Allen Hamilton
Dr. August/Dr. Wang
12/11/13

Amphibian Conservation and GIS

Amphibian populations have been on the decline in recent years, partly due to climate change, increase in mortality and loss of suitable habitat. Efforts are being made to solve these problems and GIS is playing an important role in the assessment of habitat quality, threats to amphibians and how they are spatially distributed, population management and mitigation of species extinction. Some of the tools that are being used in GIS are visual representations of buffers, the creation of network analyses, and species presence/absence surveys.

The issue of how much habitat is needed to conserve a particular amphibian species has always been a source of great concern. Some wetland species use the upland habitat of an area much more than others, so that must be taken into account. Forest cover also affects how much habitat is used. If there is too little forest cover, then some species will not even be present and the wetland will not be used, damaging populations of that amphibian species in an area. GIS has come into play to alleviate and better manage those areas. By using GIS to map habitat disturbance, forest cover loss and the movement of amphibians throughout their habitat, it allows for conservation planners and environmental managers to more effectively track amphibian species. This makes it possible for these planners and managers to record what type of habitat they prefer, what barriers might impede movement throughout their environment from a lower quality habitat to a higher quality one, and how much energy it would take to navigate such barriers. So for example, when researchers in Portugal were tracking mortality rates of toads on roadways; they were able to use GIS to track the location of the number of deaths and if there was any correlation between population changes and larger roadways. Without GIS, this type of analysis would be much more difficult.

On a larger scale, GIS is important in choosing which habitat areas are the most important to conserve in light of ever-changing land use. When site selection needs to be done, GIS can aid in that selection by compiling all of the parameters of interest and generating areas on a gradual scale which can display the best areas to conserve. Research like this has been done in Mexico to great success.

Some of the tools that have been used have included buffers, clips, network analysis and site suitability analysis. These are the main tools to really quantify the areas that need to be preserved or the number of individuals in a population that are affected by some sort of external stimulus. The sources of data have varied but it has been suggested that for organizations that cannot afford to get customized data, it is possible to get data for free off of various websites that would offer it.

There are disadvantages to using GIS as well. There is the need to ground-truth the data. Ground-truthing validates the data that you have collected and is used as a way to
proofread the datasets. Without it, it is possible to use data that could make claims about populations that are inaccurate. The data could show that a species is still thriving in an area when in actuality, the species could be in decline or even extinct. So performing *in situ* data collection becomes an important component to using GIS properly.

I think that the future of GIS in the field of amphibian conservation is going to be very valuable to the preserving of amphibian species. The more land cover data that is used, the greater the variety of analyses that can be done to map amphibian habitat preferences. I also think that there will be more use of network analysis tools because of the need to more accurately track the movement of amphibian species within their habitat. It will also be important in seeing the energy costs of movement and how barriers affect said movement. Modeling will play a significant role in the future by allowing planners to come up with scenarios that could possibly play out, like different degree changes that could occur due to global climate change. I think that remote sensing may not necessarily be used in the monitoring of actual populations, but will definitely see some play in a more supportive role, providing information on the changes in land cover and weather patterns. Overall, I think the future of amphibian is very bright, especially with the new techniques and processes that will be made available with more research and dedication from scientists and researchers who care about the biodiversity of our planet.
Annotated Bibliography


In this paper, Matos et. al. discussed the mortality rates of amphibians. GIS played an important role in the selection of sites they used to determine how country roads affected population rates. Three criteria had to be met: land use proportion, circular path to optimize sampling time and total length between 15 and 30 km. GIS was also used in the analysis of the data by using the Spatial Statistics toolbox to see if mortality rates were clustered in a particular area or were more dispersed and to determine what type of land cover was present in the area. The researchers found that mortality rates were higher in areas that had a land cover of broadleaved forest or agriculture with a road fragmenting the habitat. This was interesting to me because it shows that the GIS techniques being used here also corroborated data that were found in other studies. GIS is significant here because it allows for planners to map out high mortality areas and the variables associated with it.


Ray et. al. listed the usefulness of modeling amphibian movements through a matrix with varying paths. They did this by creating a permeability model which was used to track the energy expenditure and mortality risks of an individual moving through the landscape from a suitable breeding habitat to a suitable terrestrial habitat. A part that I thought was very interesting was how they developed the model. It seemed like they took a basic network analysis and applied different parameters like energy costs and migration barriers to find out something very specific about the predicted movements of some species like the common toad (*Bufo bufo*). The authors said that GIS was a very valuable tool, but it ends up being time consuming due to the amount of data that needs to be collected. They also said that more validation needed to be done before this particular model could be used as a standard for more amphibian species.


I like this paper because it delves into a topic that will be faced in the future: how do we manage parcels of land to enable the smallest amount of extinction in a given area? This paper
addresses that by using GIS to formulate a model based on different aspects such as how threatened a species is, how much conservation effort has been put into protecting that species, and how many amphibians can be protected by protecting one species’ home range. They were able to create a vivid map that displays which areas were the best for conserving. I really like the thought and ideas that were put behind it and I definitely think that it could be applied to other micro-endemic species in other parts of the world. One thing that they did mention is the idea of ground-truthing the information from GIS because of the fact that some of the species might or might not be extinct and they need confirmation of such information.


I thought that this paper really brought a different perspective to the idea of GIS use in amphibian conservation. It acknowledged that the technology was very valuable to research, but it also brought up an interesting point about the need to rectify the data in the GIS database with actual in situ data collection. If you just assume that based on some GIS information that a particular species is protected without checking on the ground, then you miss valuable habitat that is used by your species of interest, which is what happened in this paper. That, in addition to low resolution GIS data can lead to the inability to properly assess habitat and conserve species.


This paper talks about buffer zones and GIS once again, which seems to be an important topic in the field of amphibian conservation. The authors utilized GIS to map buffer zones in watershed and using the resulting information to assess the quality of the current buffers in place. I like how they used different aspects of GIS like topographic layers, watershed delineation tools and buffers to accurately map the streams and determine habitat disturbance. I also like how it all culminated into general trends that were found between high disturbance streams and low disturbance streams. The results of their study and the usage of GIS were able to show that current buffers were not adequate. This would not have been possible with conventional means.

I like this paper because it demonstrates the use of GIS in a capacity that allows for it to be used in simple land cover analyses. By using half of the data for modeling the other half, it allows for the construction and testing of models of land cover based in GIS. This paper also shows how important this type of research can be if the organization in question does not have the funds to perform a more thorough analysis. The land cover data that they used turned out to be a good indicator of the genetic isolation in salamander species. The data was also reinforced by the modeling that was done, which contributed to the overall analysis. I feel that this will be the way that many developing countries with an interest in conserving species will approach the problem of a lack of funding. It is cost-effective and allows for more practical steps to be taken.