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HUMAN INDUCED CONSERVATION IN THE NATURAL ISLETS. STATUS OF VERTEBRATE DIVERSITY IN THE SELECTED SACRED FORESTS OF KERALA INDIA

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Abstract
Sacred forests are conserved based on religious aspects. Regional differences are visible among sacred groves in their management policies, temple construction, landscapes, and religious beliefs. This study analyzed whether there is any relationship between vertebrate species diversity and the management policies adopted by respective owners. To examine this, twenty sacred groves were selected. The vertebrates, such as birds, reptiles, amphibians, and mammals were surveyed, which lasted up to 2 years. Specific methodologies, such as point count for bird survey and visual encounter surveys for other vertebrates, were followed. To analyze the management policies adopted by the respective owners, nine parameters were considered, and each parameter was given a score for all the study sites. 135 species of vertebrates were recorded, and their species diversity is estimated by using the Shannon Wiener Index. To estimate the association between the management policies and species diversity, the scores of each parameter for all the sacred groves were summed and correlated with the Shannon–Wiener index. A positive correlation between these factors obtained indicated that the management policies taken by the owners influenced the species conservation.

Keywords: religious rituals, management policies, Shannon–Wiener index, correlation

1. Introduction

Sacred forests or sacred groves are small repositories of native and endemic species that are conserved based on religious aspects. A unique feature of these islets is their protection, which is influenced by the informal rules and regulations of human society over generations. The area of these patches ranges from cents to hectares, ensuring the conservation of native flora and medicinally important plants(Anbarashan et al., 2011). The role of traditional beliefs in conserving biodiversity is prominent in these landscapes(Anthwal et al., 2010). Through traditional procedures, nature conservation is ensured by the existence of these patches. Informally protected small islets have same conservation as formally protected areas (Boraiah et al., 2003). The existence of sacred groves has been reported from time immemorial and still exists in its natural form

in the midst of human livelihood even though urbanization and modernization proceed in the current era. The protected areas around the world are not enough to conserve critical habitats and species(Bhagwat & Rutte, 2006), and informally protected patches also play a crucial role in conserving native species.

In India, the omnipresence of these islets ensures biodiversity conservation within the local landscape., the conservation significance of these patches is appreciable according to many studies (Kandari et al., 2014)(Panda et al., 2020).

Kerala, the state in the southern zone of India, also contains sacred groves. The state upholds ample protected areas that boost biodiversity conservation; in addition to these areas, informally protected landscapes also ensure the conservation of native species. Associated with temples and homesteads, these patches always ensure a mutualistic association with human life, as cultural dimensions of sacred groves are also a point of research interest (Chandrashekara et al., 2002). The medicinal and endemic plant conservation of sacred groves has been well discussed, but the faunal diversity and their species richness in sacred groves have never been a point of serious research interest. In this context, this study aimed to determine the associations of vertebrate species with the selected sacred groves in Kerala and to analyze the influence of ownership and management policies adopted by the respective owners for the conservation of these patches.

2. Study area

20 sacred forests selected for the current study that belongs to Northern (Kasargod, Kannur,Kozhikkode and Malappuram), Central (Palakkad, Thrissur and Ernakulam) and Southern Kerala(Alappuzha,Pathanamthitta,Kollam and Thiruvananthapuram),. The details of the selected study sites are given in Table 1, and their locations are depicted in Figure 1.The factors considered for the selection of study sites were their area and also their management policies. Other factors such as proximity to the human settlement, encroachment, disturbance level and vegetation was also taken into consideration

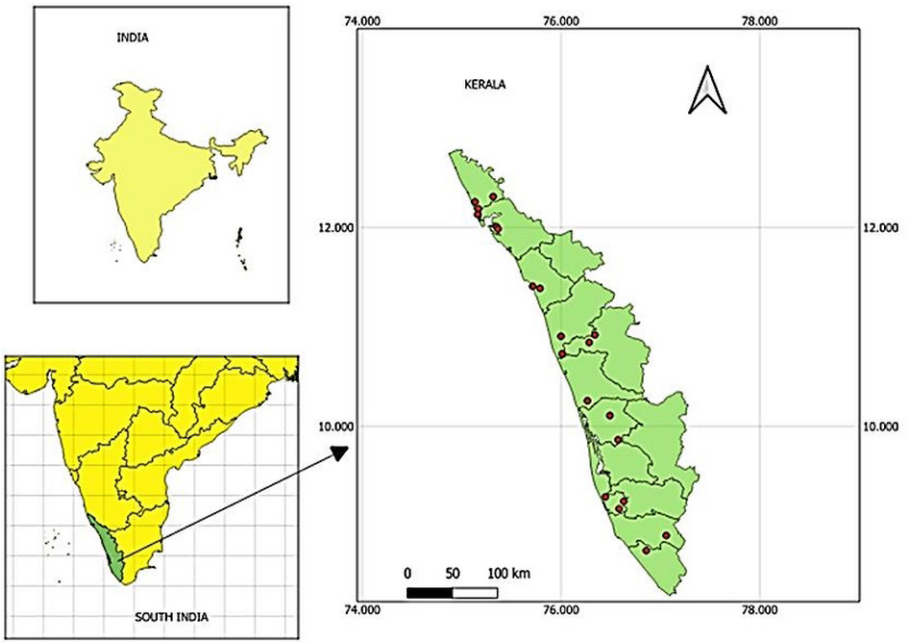

Fig. 1. Selected study sites

These sacred groves are maintained based on their own religious rules and regulations. Even though they are located in the same state, the management policies differ from each other, as every sacred grove has its own rules and management system. Therefore, this study focused on whether these management systems adopted by respective owners influence vertebrate diversity in selected sacred patches. These selected groves differ in their area, vegetation composition and canopy percentage. As travel progressed from northern Kerala to southern Kerala, there was a marked difference in the landscapes of these patches. In northern Kerala, the patch is usually composed of evergreen trees with ample area available for vertebrate conservation, whereas in some sacred groves of southern Kerala, more temple constructions are visible and small in area.

3. Methodology

Vertebrate sampling and species diversity analysis

The vertebrate species surveyed included birds, reptiles, amphibians and mammals.

For the bird survey, the point count method was used, in which the patch was divided into several points 25 m apart. Spent 5 minutes at each point, and recorded the birds seen or heard within 30 meter imaginary radius. This study followed the dimensions adopted in bird studies in fragmented forests(Raman et al., 2005). The birds were observed using 10x50 binoculars, and some were photographed by a 90D camera with a 600 mm lens. The survey time was 3 hours after sunrise, and spent 15 continuous days in sacred groves such as Kammadam sacred grove (24 ha) and Iringole Kavu sacred grove(20 ha) Vallikatu Kavu sacred grove (20 ha), spent 12 continuous days in Neeliar kottam sacred grove (6.4 ha), Vallikatu Kavu sacred grove (6.3 ha), Kayyath nagam sacred grove (6.3 ha), Karakkayil temple sacred grove (6 ha), Mannarasala (5.28) Edayilekadu sacred grove (5.2 ha), Poil Kavu sacred grove(4. 45 ha) and Pambumekkatu mana sacred grove(4.4 ha). Spent 10 continuous days in sacred groves having less than 3 ha in area, such as Mannampuram sacred grove (3 ha), Pathirikkunnath Mana sacred grove (2.4 ha),raloor kavu (2.1ha),Chandana kavu(2.1), Mookuthala temple sacred grove(2.8 ha), Vettikode temple sacred grove(1.6 ha), Shargakavu sacred grov(1.7 ha), Athipatta Mana sacred grove(0.8 ha), Kizhakomb Kavu sacred grove (0.8 ha) and Kulathoopuzha sacred grove(0.6 ha) in one year. This method is repeated in the second year that covered all the seasons. The survey period extends up to two years from August 2021 to August 2023. The birds were identified by using field guide (Grimmet et al., 2016).

For other vertebrates, such as reptiles, amphibians and mammals, visual encounter survey were time constrained was followed (Crump and Scott., 1994). The same methodology was used to survey vertebrates in all sacred groves. The study sites were divided into quadrates of 20x20 m. In each study site, the survey time was 10 hours, between 9 30 and 19 30, walked at a constant pace through the quadrates. They were found in microhabitats such as leaf litters, root buttress cavities, tree cavities, dead branches, Brocken stems and in rock crevices. Every microhabitat was surveyed to record their presence. The feathers, feces, hairs and spines were collected to identify the presence of vertebrates. Collection of specimen was avoided and the species were photographed by using a 90D camera with 18-135 mm lens and identified using the appropriate field guides (Das,2015) (Daniels,2005) (Grewal et al.,2017) (Menon,2023).

Ownership and management policies

To analyze the management policies, nine parameters are created. Selected sacred groves were examined, and the results were given scores of five. The scores for each parameter were summed and correlated by using Spearman's correlation test with the Shannon–Wiener diversity index value of

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every sacred grove to determine the influence of each parameter.

All the statistical analyses were performed with Microsoft Excel version 2011, PAST software, R software and QGIS for mapping the sites.

4. Results

Vertebrate species richness and diversity

Among the surveyed sacred groves, a total of 135 species of vertebrate were documented. Birds were dominant over the other species in terms of species distribution (Figure 1). At the individual study sites, the largest sacred grove had greater vertebrate species richness (Figure 2)

The Shannon–Wiener index was used to determine species diversity, and the results revealed that a majority of the selected patches had good vertebrate diversity irrespective of their area. The smallest sacred grove had lower diversity, whereas the largest patch had high species diversity. There were slight variations in the diversity values.

The diversity of species in an ecosystem depends on multiple factors; this study tested the effect of management policies on species diversity. The selected sacred groves were given a score based on the parameters (Table 2). The nine parameters are as follows: presence and maintenance of compound wall (A), public pathway management (B), entry into vegetation zone of sacred groves by owners (C), adoption of religious rules and regulations in temples (D), vegetation maintenance (E), maintenance of patches in their natural form (F), prevention of public entry into groves (G), not doing temple constructions (H) and prevention of public malpractices such as throwing waste into the patch (I).

The total score obtained by this method was subsequently correlated with the Shannon–Wiener diversity index, which is depicted in Figure 4.

A positive correlation (0.5) indicated that the selected parameters influenced the species diversity as well as the conservation of sacred groves. We also performed regression analysis, which revealed the same results (Tables 3 and 4), as a p value less than 0.05 indicated a linear relationship between the factors. Furthermore, the F test result is 54.62(Table 5) that highlights the regression analysis is statistically significant since a high f test index is witnessed in the current study

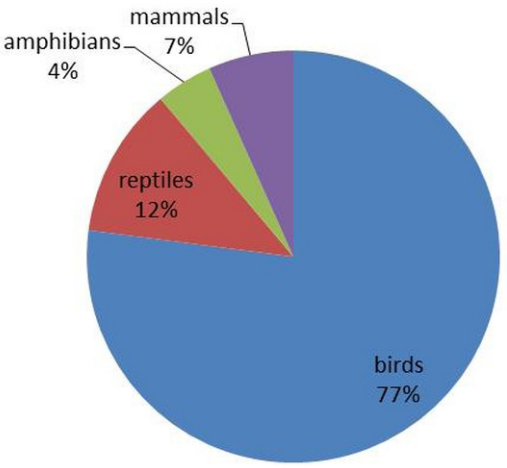

Fig. 2. Vertebrate species composition

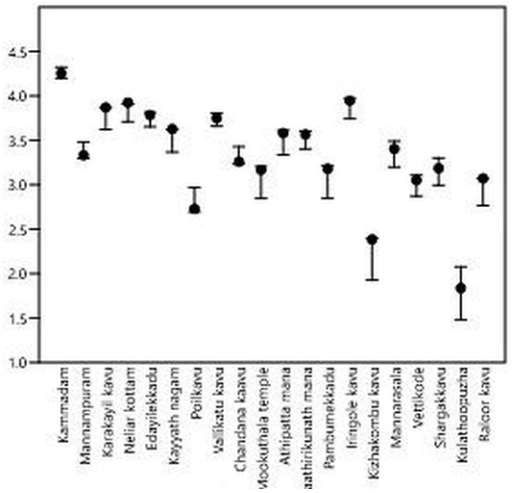

Fig. 4. Shannon–Wiener index results

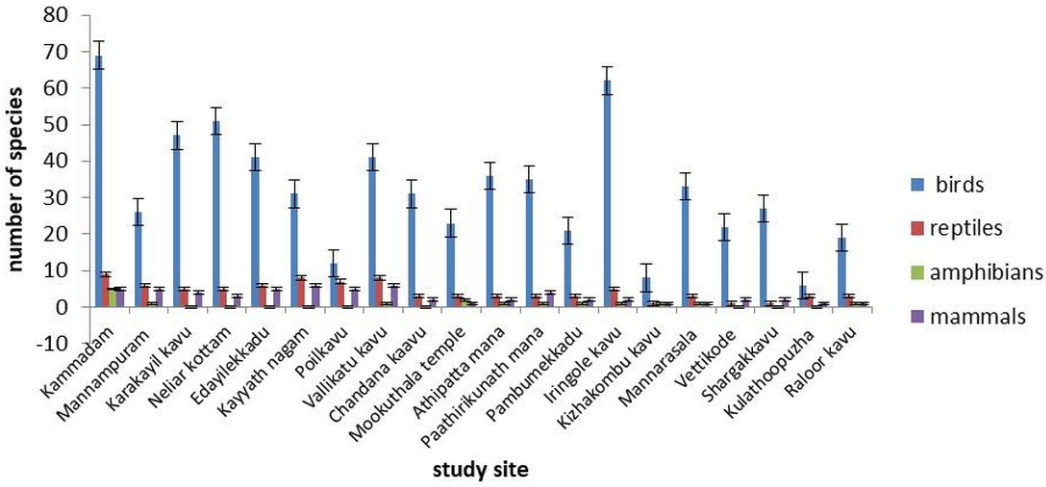

Fig. 3. Individual study site composition

5. Discussion

The study showed a linear positive relationship between management policies and species diversity in sacred groves. As religious rituals and beliefs are said to constitute the backbone of sacred grove conservation according to many reports (Chandrakanth et al., 2004)(Bhakat, 2019), this study highlights the same point. Human-induced conservation of native biota is important because these results also indicate some threats to sacred groves. The largest sacred grove in Kerala has the highest diversity, but this patch faces encroachment since there is no compound wall available to protect the patch. In the score table, the presence of a compound wall is marked as zero for this path. In the same manner, some of the selected sacred groves face some difficulties in maintaining their natural landscape; improving the scores of parameters mentioned in this study, would further boosts the conservation value of these small islets. Among the local people, sacred groves are places of divinity where the people refuse to perform any malpractice in most areas, and they also consider the species within these patches to be divine(Landry Yuan et al., 2020). In Kerala, most of the sacred groves are associated with temples and are managed by the temple trustee, where local people are the members; they promote the conservation of temples and associated vegetation through religious rules and regulations that influence their conservation. These regulatory mechanisms are unique to the sacred groves, whereas slight differences are visible when we consider the three zones that influence sacred grove conservation and species diversity. Human-induced conservation is visible in sacred groves through faiths and religious rituals (Dudley et al., 2009), which was further supported in this study. the implication of religious rituals is that they promotes nature conservation (Geng et al., 2017), this strategy of conserving natural resources through traditional beliefs has also been witnessed in other countries (Rim-Rukeh, A.; Irerhievwie, G.; Agbozu, 2013) (Prakash Kala, 2017) (Chunhabunyatip et al., 2018) which ensures the global importance of these methods of species conservation. The small religious patches in Kerala are also conserving native species through spiritual beliefs that uphold a mutualistic association between human and nature. Religious beliefs and rituals have a crucial role in determining the species diversity in small islets as we saw in this study. Through the human induced

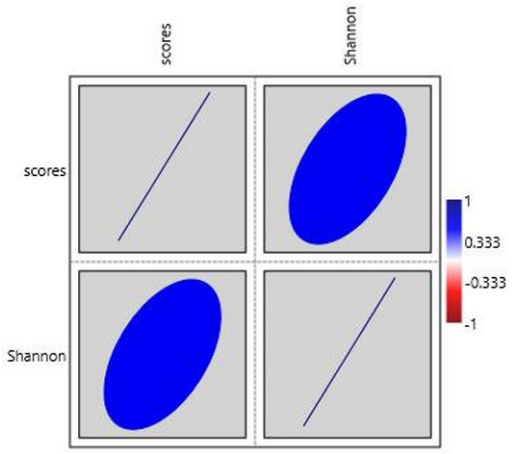

Fig. 5. Correlations between scores

practices, most of the sacred areas remain untouched as people themselves refused to enter the sacred sites unnecessarily, which directly influenced the conservation of native species. In Kerala, the omnipresence of these small islets is visible across the districts and is located amid human life. In the country too, the cultural heritage has a significant value as the country witnessed the existence of sacred groves, sacred mountains and sacred lakes, rivers that are being worshipped and preserved in their natural form where the attitude of human beings is also appreciable. A major threat facing by the sacred groves is encroachment and changing the landscape which is clearly visible in the patches of Southern zone of Kerala, the diversity of species is low as we compare with the Northern zones of Kerala. Most of the groves in Southern zone have reduced the area due to encroachment and concrete construction that altered the habitat availability for many species as a close supervision in the area as well as the landscape management policies in these patches reveals the same. Most of the patches in Northern Kerala remain untouched that provides microhabitats for many vertebrate species whereas the area covered by vegetation in the sacred groves in Southern zone is lesser than that of Northern zone. These also highlight the different attitudes of people toward the sacred patches of three zones of Kerala.

6. Conclusion

The study revealed that the selected parameters such as presence and maintenance of compound wall, public pathway management, entry into vegetation zone of sacred groves by owners, adoption of religious rules and regulations in temples, vegetation maintenance, maintenance of patches in their natural form, prevention of public entry into groves, not doing temple constructions and prevention of public malpractices such as throwing waste into the patch have positive correlation with the species diversity in the sacred groves. The positive attitude of people towards nature will boost the conservation. These small patches, irrespective of their area, provide habitats for the vertebrate species and the religious rituals and procedures resulted in the conservation of species and ecosystem for generations as most of the sacred groves remain untouched for decades. Though many groves have lost their natural form as urbanization proceeds in the current era, most of the patches are remaining in their natural form. Improving the strategies for the management efforts would further boost their preservation as this study showed the linear correlation between management strategies and the species diversity in the sacred groves.

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