Brian Mattern
APEC 480

Saving the Leuser Ecosystem with Arc GIS

Background:

Right now, a significant and relatively unreported crisis is occurring on the island of Sumatra. The Leuser ecosystem is a topographically diverse, 2.6 million hectare national park located on the southwest side of Sumatra's northern peninsula. This area is so important due to the fact that it is the largest in-tact plot of Malaysian rainforest remaining on planet earth. It is home to hundreds of species of endangered mammals, birds, reptiles, and amphibians. In fact, it is considered to be the only remaining area in Southeast Asia that is large enough to sustainably support the Sumatran tiger, orangutan, rhino, elephant, and cloud leopard species. That being said, this ecosystem also provides many benefits to humans as well. First off for the local population, it is critical to their water supply, pollination of crops, local climate control, and its ecotourism business provides a steady and sustainable source income for the local economy. It also protects local residents from deadly, life-altering landslides and flash floods. On a global scale, large and intact areas of rainforest take carbon dioxide out of the air which in turns combats global warming. Areas such as these are also considered the lungs of our planet as they clean our air, regulate the water cycle, and control the earth's temperature. In fact, one study places a yearly 400 million dollar value on the ecosystem. With the Leuser ecosystem's importance stated, it is now extremely threatened. Firstly, the ecosystem faces threats from illegal poaching, slash and burn land clearing, and logging. These threats are carefully monitored and policed by local officials. The much more significant threat to this ecosystem is a new spatial plan. The local Aceh government has introduced a new land development plan that would open up an estimated 1.2 million hectares of the forest reserve's 2.6 million hectares to mining, logging, and agriculture. Yet, most of this proposed land development has been speculated to have come from palm-oil planation lobbyists which is what most of the newly opened land is most likely to be used for. Because of an unique government situation in this area and its unique relationship with the Indonesian government, debates and court cases are raging on to determine if the plan is even legal. The ecosystem/national park is federally protected and could even soon be deemed a World Heritage site. The local government has also vowed to protect it, but their new plans say otherwise. If this plan were to come into action, this would not only create a dangerous, economy-killing, and life-threatening situation to the local communities, but it would also puncture a large hole in one of world's final shields protecting humanity from the effects of climate change. Assuming the government attempts to go along with this plan, I will try and pinpoint the prime habitats of the most vulnerable species and maintain connections between these areas in order to prevent the extinction of the area's rare, iconic species.

Literature Review:

Although this particular issue is new, the desired tasks to be completed with the GIS program are common uses of the program. For example, scientists have used GIS in many instances to identify areas that contain prime habitat for a certain species. GIS data can be used to identify areas with the proper slope, vegetation cover, distance from certain features, terrain, land use, etc. in order to pinpoint specific habitats. GIS is also consistently used to identify

populations in certain locations along with identifying specific terrain and slope that can be used to map areas of water accumulation and water flow. These uses are exactly what will be needed in trying to identify which areas to conserve and which areas to open up for the plantations. Yet, in these past studies, there have been strengths and weaknesses in trying to identify certain habitats. Low accuracy of land cover layers, the use of only a few factors, and incompleteness of other data have been huge problems in the past in trying to properly identify habitats. What has worked is having many different requirements to narrow down a single habitat. That way, there is a better chance that the areas with overlapping requirements are indeed the most likely places to find certain species.

Hypothesis:

While there are many species that are endangered by the plan to clear-cut a large section of the protected area, the habitat analysis will focus on the iconic and also endangered species of the area. These animals include the orangutans, elephants, rhinos, and tigers. Using Arc GIS, I will be able to estimate each of these species prime habitats in the Leuser ecosystem, along with where these habitats overlap. I will also use Arc GIS to attempt to connect these overlapping areas so that throughout the development of the region's land, these species will still have a chance of maintaining stable, healthy populations. More preciously, I will use Arc GIS to see if it is possible to maintain healthy populations of the Sumatran tiger, orangutan, rhino, and elephant with the acreage of land that will not be developed.

Data:

To attempt to answer the question at hand, different sets of data will be needed. First off, a 30-meter DEM of the protected area will be needed so that the elevations, water flow, and slopes of the area can be used. A 3-band Satellite imagery of the area will be needed to derive vegetation density maps. Along with these maps, a land use cover raster, road map, railroad map, and population map will be needed to conduct the research. Out of all of these data maps, the one that that could be easily obtained would be the satellite imagery and DEM from google earth data. A streams raster layer can be created from the DEM data. The roads, railroads, and land use cover map will have to be created using satellite data from google earth or other satellite data sources. The data will be structured as raster data because the pixel-like raster data can easily represent different land use, satellite photo data, and water accumulation data.

Methods:

Now here is the procedure that will use to identify the habitats. First, the DEM will be selected and using Arc's FILL, FLOWDIRETION, BASIN, FLOWACCUMULATION, STREAMLINK, and STREAM TO FEATURE a raster layer of all the streams, lakes, and rivers in the area can be obtained. With this layer obtained, the habitat refining can begin. The first step in this process will be obtaining a slope raster from the DEM. Then based on each habitat's description, the areas with the proper slope can be identified. Next, using the land use map, certain distances can be calculated from certain land uses. For example, an elephant's prime habitat may need to be within a certain distance of a stream while a tiger's habitat may need to be a certain distance away from any farmland. This can be done with the EUCLIDEAN DISTANCE tool. Based on each species' estimated needs, this tool can also be used with the roads, railroads, and populations map. Once prime habitat is located, the Focal Statistics tool can be used in order to identify areas that will be large enough and fragmented enough to support

each species. The habitats will be different for every species, but once each species' habitat is identified, the RASTER CALCULATOR tool can be used in order to see where all 4 habitats overlap. The final step from there would be to try and find the best areas to link these prime habitats so that the species can move from one area to another. In this way, smaller populations will not be cut off from one another and each species will be given its best chance at survival.

Anticipated Results:

After conducting the GIS analysis, the expected result is that for some of the species, it will be nearly impossible to maintain the proper habitat for sustainable populations. It is anticipated that the GIS data will tell us that some, but not all of the species may be headed for extinction in the Leuser ecosystem.

Policy Applications:

If the conclusions that are predicted from the study are taken seriously, they may be able to effect the decisions that the local government makes regarding the situation. The local Aceh government is under a large amount of pressure from both the Indonesian national government and local residents along with the international environmental community. If data were to come out stating that species extinction is a likely possibility due to this plan, then the pressures will mount even greater on the local Aceh government and palm oil companies that lobbied for this land. This can hopefully have one of several effects. The best case scenario would be the Aceh government returning the Leuser ecosystem's original protections and no clear-cutting will be allowed. Another positive scenario could be the Aceh government greatly reducing the area that they will allow to be clear-cut, thus keeping the prime habitat for the iconic species (and many other important species) intact. With the proper pressure and lobbying, the findings from the GIS maps could play a key role in saving some, if not all of this protected wilderness.

Estimated Costs:

The estimated costs for the project are as follows: 2 GIS specialists to collect and organize collected data at $25 an hour. They will then put together the needed maps to publish from the study. Next, we will need 4 teams each consisting of a field surveyor($25 an hour), an environmental scientist($30 an hour), a native tour guide($15 an hour), and 2 specialized biologists($23 an hour each) to help identify each animal's habitat. These teams can try and spot certain areas where populations or many individuals of their species' lives. They can also track their movement to see their range in the park. This will greatly help the GIS team focus on specific areas even before they start their analysis. The GIS analysts will also have to make sure they include these areas in their final map. Each team will spend one month in the field which brings the field team totals to $97,807 per team. Now if travel, living expenses, and equipment are included, the cost per team will run up to 120,000 which bring the final direct cost from the field teams to $360,000. The 2 GIS specialists will then have one month to produce the maps. When you include their time at work along with the software they will need to comple the Arc GIS work, the total direct cost comes to $380,000. There is no implementation costs considering the entire ecosystem is in-tact and it is the palm oil companies that will be doing the clear cutting. These companies will hopefully cut around the areas we designate, leaving all of the desired ecosystem in-tact. If a 40% overhead cost is added, the total cost to complete the study will be $532,000.

Timeframe:

The estimated time-frame for the project will take 2 months. One month for the field teams to gather their data, and another month for the GIS specialists to produce the desired maps using the data and information used by the teams.

Works Cited

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