Core Habitat Zonation for Selected Endangered Species using Remote Sensing and GIS

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Abstract: One of the most serious problems that the world is facing is the loss of biodiversity and habitats as a result of environmental degradation. There are several strategies to protect the habitats and biodiversity within a certain region such as establishing protected areas; monitoring the remaining forests and managing the landscape within limits have been employed. In this study, Predicted Habitat Distribution Model (simple spatial modeling) was developed using vegetation types, land use and land cover, DEM, slope, drainage, roads, human settlement areas and minimum habitat requirements of each species. Then, based on the checklist of presence and absence of each species, the final habitat maps for selected endangered species are generated. Integration of Remote Sensing (RS) and Geographical Information System (GIS) has proven a very effective tool to generate wildlife habitat maps at various levels. An effecting mapping could be performed based on satellite remote sensing and modeling biodiversity indicators in GIS.

1. Introduction

At present, most of the wildlife biologists have limited knowledge of remote sensing and GIS. Wildlife biologists have been used topographic maps to generate management and other maps of their interest. Although technically complex, the remote sensing and GIS techniques have revolutionized the process of data gathering and map making. Therefore, the integration of Remote Sensing (RS) and Geographical Information System (GIS) have proven that very effective tools to generate wildlife habitat maps at various levels. Conversely, Remote Sensing (RS) has become an integral part of GIS technology today, especially in studying wildlife habitat; habitat mapping and modeling were greatly facilitated by the development of satellite remote sensing.

2. Study Area

Kayah-Kayin and Tenisserim Ecoregion (Ecoregion 29) is the richest in species in mainland Southeast Asia, and the cross road to exchange species among different geographic regions of Holartic, Oriental and Greater Sundas Island. On the other hands, this ecoregion forms a junction of the Indo-Chinese, Indo-Burmese, and Malaysian floral and faunal elements. The flora and fauna in this region is distinct and includes several endemic species. Among the ecoregions of Indochina, this ecoregion contains some of the highest diversity of both bird and mammal species found in the Indo-Pacific region.

This region is habitat for 33% of all known species in Mainland South East Asia. There are 45 species of mammals are classified as endangered and at least 15 species classified internationally as endangered. According to the World Conservation Union (IUCN) standards, there are three critically endangered species, six endangered species, 23 vulnerable species, 22 lower-risk/near threatened species and six data-deficient species found in this region. These species include three endemic species.

The existing protected areas that cover 32% (35030 km^2) of the ecoregion and most of these protected areas are located in Thailand. Large blocks of intact seasonal evergreen forest habitats are still remaining in Myanmar, but these are mostly not protected. Some protected areas have been designated in the portion of this ecoregion that lies within Myanmar, but their effectiveness is difficult to assess at this time due to the political instability of the region. The last section of rainforest is also threatened by Yadana natural gas pipeline, in addition to teak logging, that passed directly through Kaser Doo Wildlife Sanctuary (Myanmar); and the Thong Pha Phum forest, which is in the process of being declared a National Park by the Thai government, and which is in the center of other protected areas such as Thong Yai Naresuan, Huai Kha Kaeng Wildlife Sanctuaries; and Kaho Laem and Sai Yok National Park. The previously isolated region has also caused an increase in illegal hunting, logging, and wildlife trade. The road, which runs parallel to the pipeline, divides the

forest into two separate areas, thus altering the migration patterns of wild animals. In the long term this will pose a serious threat to survival of wildlife. The main objective is to find out habitats of selected endangered species in Kayah-Kayin and Tenasserim Ecoregion and to provide guidelines on how to address habitat mapping by using RS and GIS at regional and landscape level.

3. Data used Methodology

- MODIS satellite data with the spatial resolution of 250 m.
- Digital map of entire Ecoregion with the scale of 1 : 250000
- Topographic/ Vegetation/ LU&LC/ Geology/ Soil map
- Annual rainfall and temperature for 10 years
- Ancillaries data

Unsupervised (IsoData classifier) and supervised classifications (Artificial Neural Network (ANN) classifier) were used to identify the vegetation type, land use and land cover. After that the integration of satellite derived vegetation type and land use and land cover; and GIS modeling and analysis for landscape, vegetation map and habitat maps for selected endangered species are generated. After classification of different vegetation and land cover types, remote sensing data was imported into the GIS platform. This was the most important primary data, which is the basic input for further analysis and modeling.

Model was developed for these habitats using the data of stream networks, elevation data (slope and aspect), climate (rainfall and temperature), soil, geology, forest type and land cover; and reports/literature on selected endangered species' habitats.

4. Database preparation

Huge database comprising of very specific and large topographic, climatic and biotic features was developed. This includes the spatial and non-spatial data from primary and secondary sources. The data from various sources was systematically organized into database by proper data structure and coding standard.

Various factors that needed to investigate core habitat area for selected endangered species are conducted as follows: forest type , streams and lakes (water resources), protected area networks, land use and land cover, soil, road and tracts, and contour lines.

5. Considerations for habitat modeling

Following Model (Figure 1) was used to predict the habitat requirements with additional set of considerations: (1) Core Habitat Zonation is specific to the organisms being studied and required an understanding of the biology of the organisms, (2) Habitat models only predict potential biotic distributions, while actual distributions may depend upon limits to dispersal, history, biotic interactions, and time lags, and (3) Potential habitat is not static, but rather is dynamically changing over both short and long time scales.

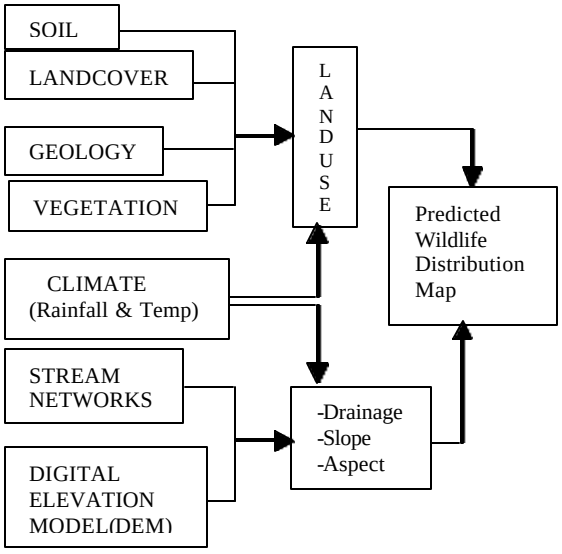

Figure 1: Flowchart of Predicted Habitat Distribution Model

7. Results and Discussion

Needless to mention that accurate input information to any habitat model increases the reliability of the model outputs i.e. core habitat maps and habitat information. Core-habitat maps (Figure 2) were generated using knowledge-base approach and checklist of presence and absence of selected species in the Ecoregion 29. The degradation activities (extensive shifting cultivation, excessive logging, increasing in human population, development of infrastructure,

and conversion of forest habitats to agricultural land) have altered the natural landscape to great extent in ecoregion 29. Because of these increased anthropogenic activities, the natural landscape have become fragmented. In addition to forest cover lost, fragmentation has a great impact on biodiversity and habitat of wild species.

The fragmentation of forest communities lead to high patch density and also affected various ecological processes such as species distribution and degradation of habitats of keystone or indicator species. For core habitat zonation as well as mapping of habitat for endangered species deals with these transformations. These land transformations have resulted in the alteration of natural habitats and have brought in lost of biodiversity.

In the core habitat maps of selected species are overlapping. Mostly in the Western Forest Complex (Thailand) and Tenasserim (Southern Burma) because this part is in transition zone of Northern Indochina and Central Indochina, and the species composition (Flora and Fauna) are also very high. Conversely, wild species and organisms also vary in the extent to which they need a diverse environment. And also the diversity of forest and landscape depend on the scale at which viewed by individual species. Some species can live in variety of habitats, some require diverse habitats, and some require uniform habitats. This part is also liberated from development pressure and difficult to assess. Thus, the overlapping of habitats are acceptable.

8. Conclusion

Habitat zonation of endangered species is important to protect them from extinction. The current practice is non-technical and depends on physical reporting of endangered animals by forest guards.

A method is developed to use MODIS satellite data along with land use, land cover, topographic, environmental and GPS records integrated and analyzed in the GIS.

Spatial modeling of Predicted Habitat Distribution is based on the basic requirement for each species by using the knowledge-based approach (presence and absence of species, their geographical distribution, home range, etc.) so as to derive more meaningful habitat zone map.

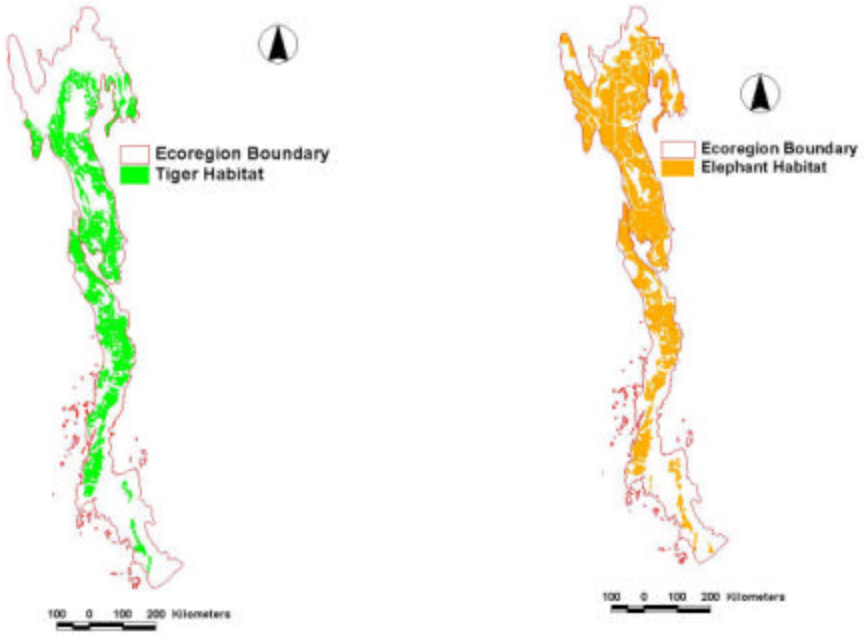

Figure 2:
Two Core habitat maps for Eco region 29