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依據出現型資料下的共同物種數估計

Estimate the Richness of Shared Species

Based on Incidence Data

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**MASTER’S THESIS ACCEPTANCE CERTIFICATE**

**NATIONAL TAIWAN UNIVERSITY**

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本論文係 郭昱嫻 R110621201在國立臺灣大學農藝學系完成之碩士學位論文，於民國113年6月321日承下列考試委員審查通過及口試及格，特此證明。

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（指導教授Advisor）

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# 摘要

兩群落之間的共同物種在群落中所佔的比例，可以做為一種表示*Beta*多樣性最簡單且直觀的指標之一。在過去的許多文獻中，以針對不同抽樣方式、調查方法或是資料型態，提出許多針對群落之間共同物種數的估計方法。且在估計方法的建構中，其中一項常見的估計方式便是使用有母數估計。而在過去也有許多研究針對估計單群落中的物種數，在假設出現型資料中，物種在出現的區塊數占群落中之比例服從Beta二項分佈 (Beta-binomial distribution) 的情況下使用動差法 (moment mothed) 建立估計式，且都得到良好的估計效果。因此，本文基於群落中物種出現區塊比例為Beta二項分佈的假設，使用動差法分別針對取後放回與取後不放回兩種抽樣方式，建立三個估計式。並透過多次的電腦模擬，評估估計式的優劣與穩定性。在結果方面，相較於原有的共同種估計方法，本文所提出的方式獲得較小的偏誤，且在RMSE與95%信賴區間涵蓋率 (95% confidence interval coverage) 兩項評估指標上，也相較現有的估計方法具有更好的表現。最後，將其應用至實例資料中，比較本篇所提出的估計式與現有估計式的結果差異，在計算群落共同種時，本文所提出的估計結果會高於現有估計式。

關鍵字：物種數、共同物種、Beta二項分佈、動差法、有母數估計

# Abstract

The proportion of shared species between two communities can serve as one of the simplest and most intuitive indicators of Beta diversity. Numerous studies in the past have proposed various methods for estimating the number of shared species between communities, taking into account different sampling methods, survey techniques, and data types. One common estimation approach among these methods is parametric estimation. Previous research has also developed estimation formulas for single-community species counts using the method of moments, assuming that the proportion of species occurrences in the sampling blocks follows a Beta-binomial distribution. These methods have yielded good estimation results. Therefore, based on the assumption that the proportion of species occurrences in a community follows a Beta-binomial distribution, this study employs the method of moments to establish three estimation formulas for two sampling methods: sampling with replacement and sampling without replacement. The study evaluates the accuracy and stability of these estimation formulas through extensive computer simulations. The results show that compared to existing methods for estimating shared species, the proposed methods exhibit smaller biases and perform better regarding RMSE and 95% confidence interval coverage. Finally, the study applies these methods to real-world data, comparing the proposed estimation formulas with existing ones. The proposed estimations yield higher values for the number of shared species between communities compared to existing methods.

Keywords: Species richness, shared species, Beta-binomial distribution, moment method, parametric method.