Wildlife managers have come to rely geographic information systems (GIS) to accomplish numerous goals that would otherwise be quite difficult or impossible to achieve otherwise. The availability of layers like USGS NLCD and NED have made it possible for ecologists and conservation managers to create highly accurate models and has made GIS an essential tool for practitioners. Readily available high resolution orthophotos have made it possible to observe the quality of potential study sites and when coupled with attribute data has been shown to effectively predict site conditions (Dettmers and Bart, 1999). The purpose of this paper is to present popular uses of GIS in the context of wildlife management, illustrate favored layers and methods employed by practitioners, and to discuss the current limitations of GIS.

The current accuracy and scope of information available to GIS users has led to interesting uses for professionals like wildlife managers, ecologists, and site planners. Researchers now rely heavily on GIS in order to delineate potential habitat for species of interest (Dettmers and Bart, 1999; Luto et al., 1996). GIS is also used to create models from land cover and hydrology data (Mitchell et al 1996) and is being used to evaluate areas in need of conservation (Brown et al., 2009).

When researchers commit to monitoring a species they need study areas of varying habitat quality (Walsh et al., 2012). One way to find potential sites is by using a GIS to input site characteristics that fall within the threshold of quality habitat on the basis of variables such as elevation, soil type, and slope. This approach has led to success in delineating territory for species and is reliant upon existing literature which carefully defines habitat necessities for a given species (Dettmers and Bart, 1999; Luto et al., 1996).

Habitat suitability indexes are used to predict the location of habitat that might be used by species of interest. These models are instrumental in identifying important habitat for protection of study. These models are based on scientific literature that sometimes does not adequately document site characteristics that are vital in the presence of an organism. However, over time more information has been gathered regarding the habitat requirements of certain species and it is now possible to make better inferences about which habitats are favorable to a given species (Dettmers and Bart, 1999).

The data layers and processes used by researchers differ by end goal and can cover many functions. In studies that involve establishing critical conservation lands it is common that buffers are used to define areas that should be off limits as they are close to ecologically sensitive areas (Baldwin et al., 2006; Brown et al., 2009). Commonly used data layers include National Land Cover Data (NLCD), National Elevation Data (NED), National Wetlands Inventory (NWI), Soils layers, and TIGER line. Typical models include general habitat indexes, species-specific habitat indexes, contaminant models, and migration models. Creating the aforementioned models requires a multitude of different kinds of data and requires a variety of procedures to analyze the data. Despite the large number of data layers that exist sometimes it is not possible to easily use GIS in creating models.

GIS data layers are useful due to the information they provide about commonly referenced systems like roads or wetlands. In many instances it is sufficient to simply have a data layer that shows where one soil type ends and another begins or the forest type of an area. However, some studies rely on an even finer degree of detail that is not always present in attribute data. In a study by Luto et al.
(2002) the researchers explain how indicator species of plants were vital in order to predict butterfly habitat yet a when they used a GIS to find such habitats they only found the indicator species in 66% of predicted habitats. The level of detail needed to predict the presence of such indicator species can be a product of human error due to lack of knowledge about site characteristics needed for the indicator species however it can also be due to a lack of specialized data that would otherwise make predictions more accurate. Another study focused of the uses of GIS in modeling the spread of disease and contaminants. The researchers concluded that GIS can give a broad idea of contaminant flows however this is limited by the size of raster cells and the generalizations they make about relatively large plots of land (Jarup, 2004). Another limitation is not so much a fault of GIS data but lack of complete knowledge when constructing models. This can lead to inaccurately defining habitat restraints for species’ or can yield lacking models of water runoff (Dettmers and Bart, 1999).

The future of GIS seems to depend on the availability of even more accurate data layers that include more attributes and can represent an area even more finely. While the current level of accuracy is sufficient for most uses it is inhibiting for those who require a greater degree of detail. Until these needs can be reconciled with limitations such as cost and current technology it will be up to users to make the most with the available data.

GIS Annotated Bibliography


Researchers Baldwin *et al* wanted to investigate the most efficient way to delineate conservation areas for amphibians. They did this by following 43 wood frogs (*Rana sylvatica*) around the different habitats that they used. Wood frogs are very mobile and rely on different habitats as per their life history. As a result the researchers found that vernal pools, upland habitat, and wintering habitat, were needed in order for wood frogs to exist in an area. This allowed researchers to identify the actual area needed by wood frogs and made it possible to represent habitats and the other migration routes used by wood frogs. This is an interesting study because it shows that it is possible to predict both high quality amphibian habitat and other vital areas. This information would be useful to compile in a GIS software and can be used to identify conservation areas that are minimally impacted by habitat fragmentation and are well connected for ease in migration between amphibian routes.


Brown *et al* made recommendations for new conservations lands by compiling many GIS data layers that convey information about their use as habitat and then prioritizing the habitat values and picking areas of highest conservation value. Professor August demonstrated this when discussing interpolation. See the link “A Sample GIS Model” on the edc.uri.edu/nrs/ site. Higher value lands were those that had rare terrain and features as well as those associated with high biodiversity. This study is useful in how is approaches very broad and simplified habitat surveys that give a broad idea areas with high biodiversity. The aim of the study was not to be species-specific in how areas were targeted but to identify habitat that many wildlife could use.

In this study the researchers hoped to explore alternative ways of finding habitats for selected species like scarlet tanager (Piranga olivacea) and hooded warbler (Wilsonia citrina). This was done because habitat suitability indexes and other traditional models were not very accurate at predicting species presence. Dettmers et al created models of potential songbird habitat by selecting habitat traits and finding areas that had those traits required by various species. Features like terrain slope, moisture index, water flow direction, and soil cover were used to predict which vegetation could be found at a site and thus give insight into associated animal species. The researchers did well in creating strict habitat requirements which isolated the highest quality habitat which increased the probability of finding the given species in a habitat. The study was able to locate areas inhabited by certain species but also missed many areas as well. Despite this shortcoming it seems that with adequate information it is possible to use GIS to better predict inhabited areas which is currently useful in selecting study areas of animals and is also used to identify areas that rare species inhabit.


The purpose of this study was to identify areas and factors that were significant in deer-vehicle collisions (DVC). This was done by compiling species specific habitat preferences for white-tailed deer (Odocoileus virginianus) with sites of DVC on a GIS. Areas with different amounts of collision rates were compared and attributes of the roads such as speed limit, how busy the road is, shape of road stretch, and distance from urban areas were analyzed. In the end the researchers found that areas which had higher speed limits and were further from urban areas were more likely to experience higher rates of DVC. This study is important because it makes it possible to predict areas of higher DVC by using GIS TIGER data and other layers. In the context of a nature reserve it makes it possible to predict if habitat fragmentation exists for white-tailed deer or other mobile species.


Lars Jarup examined the use that GIS can have in mapping the spread of disease. Because diseases are carried by vectors, winds, water, or means it is possible to track the potential spread of a disease over a given amount of time. Jarup details how in the context of human disease a GIS can be used to monitor the spread of diseases and areas of disease occurrence. For exposures to contaminants it can be used to monitor exposures from a given point such as an industrial plant or can predict where the contaminant will move based on transport systems. Jarup also warns of using GIS when the detail must be very fine as you cannot expect all of the soil in 30m raster cells to be contaminated or to have water runoff leading in a uniform direction. In a wildlife context this can be useful in mapping wildlife diseases in order to anticipate areas that a disease can spread to. Also it can allow managers to set up traps for pests like the Emerald Ash Borer (Agrilus planipennis) before they have established a population.


In this study the researchers chose a lake in Illinois to observe as it had pretty well documented information regarding soil types and watersheds at and around the lake and for the surrounding rivers
and lands. Numerous equations relating to the different pour size of soils, solubility of herbicides, half-life, and flow rate of water in soils were used to replicate the amount of herbicides that would be passed through the watershed. Once these factors were established, models were made which replicated the amount of herbicides and their path through soils. Models based off of changes in soil texture, vegetation composition, and amount of rainfall were used to estimate how such variables impact herbicide transport. This study is interesting because it can help conservation managers determine how resilient a reserve would be to different kinds of water soluble nutrients and could predict where the contaminants will have the most impact.