



Modeling the Distribution of Rare or Cryptic Bird Species of Taiwan

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ABSTRACT: For the study of the macroecology and conservation of Taiwan's birds, there was an urgent need to develop distribution models of bird species whose distribution had never before been modeled. Therefore, we here model the distributions of 27 mostly rare and cryptic breeding bird species using a statistical approach which has been shown to be especially reliable for modeling species with a low sample size of presence localities, namely the maximum entropy (Maxent) modeling technique. For this purpose, we began with a dedicated attempt to collate as much high-quality distributional data as possible, assembling databases from several scientific reports, contacting individual data recorders and searching publicly accessible database, the internet and the available literature. This effort resulted in 2022 grid cells of 1×1 km size being associated with a presence record for one of the 27 species. These records and 10 pre-selected environmental variables were then used to model each species' probability distribution which we show here with all grid cells below the lowest presence threshold being converted to zeros. We then in detail discuss the interpretation and applicability of these distributions, whereby we pay close attention to habitat requirements, the intactness and fragmentation of their habitat, the general detectability of the species and data reliability. This study is another one in an ongoing series of studies which highlight the usefulness of using large electronic databases and modern analytical methods to help with the monitoring and assessment of Taiwan's bird species.

KEY WORDS: Biogeography, conservation status, GIS, rarity, Taiwan avifauna.

INTRODUCTION

Taiwan is an important biodiversity hotspot of endemism for many taxa. One of the most visible and well-documented taxa of Taiwan's fauna is its avifauna, with more than 589 bird species having been recorded in all of Taiwan, including its outlying islands (Chinese Wild Bird Federation, 2011) and 145 species having been reported as breeding birds on Taiwan's mainland (Fang, 2008). Recently, the first comprehensive avifauna of Taiwan was published (Severinghaus et al., 2010, abbreviated as AT from hereupon), and constant-effort monitoring schemes have been set up, such as the Taiwan Breeding Bird Survey (BBS Taiwan) and the Monitoring Avian Productivity and Survivorship in Taiwan (MAPS Taiwan) project (Lin, 2012). Therefore, more and more information is now available to assess the status of Taiwan's bird species, such as their rarity and threat of extinction (AT; Council of Agriculture of Executive Yuan, 2009; Ko et al., 2009b; Chinese Wild Bird Federation, 2010; Walther et al., 2011; Wu et al., in press; in review).

Species are rare for different ecological and evolutionary reasons, and, consequently, also display different kinds of rarity: they have small ranges, they occur in few habitats, they have small population sizes, or any combination of these (Rabinowitz, 1981; Kunin and Gaston, 1993; Kunin and Gaston, 1997). Moreover, they may not be rare at all as defined above, but simply

appear rare because they are difficult to record for various reasons, e.g., being cryptic, difficult to identify or occurring in inaccessible regions.

In this study, our only criterion of rarity is the number of geographically separated localities where a species was recorded. We do not assume that a low number of such records necessarily implies that the species is ecologically rare as defined above. However, most of the species with a low number of records will also be ecologically rare although some may simply be difficult to record (see Discussion for species-specific details).

With the growing availability of locational databases on Taiwanese birds, there is also a growing need to analyze this information. In an effort to collate much of the available distributional data on Taiwanese birds, Wu et al. (in press) recently built statistical distribution models for 116 out of the total of 145 Taiwanese breeding bird species. The models were used to highlight areas of high avian species richness (Wu et al., in review) and to reassess the conservation status of Taiwan's avifauna (Wu et al., in press). These 116 species were chosen because they had been recorded in ≥ 30 geographically separated localities within a grid of 36022 pixels of 1×1 km size covering mainland Taiwan.

Most of these 116 species are the more common or more easily recorded species of Taiwan, while the remaining 29 species are mostly rare or cryptic species.