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Diversity, regeneration status and socio-economic importance of the vegetation in the islands of Lake Ziway, south-central Ethiopia

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Abstract

This study was conducted in the islands of Lake Ziway located in the main Ethiopian Rift Valley in south-central Ethiopia. Its main objective was to investigate the diversity, regeneration status, socio-economic importance and the factors that cause degradation of the plant resources in the islands. A total of 73 relevés, measuring 20×20 m, were established along line transects laid from the central part of each island to the lake edge in eight aspects. Herbaceous species were sampled by using a 2×2 m sub-relevé laid within each relevé. In each relevé, the cover/abundance of each species was estimated, woody species were counted, diameter at breast height and height of trees and shrubs and the environmental variables altitude, slope, aspect and position were measured. Participatory Rural Appraisal was employed to generate the socio-economic information. A total of 141 species belonging to 113 genera and 55 families were identified, of which 18.4% were trees, 21.3% trees/shrubs, 12.1% shrubs, 3.5% lianas, 4.3% herbaceous climbers and 40.4% herbs. The overall Shannon diversity and evenness of woody species in the islands were 2.60 and 0.62, respectively. The number of species on the islands correlated with island's size, habitat diversity and degree of human disturbance. The similarity in species composition between the islands was low, indicating that each island has its own unique flora. Nine plant communities were recognized and described. The total density and basal area of the vegetation were 2979 individuals ha^{-1} and 191 $m^2 ha^{-1}$, respectively. The importance value index and the diameter and height class distribution revealed that some species are threatened and need the highest priority for conservation. The socio-economic survey showed that the island communities are highly dependent on the natural vegetation for various purposes. On the other hand, the islanders have maintained the soil and vegetation resources for centuries through their indigenous resource management systems and practices. Human population growth coupled with farmland expansion, soil erosion, free grazing and cutting trees for various purposes are the major threats to the vegetation resources in the islands. The implications of the results are discussed and recommendations are suggested for conservation, management and sustainable utilization of the fragile island ecosystems.

Keywords: Diversity; Regeneration; Conservation; Plant community types; Socio-economics; Islands of Lake Ziway

Introduction

Ethiopia is endowed with an immense wealth of biological resources due to its diverse topography,

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climate and edaphic (soil) factors, which resulted in ecosystem diversity. It is recognized internationally as a major center for biodiversity (Edwards and Ensermu, 1999; Yonas, 2002). The Ethiopian flora is very heterogeneous and has many endemic species. Ethiopia possesses over 7000 species of higher plants, of which about 12% are endemic (IBCR, 2001). Vegetation types in Ethiopia are highly diverse, ranging from Afroalpine to desert vegetation. However, the biological resources of Ethiopia are being destroyed at an alarming rate because of a combination of factors. Owing to the increasing realization of the importance of conservation, management and sustainable utilization of biological resources in socio-economic development and the gaps that exist in the conservation efforts in Ethiopia, at present, various institutions have been established and a range of endeavors have been underway.

Islands have distinctive ecological systems. They shelter unusual relicts, strange combinations and extraordinary evolutionary radiations (Jeffries, 1997). Quite often, there is high endemism on islands (Cook and Macdonald, 2001; Cook et al., 2001; Rosenzweig, 1995), which is most probably attributed to allopatric and sympatric speciation. Islands generally have low species richness (Cook and Macdonald, 2001; Jeffries, 1997; Mooney et al., 1995), but there are some islands such as Madagascar, Mauritius, Galapagos and Hawaii which possess a very high biodiversity (Jeffries, 1997). Floras of islands usually comprise a specialized subset of the mainland flora, or evolutionary derivatives of these subsets, members of which have been able to gain access to the islands by means of long-range dispersal and subsequently evolve in the unique habitat conditions and unique habitats, which are usually free of intense competition (Kellman, 1980). The dynamics of island biotas depend on two processes, immigration and extinction (Begon et al., 1996; Jeffries, 1997; Ricklefs and Miller, 2000; Rosenzweig, 1995). Species diversity on islands depends on island size, habitat heterogeneity, species interactions like competition and predation, distance from the mainland, richness and dispersal ability of the source pool species, or combinations of these factors. Disturbance regime is also an important factor that determines species richness on islands.

Island ecosystems are extremely fragile, and the biota are sensitive to extinction (Begon et al., 1996; Cook and Macdonald, 2001; Cook et al., 2001; Jeffries, 1997). This is because they are vulnerable to natural calamities such as climatic changes, diseases and storms and a variety of anthropogenic disturbances like habitat destruction and fragmentation, overexploitation and species introductions. Deliberate or unintentional introductions of species can be disastrous to an island's flora and fauna. For instance, the islands of Hawaii have lost more than half of their original endemic species due to incautious introductions of other animals and plants (IUCN/UNEP, 1986). Islands of Africa like Mauritius, Reunion and Rodriguez have suffered from a devastating wave of extinctions in historic times, much of which can be attributed to introduced species (IUCN, 1990). To date, there is increasing impoverishment of island biota due to escalating human impacts.

Islands have played a historic role in the understanding of biodiversity. The Galapagos Islands are prime examples for understanding and explaining evolutionary processes. The theory of island biogeography has many implications for the conservation and management of ecosystems. Island biogeography has particular relevance in the design, selection and management of protected areas (IUCN/UNEP, 1986). Size, shape and ecosystem coverage of protected areas are important parameters since the number of species that a protected area can hold at equilibrium will depend on its size, habitat diversity, distance from other similar habitats and the dispersal power of the species concerned. Protecting islands as nature reserves has several advantages because islands have clear boundaries, have already developed a balance between their size and species number, cannot be easily encroached upon and are relatively independent ecological units (IUCN/UNEP, 1986).

Africa's biodiversity is seriously threatened not only on the mainland but also on its islands (IUCN, 1990). This is mainly due to the increased pressure exerted by the rapidly growing human population. The situation is more serious on the islands. This is because islands have their own natural limitations in addition to anthropogenic influences. Therefore, islands need special attention since they are extremely fragile ecosystems. The islands of Africa possess a unique biological diversity. Madagascar, Mauritius, Comores, Sao Tome and Principe and Seychelles are important centers of endemism, and Madagascar has the highest level of endemism in Africa (IUCN, 1990). In Ethiopia, there are lake and habitat islands. Islands can be found in Lakes Tana, Ziway, Langano, Shalla, Abaya and others. The biodiversity of these islands of inland lakes in Ethiopia is under threat both due to natural calamities and ever-increasing human impacts.

Many islands are quite insufficiently studied ecosystems. Two major reasons include their inaccessibility to researchers and lack of recognition. As a result, information on island biota is still limited. This is particularly true in Ethiopia where the diversity, endemicity, dynamics, conservation status and rate of depletion of island biota have not been assessed. And specific threats to the country's island biota have not yet been identified. Thus, the present study was undertaken with the following objectives to: (a) assess the species diversity (richness and evenness) and plant communities of the vegetation in the islands of an important Ethiopian lake; (b) determine the population structure