid area, with survey points viewed as spatial repeats. Taiwan island is divided into 91 stratums, defined by 41 eco-regions (Su 1992) combined with 3 different elevational zones (0–1,000 m, 1,000–2,500 m, 2,500–4,000 m). We allocated the 450 sampling sites into each stratum by the area proportional to the area of each stratum. Additional sites, which we termed the "customized" set of samplings sites, were selected manually by surveyors at locations where no pre-selected sites existed. To date, sampling sites, including all types, number now approximately 762. All sampling sites were available to be adopted by one or several volunteer surveyors each year, whereby we encouraged the same surveyor to adopt the same sampling site as long as possible. Each sampling

sites was surveyed twice a year (once per trip), which, in combination with the 6–10 survey points per site, gives each site a minimum sampling effort of 12 repeated samples. The above sampling effort ensures the likelihood of detecting 80% of species present and keeping the coefficient of variance below 20 % in the breeding season within each site on Taiwan (Shiu and Lee 2003). Surveys are performed during the breeding season between March and June, with sites at higher elevations surveyed in a later sequence. Surveys are conducted within four hours after sunrise on each day. The point-count method (Bibby *et al.* 2000) with a 6–minute stop time was conducted on each survey point, ensuring that this level of sampling effort detected a minimum of 80% of the species at each site (Ding 1993, Shiu and Lee 2003). We record every detected bird individual, regardless of migratory status or whether it was sighted or heard. For each bird record, the period of detection time (0–3 minutes, 3–6 minutes, and records beyond the 6–minute stop time are tagged as supplementary), horizontal distance to the observer (0–25m, 25–100m, >100m, flyover), and the formation of a flock with more than five individuals were recorded. For each survey point during each survey trip, the main-habitat, sub-habitat, presence of water-bodies, weather condition, and starting time were recorded. Habitats were classified by surveyors in the field according to categories listed in Table 2. Differences between the main and sub-habitat were judged by the percentage of area which each habitat type covers within a 100 meters radius, and only recording the two most prevalent types of habitats.

Table 2. BBS Taiwan habitat classification scheme
表2. BBS Taiwan棲地紀錄表

A-Forest	
A1	Broadleaved forest
A2	Conifer forest
A3	Mixed conifer-broadleaved forest (each >10%)
A4	Bamboo forest
A5	Mixed bamboo-broadleaved forest (each >10%)
A6	Windbreak forest (e.g. Casuarina stand)
A7	Other
B-Farmland	
B1	Rice field
B2	Other aquatic farmland (e.g. lotus or water chestnut field)
B3	Sugarcane field

B4	Dryland farm (e.g. vegetable, peanut or pineapple farm)
B5	Orchard or nursery (e.g. betel nut, tangerine, banana or wax apple orchard)
B6	Other
C-Grassland (natural and semi-natural)	
C1	Tall grassland (height >50cm, e.g. silvergrass grassland)
C2	Low grassland (height <50cm, e.g. the Lungpan grassland, pasture)
C3	High marsh (height >50cm, e.g. reed marsh)
C4	Low marsh (height <50cm, e.g. tuberous bulrush or sedge saltmarsh)
C5	Bamboo grassland
C6	Other
D-Inland (freshwater) wetland	
D1	Water storage area
D2	Lake (natural)
D3	River (water surface width >3m)
D4	Stream (water surface width <3m)
D5	Other
E-Aquaculture pond and saltpan	
E1	Flooded
E2	Dried
E3	Abandoned (vegetation overgrown to the center)
E4	Other
F-Coast	
F1	Tidal mudflat
F2	Tidal rock coast
F3	Rocky shoreline
F4	Sandy shoreline
F5	Marine
F6	Other
G-Urban and rural habitat	
G1	Urban building area
G2	Urban park and greenspace
G3	Rural setting
G4	Other
H-Other habitat type (with remarks)	

Study extent description: Sampling sites of the BBS Taiwan were selected to cover all major habitats on the main island of Taiwan, with an additional set on Lanyu Island that was surveyed during 2015. Other Taiwan's main associated islands is anticipated to be covered in the near future. Currently, the dataset contains 454 sampling sites, which includes a total of 3,901 survey points (Fig. 2). The major habitat types covered by these sampling sites include forests (48%), farmlands (24%), urban areas (12%), wetlands (7%), and grasslands (6%) (Fig. 3)

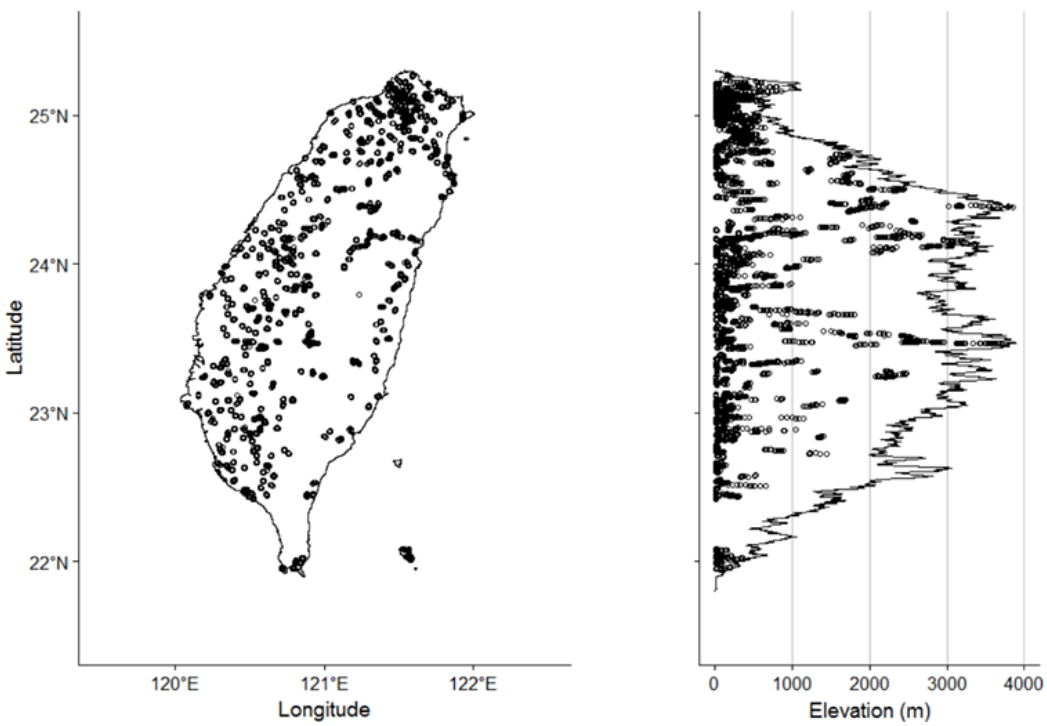

Fig 2. Distribution of sampling sites across the main island and Lanyu Island in Taiwan. Solid line on the right is the highest altitude in the survey area at each latitude.

圖2. 調查樣區於臺灣本島與蘭嶼的分布狀況；右圖實線爲各緯度最高海拔。

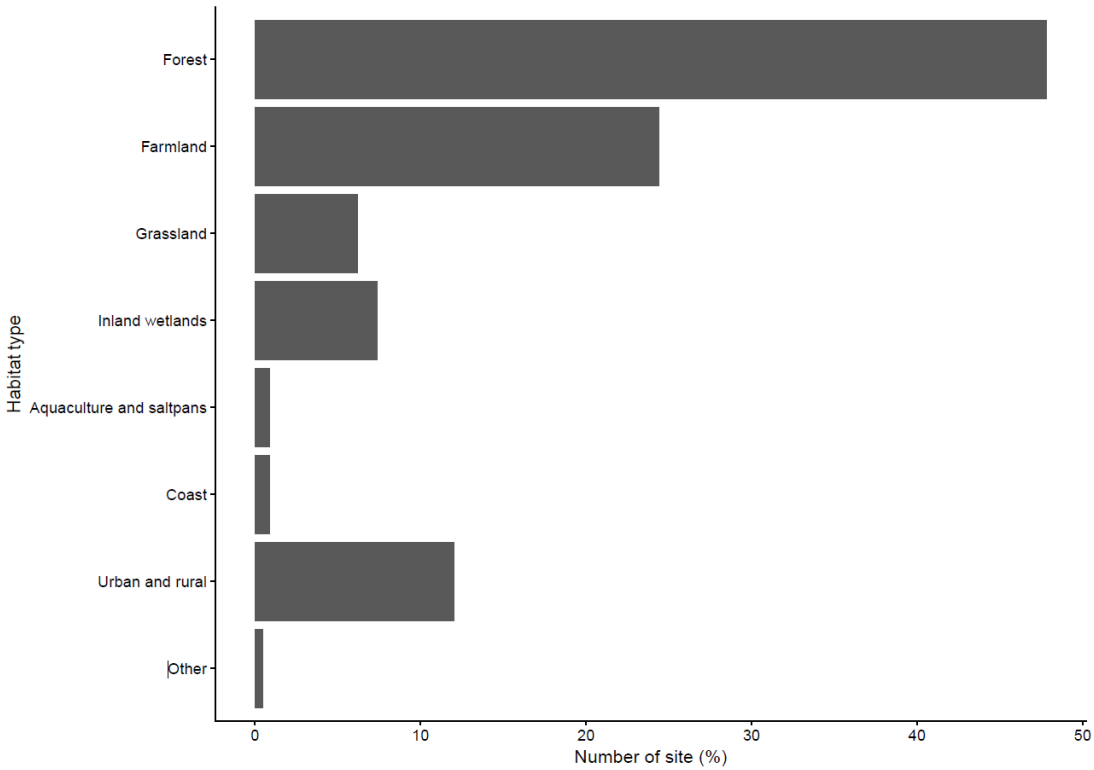

Fig 3. Percentage of habitat type coverage of sampling sites.
圖3. 調查樣區的棲地分布比例

Quality control description: Efforts to maintain the quality of data were implemented before and after each survey. Before surveys, training workshops with field excursions were held to ensure that each volunteer surveyor fully understood the survey methods. After the data were submitted by the surveyors, the location of survey points, correctness of the time period, distance, and flock notes were reviewed the BBS Taiwan workgroup. Filters for rare or easily-misidentified species and unusually high numbers were also used to detect possibly erroneous records. The highlighted records were then double-checked with surveyors, and doubtful records were deleted from the release version of the dataset. The taxonomic system follows the Checklist of Birds of Taiwan maintained by the Bird Record Committee of the Chinese Wild Bird Federation (Ding *et al.* 2017). All columns in the dataset are described in the metadata provided through the GBIF Integrated Publishing Toolkit (IPT) hosted by Taiwan Biodiversity Information Facility (TaiBIF). The dataset accompanying this data paper is the complete set

of the collected raw data.

Datasets

Dataset description

Object name: Darwin Core Archive The Taiwan Breeding Bird Survey Data

Character encoding: UTF-8

Format name: Darwin Core Archive format

Format version: 1.0

Distribution:

http://ipt.taibif.tw/archive.do?r=bbstaiwan_dataset

https://www.gbif.org/dataset/f170f056-3f8a-4ef3-ac9f-4503cc854ce0

Publication date of data: 2017-10-04

Language: English

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Metadata language: English

Date of metadata creation: 2017-07-13

Hierarchy level: Dataset

Acknowledgements

We thank all of the participants of BBS Taiwan, including the project organizers, regional organizers, workshop speakers, and survey volunteers. We thank Mai Guan-Shuo of the Systematics and Biodiversity Informatics Center with solving Darwin Core Archive difficulties, Liu Kuan-Ting for technical support in preparing the dataset, and An-Yu Chang for image production. The BBS Taiwan workgroup thanks the Forestry Bureau, Council of Agriculture, and the Biodiversity Research Center, National Taiwan University, for funding the project in the initial stage. Bruno A. Walther edited this manuscript.

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