Habitat loss and fragmentation are the lead causes attributed to biodiversity loss. Geographic information systems (GIS) and remote sensing (RS) have been instrumental in the assessment of habitat and biodiversity. These systems provide a way to analyze landscape patterns and spatial relationships between habitat types and the biodiversity that they support. This capability saves planners and scientists valuable time and money. Additionally, land cover types can be linked spatially to existing data such as habitat preferences of particular species or biological surveys. These programs provide a framework for field study design and are also powerful tools for conservation planning and management. The applications of GIS and RS with regards to biodiversity are vast and scientists are beginning to perfect the methods and skills necessary to utilize the full capacity of these systems.

There are several applications of GIS and RS with regards to biodiversity. One of the most popular methods found in the research is the classification of land cover or habitat types within a study area using satellite images and aerial photographs. The classification types can be based on existing vegetation and land cover/land use maps. Supervised classification seems to be the most common classification method which means that analyst must have knowledge of the study area a priori. Once the study area has been delineated by habitat type, the individual study sites within the habitats can be selected. Depending on the purpose of the study, the field work can involve verifying the accuracy of the classification by analyzing the vegetation on the ground or it can go a step further and collect more detailed information specific to that habitat type such wildlife species diversity or abundance. Furthermore, existing surveys and studies can be spatially linked to the delineated habitat types. The information gathered can be extrapolated for estimations of biodiversity for similar habitat types provided that specific parameters and assumptions are met.

There is a variation of the method outlined above is also found in the literature for biodiversity assessments. Both methods begin by dividing satellite images or aerial photographs into habitat types, but this variation starts with field studies of a particular species and then uses that existing information to rank habitat preferences and spatially show where a particular species is likely to be located. Whereas in the first method, the study area was divided geographically and then more detailed information was collected about that particular site, this method starts with the more detailed information and then creates a map to present that information geographically. Both are powerful tools for collecting information on biodiversity.

The “rapid assessment” of biodiversity is another application of GIS and RS that is becoming prevalent for biodiversity assessments as researchers and scientists race to identify and protect species before their habitats are destroyed. Most of the rapid assessment methods make use of satellite images and aerial photographs as well as existing studies to reduce the amount of field work required. Field work is the most time consuming and expensive part of biological assessments. Methods that are able take advantage of the existing documented studies while minimizing the amount of field work greatly reduces the time and money associated with biological assessments. Rapid assessment methods tend
to create models based on the existing studies that can provide information on the biodiversity of a site. A balance must be struck in this method to make educated assumptions to generalize detailed data while at the same time present information that is meaningful.

The use of GIS and RS for biodiversity assessments has many advantages. The ability to identify and delineate habitat types by satellite images and aerial photography is critical. This allows the researcher to obtain a more detailed view of the study area and understand how it fits into the landscape of the region. It greatly reduces the amount of on the ground vegetation identification which saves both time and money.

In addition, these programs provide a way to analyze and link habitat and biodiversity data spatially. The classification of habitat types is one component, but the addition of the spatial relationships gives a fuller picture. GIS can be used to overlay specific criteria and analyze topologic relationships or to add restrictions such as buffer zones. A geographic representation of the information often enables a wider audience to understand and interpret study results. This is extremely important for multi-disciplinary projects where scientists from all different fields are working together and in terms habitat conservation and management where many of the decision makers are not scientists. Detailed scientific studies are imperative for biodiversity conservation and it is important to present the data and results in a way that can be easily interpreted by a wide audience.

The main disadvantage that I have found in the literature regarding GIS and RS is its lack of use across disciplines. As more is learned about the capabilities of GIS and RS, their applicability to a large variety of fields becomes apparent. It seems that the bridge between ecologists/environmental scientists and computer scientists is still in the process of being built. There are articles published on analyzing environmental data with GIS and RS that are interesting technically, but are not applicable to an environmental scientist. Conversely, there are purely ecological/environmental articles that have a spatial component to the data that could benefit from the use of GIS and RS, but that piece is missing.

I think as more people are trained in GIS and RS, including non-computer scientists, it will be a technology that continues to grow and gain esteem. Data is being shared across the world as technology and software are improving exponentially. People from different countries and backgrounds are able to collaborate and work together. GIS and RS can be used to synthesize biodiversity data and relate it spatially, providing a comprehensive dataset and snap shot of the status of global biodiversity. The environmental field is becoming increasingly multi-disciplinary and presenting study results in ways that are accessible to a wider range of people is imperative. Effective communication of biodiversity assessments is an integral component of habitat and biodiversity conservation.
Annotated Bibliography


This paper documents a model that was created to assess the biological richness (BR) of an area in the Eastern Himalayas. BR was estimated using six biological attributes; spatial, phytosociological, social, physical, economical, and ecological. The three-tiered approach used in this assessment is geospatial tools (RS, GIS, GPS), field survey, and landscape analysis. The vegetation and land cover types were classified by RS. The sites were then ground truthed to ascertain the accuracy of the classification (which was reported as 89%). The spatial data and their attributes were analyzed using GIS. To obtain the spatial attribute several parameters were derived; location of vegetation/habitat type, fragmentation, patchiness, porosity, interspersion, and juxtaposition. These parameters were then weighed to obtain the disturbance index. The BR was then calculated as a function of the ecosystem uniqueness (ecological attribute), species diversity (phytosociological attribute), biodiversity value (economical attribute), terrain complexity (physical attribute), and disturbance index (spatial attribute). Each of these factors consisting of several equations and variables, similar to that explained for the disturbance index. The model identified the BR ranking from high to low as the sub-tropical evergreen forests, tropical semi-evergreen forest, temperate and sub-alpine forest, and then degraded and barren areas, respectively.

I think that the paper presents an interesting concept. In order to prioritize and manage conservation areas for biodiversity, methods to rapidly assess the biological richness are needed. RS and GIS analysis is a great way to do this. My concern with this particular method is the complexity involved. With each added variable and sub-analysis, more error is introduced into each level. There are so many estimations and assumptions involved in attempting to model a complex and dynamic system that I wonder if it is possible to model sites in other regions and if the assumptions would hold true. Also, I wonder if these same results be obtained using fewer variables and levels.


This paper evaluates non-flying mammal species abundance and diversity in five habitat types in Costa Rica: relatively extensive forest, coffee plantation, pasture, coffee with adjacent forest remnant, and pasture with adjacent forest remnant. This study looked the effect of habitat type as well as proximity to the forest. Landsat TM images from 1997 and 2000 were used to assess the change in forest cover and to analyze the proximity of the sites to the forest. Supervised classification was used to determine the locations of “forest units.” The classification was then verified using 1992 aerial photographs and ground truthing. The study found that species richness of mammals varies with habitat type but not with distance from the extensive forest.

The definition of “forest units” was not clear, but it appears that it meant all areas of relatively extensive forests and forest remnants. It seems that it would have been useful to classify and map all the habitat

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types using remote sensing to see the matrix of land cover within the study area. From the description of coffee sites, it seems that it is full sun coffee plantations that were sampled; full sun coffee plantation and then full sun coffee that is next to forest remnants. It would have been interesting to see the comparison of mammal diversity and richness in shade grown coffee plantations and shade grown coffee next to forest remnants.


This paper used GIS, RS, and field studies to assess the bat diversity for habitat and landscape scales in Quindío, Colombia. The three habitats analyzed were forest, shade coffee, and associated coffee. Shade coffee was defined as coffee grown with “shadow” tree species. The term “associated coffee” was defined as sun grown coffee as a monoculture or with banana with no trees or isolated trees only. For the landscape scale, two matrixes were identified: predominately associated habitat and predominately shade coffee habitat. The analysis was based on a 1996 Landsat TM image with 23 m resolution. The habitat types were classified in GIS using an existing vegetation and land use map and FRAGSTATS where the authors selected the mean patch size and the mean patch fractal dimension. The classifications were then verified by field surveying six sites in each habitat type with three sites located in each matrix. Bat data was collected at each site.

This paper gives a nice example of how to use GIS and RS in conjunction with field surveys. By analyzing the landscape and habitat types remotely, then ground-truthing the results, the accuracy of the classification technique can be evaluated. This method enables to experimenter to choose study sites that are distributed across habitat types and matrixes beforehand. Once the data is collected and analyzed on the bat diversity within each habitat and matrix type, it can be extrapolated to estimate the bat diversity for regions of the same classification given that certain parameters that influence the bat habitat are met.


The authors used Landsat TM images and field studies to determine the richness of biodiversity in Sango Bay, Uganda. Field sites were visited in order to run a supervised classification of the land cover types from the satellite image. It was documented that this provided an accuracy of 86%. Existing small mammal, bird, and vegetation surveys were linked with the land cover types to provide a biodiversity rating for the sites, thus producing a biodiversity map of the area.

The paper gives a concise overview of how existing studies can be coupled with RS data to produce useful information about the biodiversity of an area that can be applied to conservation planning. It provides nice detail of the methods used for RS and classifications. It also explains some of the issues they had with data collection and the error that is introduced when numerous, but necessary assumptions are made. The authors make a good point about the need to compile geographic
information for use in conservation planning, even if at the moment the information is more general rather than detailed in nature.


The San Joaquin Kit Fox is federally listed as an endangered species and listed as threatened by the state of California. The paper describes a method to assess potential habitat for the fox using existing ecological studies, vegetation maps, and GIS that could be used in the development of Habitat Conservation Plans (HCP). A high resolution vegetation/land cover map was first converted into raster format. The intrinsic habitat values were assigned to each habitat type based on the fox’s habitat preference as determined by existing studies and consultations with experts. The neighborhood value of the cells was then calculated based on the fox’s range. A cell was assigned a higher rank if it were surrounding by higher intrinsic habitat value cells. The scores for the intrinsic and neighborhood cells were combined to give a habitat preference ranking. The last step was to overlay major roads that intersected the site and account for the reduction in habitat score for the roadway and a buffer area around it. The outcome of this analysis is a map that shows the preferred habitat type for the fox based on vegetation and land cover, location relative to other habitat types, and known landscape barriers in this case roadways.

This paper is really well written and explains the methods and rationale clearly. The methodology used in this case study can be applied to a variety of species and potential habitats. As a follow-up study, it would be interesting to see if the potential habitats derived are actually used by the foxes to assess the validity of the model.


Black and white aerial photographs were used to identify the land cover types in the Central Catchment Area of Singapore with an 85% level of accuracy. The four land cover types were categorized as open areas, closed forest with small trees, continuous canopy with large trees, and forest with tall continuous canopy with trees larger than in the previous category. The land cover types were mapped by tracing the areas, then overlaying the polygons on a topographic map. Sites within each of these land cover types were then ground truthed to determine the accuracy.

I found it interesting that the land cover types could be determined with such accuracy from black and white aerial photographs. There is a need to establish methods of rapid assessments for biodiversity conservation and other uses. This could be a first step in that assessment. I wonder how this method would have compared to using satellite images and evaluating the differences in vegetation types with the infrared band.