



A dataset of bird distributions in zoogeographical regions of China

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Abstract

Background

China, the largest country in Asia, has a land area of approximately 9.6 million square kilometres. There are 1481 bird species (following the taxonomy of IOC World Bird List version 12.1) recorded in two zoogeographical realms, seven regions and 19 subregions in the country. From 1955 to 2017, six authoritative monographs were published, which recorded the distribution area for all bird species in China and were widely quoted by research papers and field guides. This massive amount of data could be used to address many hot topics in ornithology, biogeography and ecology. However, rapid changes in the taxonomic status and different schemes of zoogeographical regionalisation in these six monographs provided limits to the utilisation of these valuable data.

New information

By integrating the data from the six monographs, we presented an open-access dataset on the occurrences and residence types of all Chinese bird species in zoogeographical

regions over the past 60 years. The taxonomic statuses for these species were determined following the IOC World Bird List version 12.1 and the zoogeographical regions were based on the updated scheme. These data provide valuable information for the research in bird ecology and conservation biology.

Keywords

birds, China, distribution, residence type

Introduction

Bird distribution data are vitally important for addressing many hot topics in ecology (Powney and Isaac 2015). Combined with knowledge of phylogeny and ecological traits, the distribution data could contribute to identification of biodiversity hotspots and assessment of conservation prioritisation (Loiseau et al. 2020, Jetz et al. 2014, Benedetti et al. 2022). Macroecology and biogeography also require large-scale distribution data to explain spatial patterns of diversity (Davies et al. 2007, Lennon et al. 2001, Komaki 2021). The impact of global climate change on birds has caused widespread discussion and much of this evidence is based on the knowledge of range shifts (Gillings et al. 2015, Hitch and Leberg 2007, Huntley et al. 2006). Although the occurrence data have been growing continuously under wider public participation, the historical data are difficult to supplement (Peterson et al. 2018). Earlier historical literature may have a positive effect on improving the temporal coverage (Narwade et al. 2011).

China, the largest country in Asia, has a land area of approximately 9.6 million square kilometres and a vast maritime territory (Zheng et al. 2015). The interaction of complex topography and climate provides abundant niches for organisms and breeds high biodiversity in this country (He et al. 2017). According to historical literature and bird surveys, 1481 bird species have been documented in China so far, which is equivalent to 13% of the bird species in the world (Gill et al. 2022, Zheng 2017). However, the existing digital accessible dataset could not fill the gap completely in China's bird distributions. The most prominent portal of diversity data, Global Biodiversity Information Facility (GBIF) has a number of occurrence data of China's birds, but the tremendously low temporal coverage hinders researchers from revealing the distributional dynamics of each species (Huang et al. 2020). The Birdlife International and Handbook of the Birds of the World also provide digitised distribution maps for birds, but static maps could not show the distributional dynamics. In addition, the bird species diversity would be underestimated, based on the above digital dataset (Ding et al. 2022). For instance, the record of Velvet Scoter, *Melanitta fusca*, in Shannxi Province is not included in the distribution map by Birdlife International (Zheng 2017, Ding et al. 2022).

Since 1955, six Chinese ornithology monographs have been published which were widely quoted by research papers and field guides. These authoritative data could provide historic distributions and geographic dynamics of Chinese birds at the scale of zoogeographical

regions. The systematic study of the avifauna in China began in the middle 19th century (Swinhoe 1863). After the middle 20th century, ornithologists carried out many bird surveys and published local avifaunas. Cheng Tso-hsin systematically summarised these data in the first and revised editions of *The Distribution List of Chinese Birds* (Cheng 1955, Cheng 1958, Cheng 1976) and *A Synopsis of the Avifauna of China* (Cheng 1987), which were the representative works of bird classification and fauna research at that stage. From the 21st century, the vigorous growth of bird watching activities has provided much new data. Three versions of *A Checklist on a Classification and Distribution of the Birds of China* (Zheng 2005, Zheng 2011, Zheng 2017) reflected this latest progress in bird classification and distribution.

However, rapid changes in taxonomic status and different schemes of zoogeographical regionalisation in the monographs limit the utilisation of these valuable data. Following IOC World Bird List version 12.1, the taxonomic status of nearly 300 bird species in early monographs need to be updated and the scientific names of more than 400 species also need to be updated due to taxonomic changes. In addition, the standards used to divide zoogeographical regions/subregions are not consistent in the six monographs. Besides, the two versions of *The Distribution List of Chinese Birds* (Cheng 1955, Cheng 1958, Cheng 1976) written in Chinese were published fifty years ago and are not easily accessible now. All these factors make it difficult to digitise these data. The present project aims to sort out the data from the six monographs under unified standards and provide an open-access dataset about Chinese bird occurrences in zoogeographical regions that could be used in further research to better understand the bird diversity in this country.

General description

Purpose: There are six authoritative bird monographs on the occurrence of bird and residence types in China that were published from 1955 to 2017. Rapid changes in taxonomic status and different schemes of zoogeographical regionalisation limit the utilisation of these valuable data. The objective of this study will present a digitalised dataset on bird distributions in zoogeographical regions of China over the past 60 years under unified standards.

Sampling methods

Sampling description: The dataset, compiled from six fauna books published from 1955 to 2017 (Cheng 1955, Cheng 1958, Cheng 1976, Cheng 1987, Zheng 2005, Zheng 2011, Zheng 2017), indicates the distributions and residence status of birds in China.

We follow the taxonomy and nomenclature in the IOC World Bird List version 12.1 which is an up-to-date evolutionary classification of world birds constructed by the international community of ornithologists (Gill et al. 2022) and adopt the following strategies to normalise the data: 1) The scientific name would be revised directly if the taxonomy change does not affect its species rank, for example, the scientific name of Swinhoe's

Storm Petrel is *Oceanodroma monorhis* in all six monographs, but is changed to *Hydrobates monorhis* as the previous genus *Oceanodroma* is paraphyletic (Penhallurick and Wink 2004); 2) The species would be assumed as a non-detection in the time periods before it was discovered, for example, *Stachyris nonggangensis* is a new species described in 2008 (Zhou and Jiang 2008), which is recorded as a non-detection in the four monographs published before 2008; 3) If a taxon is treated as a synonym of another species, its distribution area would be lumped into the respective species, for example, the species *Caprimulgus centralasicus* is now regarded as a synonym of *Caprimulgus europaeus* (Schweizer et al. 2020), so the distribution data of *Caprimulgus centralasicus* are merged into *Caprimulgus europaeus*; 4) If a taxon were regarded as a subspecies previously, but is given a species rank now, its distribution area was adjusted according to the original document at subspecies level, for example, common blackbird is split into three species, *Turdus mandarinus*, *Turdus maximus* and *Turdus merula* (Nylander et al. 2008), the distribution area is adjusted according to the respective subspecies.

The first division scheme of China zoogeographical regions was initiated in 1959 and utilised by Cheng in his two monographs (Cheng 1976, Cheng 1987). Then, the scheme was revised twice in 1978 and 1999 (Zhang 1999) and Zheng followed these revisions in his three monographs (Zheng 2005, Zheng 2011, Zheng 2017). The main changes were that: a) the Songliao Plain Subregion, the Himalaya Subregion and the South China Sea Islands Subregion were added so that the total number of subregions increased from 16 to 19; b) the border between the South-western Region and the Qinghai-Xizang Region was adjusted; c) Altay Prefecture was regarded as a part of the West-desert Subregion instead of the Da Hinggan Mountain Subregion. Thus, we follow the zoogeographical regionalisation of China adapted by Zheng (2017) and show the map in Fig. 1 (Zhang 1999). If Cheng was unsure of a distribution, it was noted with a question mark in his monographs (Cheng 1955, Cheng 1958, Cheng 1976, Cheng 1987). These questionable areas were not included in our dataset. For the species distribution boundary close to the boundary between zoogeographical subregions, the data are entered by carefully comparing the distribution maps/textual description of the administrative area with the boundary of the zoogeographical regions (Fig. 1). The data from Zheng's three monographs (Zheng 2005, Zheng 2011, Zheng 2017) are entered according to the records of zoogeographical region codes and provincial administrative units.

For each species, the status in each subregion is indicated in the dataset. The residence types are divided into five categories: resident (R, the birds that live in the subregion all year round and do not migrate in the spring and autumn), summer visitor (S, the birds that come to the subregion for breeding in spring and leave in autumn), winter visitor (W, the birds that come to the subregion for overwintering and leave in spring), passage migrant (P, the birds that stop off in the subregion during their migration, but do not stay there for a long time) and vagrant visitor (V, the birds that occur in the subregion by deviation of the regular path during their migration or are scarce species in the subregion). If the species occurs in the zoogeographical region with particular residence type, it is recorded as "1" in the cell; otherwise, it is recorded as "0" in the cell. It should be noted that there is more than one residence type in the same subregion for many species, for example, Demoiselle

reach to collect or observe birds have been limited thus far. Hence, false negatives, in which a species failed to be reported from the sites where it actually occurs, are inevitable in these six monographs. These errors should be considered or corrected when the dataset is used. There are many analytical tools that can deal with distribution data with false negatives (Altwegg and Nichols 2019, Miller et al. 2019).

Geographic coverage

Description: China has a land area of approximately 9.6 million square kilometres with two zoogeographical realms, seven regions and 19 subregions (Fig. 1, Table 1).

| Table 1. | | | | | |
|--|----------------------------|-----------------------------------|---|-------------------------------------|-------------------|
| The division of zoogeographical regions of China (Note: Only the land area of each subregion is calculated in this table. Subregion VIIC includes Hainan Island and adjacent islands and the centre of Hainan Island is recorded as the geometric centre of this subregion. Subregion VIID includes Taiwan Island and adjacent islands and the centre of Taiwan Islands is recorded as the geometric centre of this subregion. Subregion VIIE includes the islands in the South China Sea and Huangyan Dao is regarded as the geometric centre of this subregion). | | | | | |
| Realm | Zoogeographical region | Zoogeographical subregion | Ecogeographical Fauna Group | Area | Geometric centre |
| Palearctic Realm | I. North-eastern Region | IA. Da Hinggan Mountain Subregion | Boreal forest fauna | 2.5×10 ⁵ km ² | 50.59°N, 124.15°E |
| | | IB. Changbai Mountain Subregion | Temperate forest, forest-steppe and farmland fauna | 4.1×10 ⁵ km ² | 45.15°N, 125.00°E |
| | | IC. Songliao Plain Subregion | Temperate forest, forest-steppe and farmland fauna | 2.5×10 ⁵ km ² | 44.59°N, 128.70°E |
| | II. North China Region | IIA. Huang-Huai Plain Subregion | Temperate forest, forest-steppe and farmland fauna | 4.1×10 ⁵ km ² | 36.37°N, 117.16°E |
| | | IIB. Loess Plateau Subregion | Temperate forest, forest-steppe and farmland fauna | 5.7×10 ⁵ km ² | 37.43°N, 110.71°E |
| | III. Mongo-Xinjiang Region | IIIA. East-Meadow Subregion | Temperate steppe fauna | 7.0×10 ⁵ km ² | 44.43°N, 117.12°E |
| | | IIIB. West-desert Subregion | Temperate desert and semi-desert fauna | 1.9×10 ⁶ km ² | 40.63°N, 92.18°E |
| | | IIIC. Tianshan Hilly Subregion | Alpine forest-steppe, meadow steppe and cold desert fauna | 4.1×10 ⁵ km ² | 43.34°N, 83.91°E |
| | IV. Qinghai-Xizang Region | IVA. Qiantang Plateau Subregion | Alpine forest-steppe, meadow steppe and cold desert fauna | 1.2×10 ⁶ km ² | 34.03°N, 87.51°E |
| | | IVB. Qinghai-Zangnan Subregion | Alpine forest-steppe, meadow steppe and cold desert fauna | 8.2×10 ⁵ km ² | 32.86°N, 95.37°E |

| Realm | Zoogeographical region | Zoogeographical subregion | Ecogeographical Fauna Group | Area | Geometric centre |
|----------------|-------------------------|--|---|-----------------------------------|-------------------|
| Oriental Realm | V. South-western Region | VA. South-West Mountains Subregion | Subtropical forest, scrub, grassland and farmland fauna | 5.2×10^5 km ² | 28.45°N, 102.12°E |
| | | VB. Himalaya Subregion | Subtropical forest, scrub, grassland and farmland fauna | 1.3×10^5 km ² | 28.39°N, 93.65°E |
| | VI. Mid-China Region | VIA. Eastern Hillock-Plain Subregion | Subtropical forest, scrub, grassland and farmland fauna | 8.6×10^5 km ² | 29.21°N, 115.95°E |
| | | VIB. Western Mountain-Plateau Subregion | Subtropical forest, scrub, grassland and farmland fauna | 7.1×10^5 km ² | 29.71°N, 108.33°E |
| | VII. South China Region | VIIA. Min-Guang Coastal Subregion | Tropical forest, scrub, grassland and farmland fauna | 3.7×10^5 km ² | 23.43°N, 111.75°E |
| | | VII B. Diannan Hilly Subregion | Tropical forest, scrub, grassland and farmland fauna | 1.9×10^5 km ² | 23.88°N, 100.77°E |
| | | VII C. Hainan Island Subregion | Tropical forest, scrub, grassland and farmland fauna | 3.5×10^4 km ² | 19.19°N, 109.74°E |
| | | VII D. Taiwan Subregion | Tropical forest, scrub, grassland and farmland fauna | 3.6×10^4 km ² | 23.75°N, 120.97°E |
| | | VII E. South China Sea Islands Subregion | Tropical forest, scrub, grassland and farmland fauna | 2.0×10^2 km ² | 15.11°N, 117.46°E |

Taxonomic coverage

Description: This dataset provides the distribution information for the 1481 species of birds recorded in China, which belong to 28 orders and 114 families, following IOC World Bird List version 12.1 (Gill et al. 2022) for nomenclature (Table 2).

| Table 2. The taxa included in The Dataset on the Birds Distribution in China over the past 60 years | | | |
|--|------------------|--------------------|-------------------|
| Rank | Scientific name | Number of families | Number of species |
| Order | Anseriformes | 1 | 55 |
| Order | Galliformes | 1 | 64 |
| Order | Caprimulgiformes | 1 | 6 |
| Order | Podargiformes | 1 | 1 |

| Rank | Scientific name | Number of families | Number of species |
|-------|---------------------|--------------------|-------------------|
| Order | Apodiformes | 2 | 16 |
| Order | Otidiformes | 1 | 3 |
| Order | Pterocliiformes | 1 | 3 |
| Order | Columbiformes | 1 | 31 |
| Order | Cuculiformes | 1 | 20 |
| Order | Gruiformes | 2 | 29 |
| Order | Podicipediformes | 1 | 5 |
| Order | Phoenicopteriformes | 1 | 1 |
| Order | Charadriiformes | 13 | 135 |
| Order | Phaethontiformes | 1 | 3 |
| Order | Gaviiformes | 1 | 4 |
| Order | Procellariiformes | 4 | 16 |
| Order | Ciconiiformes | 1 | 8 |
| Order | Suliformes | 3 | 11 |
| Order | Pelecaniformes | 3 | 35 |
| Order | Accipitriformes | 2 | 55 |
| Order | Strigiformes | 2 | 33 |
| Order | Trogoniformes | 1 | 3 |
| Order | Bucerotiformes | 2 | 6 |
| Order | Coraciiformes | 3 | 23 |
| Order | Piciformes | 3 | 43 |
| Order | Falconiformes | 1 | 12 |
| Order | Psittaciformes | 1 | 10 |
| Order | Passeriformes | 59 | 850 |

Temporal coverage

Notes: The six monographs were published from 1955 to 2017. The Distribution List of Chinese Birds (Cheng 1955, Cheng 1958) includes bird records since 1922, which makes the state of temporal coverage shift to an earlier date.

Usage licence

Usage licence: Creative Commons Public Domain Waiver (CC-Zero)

Data resources

Data package title: A dataset of bird distributions in zoogeographical regions of China

Number of data sets: 1

Data set name: A dataset of bird distributions in zoogeographical regions of China

Description: The dataset (Suppl. material 1) which is collected from six avifauna monographs reflects the bird distributions in China in six different time periods from 1955 to 2017 in zoogeographical regions. The taxonomy and nomenclature follow IOC World Bird List (v. 12.1) (Gill et al. 2022) and the zoogeography follows Zhang (1999). The residence type in each subregion of the total 1481 species is recorded by "0" and "1" as presence/absence in the dataset.

| Column label | Column description |
|-----------------|--|
| The data source | The monograph from which the data were collected (author, year). |
| Scientific name | The scientific name of the bird. |
| English name | The English name of the bird. |
| Chinese name | The Chinese name of the bird. |
| IAR | The resident in Da Hinggan Mountain Subregion. |
| IAS | The summer visitor in Da Hinggan Mountain Subregion. |
| IAW | The winter visitor in Da Hinggan Mountain Subregion. |
| IAP | The passage migrant in Da Hinggan Mountain Subregion. |
| IAV | The vagrant visitor in Da Hinggan Mountain Subregion. |
| IBR | The resident in Changbai Mountain Subregion. |
| IBS | The summer visitor in Changbai Mountain Subregion. |
| IBW | The winter visitor in Changbai Mountain Subregion. |
| IBP | The passage migrant in Changbai Mountain Subregion. |
| IBV | The vagrant migrant in Changbai Mountain Subregion. |
| ICR | The resident in Songliao Plain Subregion. |
| ICS | The summer visitor in Songliao Plain Subregion. |
| ICW | The winter visitor in Songliao Plain Subregion. |
| ICP | The passage migrant in Songliao Plain Subregion. |
| ICV | The vagrant migrant in Songliao Plain Subregion. |
| IIAR | The resident in Huang-Huai Plain Subregion. |
| IIAS | The summer visitor in Huang-Huai Plain Subregion. |

| | |
|-------|--|
| IIAW | The winter visitor in Huang-Huai Plain Subregion. |
| IIAP | The passage migrant in Huang-Huai Plain Subregion. |
| IIAV | The vagrant migrant in Huang-Huai Plain Subregion. |
| IIBR | The resident in Loess Plateau Subregion. |
| IIBS | The summer visitor in Loess Plateau Subregion. |
| IIBW | The winter visitor in Loess Plateau Subregion. |
| IIBP | The passage migrant in Loess Plateau Subregion. |
| IIBV | The vagrant migrant in Loess Plateau Subregion. |
| IIIAR | The resident in East-Meadow Subregion. |
| IIIAS | The summer visitor in East-Meadow Subregion. |
| IIIAW | The winter visitor in East-Meadow Subregion. |
| IIIAP | The passage migrant in East-Meadow Subregion. |
| IIIAV | The vagrant migrant in East-Meadow Subregion. |
| IIIBR | The resident in West-desert Subregion. |
| IIIBS | The summer visitor in West-desert Subregion. |
| IIIBW | The winter visitor in West-desert Subregion. |
| IIIBP | The passage migrant in West-desert Subregion. |
| IIIBV | The vagrant migrant in West-desert Subregion. |
| IIICR | The resident in Tianshan Hilly Subregion. |
| IIICS | The summer visitor in Tianshan Hilly Subregion. |
| IIICW | The winter visitor in Tianshan Hilly Subregion. |
| IIICP | The passage migrant in Tianshan Hilly Subregion. |
| IIICV | The vagrant migrant in Tianshan Hilly Subregion. |
| IVAR | The resident in Qiantang Plateau Subregion. |
| IVAS | The summer visitor in Qiantang Plateau Subregion. |
| IVAW | The winter visitor in Qiantang Plateau Subregion. |
| IVAP | The passage migrant in Qiantang Plateau Subregion. |
| IVAV | The vagrant migrant in Qiantang Plateau Subregion. |
| IVBR | The resident in Qinghai-Zangnan Subregion. |
| IVBS | The summer visitor in Qinghai-Zangnan Subregion. |
| IVBW | The winter visitor in Qinghai-Zangnan Subregion. |

| | |
|-------|--|
| IVBP | The passage migrant in Qinghai-Zangnan Subregion. |
| IVBV | The vagrant migrant in Qinghai-Zangnan Subregion. |
| VAR | The resident in South-West Mountains Subregion. |
| VAS | The summer visitor in South-West Mountains Subregion. |
| VAW | The winter visitor in South-West Mountains Subregion. |
| VAP | The passage migrant in South-West Mountains Subregion. |
| VAV | The vagrant migrant in South-West Mountains Subregion. |
| VBR | The resident in Himalaya Subregion. |
| VBS | The summer visitor in Himalaya Subregion. |
| VBW | The winter visitor in Himalaya Subregion. |
| VBP | The passage migrant in Himalaya Subregion. |
| VBV | The vagrant migrant in Himalaya Subregion. |
| VIAR | The resident in Eastern Hillock-Plain Subregion. |
| VIAS | The summer visitor in Eastern Hillock-Plain Subregion. |
| VIAW | The winter visitor in Eastern Hillock-Plain Subregion. |
| VIAP | The passage migrant in Eastern Hillock-Plain Subregion. |
| VIAV | The vagrant migrant in Eastern Hillock-Plain Subregion. |
| VIBR | The resident in Western Mountain-Plateau Subregion. |
| VIBS | The summer visitor in Western Mountain-Plateau Subregion. |
| VIBW | The winter visitor in Western Mountain-Plateau Subregion. |
| VIBP | The passage migrant in Western Mountain-Plateau Subregion. |
| VIBV | The vagrant migrant in Western Mountain-Plateau Subregion. |
| VIIAR | The resident in Min-Guang Coastal Subregion. |
| VIIAS | The summer visitor in Min-Guang Coastal Subregion. |
| VIIAW | The winter visitor in Min-Guang Coastal Subregion. |
| VIIAP | The passage migrant in Min-Guang Coastal Subregion. |
| VIIAV | The vagrant migrant in Min-Guang Coastal Subregion. |
| VIIBR | The resident in Diannan Hilly Subregion. |
| VIIBS | The summer visitor in Diannan Hilly Subregion. |
| VIIBW | The winter visitor in Diannan Hilly Subregion. |
| VIIBP | The passage migrant in Diannan Hilly Subregion. |

| | |
|-------|---|
| VIIBV | The vagrant migrant in Diannan Hilly Subregion. |
| VIICR | The resident in Hainan Island Subregion. |
| VIICS | The summer visitor in Hainan Island Subregion. |
| VIICW | The winter visitor in Hainan Island Subregion. |
| VIICP | The passage migrant in Hainan Island Subregion. |
| VIICV | The vagrant migrant in Hainan Island Subregion. |
| VIIDR | The resident in Taiwan Subregion. |
| VIIDS | The summer visitor in Taiwan Subregion. |
| VIIDW | The winter visitor in Taiwan Subregion. |
| VIIDP | The passage migrant in Taiwan Subregion. |
| VIIDV | The vagrant migrant in Taiwan Subregion. |
| VIIER | The resident in South China Sea Islands Subregion. |
| VIIES | The summer visitor in South China Sea Islands Subregion. |
| VIIEW | The winter visitor in South China Sea Islands Subregion. |
| VIIEP | The passage migrant in South China Sea Islands Subregion. |
| VIIEV | The vagrant migrant in South China Sea Islands Subregion. |
| Note | Notes of the status and taxonomic changes. |

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Author contributions

C.X. designed the study and collected all the monographs. J.H. and Q.Z. collected the data. Q.Z. compiled the data. Q.Z. and C.X. drafted the manuscript. A.M. edited the manuscript.

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Supplementary material

Suppl. material 1: A dataset of bird distributions in zoogeographical regions of China [doi](#)

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Data type: occurrences

Brief description: The dataset which is collected from six avifauna monographs reflects the bird distributions in China in six different time periods from 1955 to 2017 in zoogeographical regions. The taxonomy and nomenclature follow the IOC World Bird List (v. 12.1) (Gill et al. 2022) and the zoogeography follows Zhang (1999). The residence type in each subregion of the total 1481 species is recorded by "0" and "1" as presence/absence in the dataset.

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