Combining field work with GIS analysis to produce a Land-Use Map

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In many parts of the world, forests are threatened for a variety of reasons. In order to protect these wooded areas, and the valuable resources they provide, many conservation organizations have begun mapping the forest cover in the regions in which they work. This effort stems from a need to focus conservation action, to figure out where protection initiatives are most necessary and which measures will be most helpful. Recently, owing much to the increased availability of satellite imagery, remote sensing has become a commonly used tool to assess land cover (particularly forest cover) across many landscapes.

Remote sensing allows conservation practitioners to understand the land-cover for a large swath of area with comparatively little man-power or field effort and thus provides an expedient means to understand conditions on the ground. However, it has some significant drawbacks, which can lead to improperly classified images and land-covers, producing misleading results. Often, a minimalist approach to groundtruthing (or gathering data about forest cover in the field) can contribute to such problems. A lack of technical expertise can also create issues when classifying images.

Remote sensing particularly troubled us with its definitions. Attempting to prioritize conservation action around Balpakram National Park in north-east India, we turned to a 2009 report generated by the Forest Survey of India. Utilizing remote sensing techniques, the Forest Survey found the forest cover in the Indian state of Meghalaya to be increasing and currently standing at 77.23% of the state's total area (FSI, 2009). Specifically, in South Garo Hills District, the Forest Survey reported 91.35% of the area to be covered by forest (FSI, 2009). However, the report employs a broad definition of forest cover, "All lands, more than one hectare in area, with a tree canopy density of more than 10 percent irrespective of ownership and legal status. Such lands may not necessarily be a recorded forest area. It also includes orchards, bamboo and palm," (FSI, 2009). This loose definition led to the inclusion of lands as "forest" that harm biodiversity more than help it. Additionally, the maps generated from the remote sensing effort did not provide the necessary scale for the landscape level at which we worked. We realized we would have to utilize a methodology other than remote sensing in order to understand better what forest acreage remained intact around Balpakram National Forest.

In early 2010, we visited various *aking*s (or communal land holdings) which border Balpakram National Park in South Garo Hills District, Meghalaya, India. The purpose of these visits was to gather data on forest cover (as opposed to orchard cover) and various environmental threats in the area. We then planned to place this data on a map, in essence creating a land-use map. We divided the analysis area into three basic land-use categories: Orchard Cover (under intense and constant cultivation by humans), *Jhum*/Forest Mix (area that is under shifting cultivation by humans), and Natural Forest Cover (under no agricultural cultivation by humans). Since we found elephant dung in both *Jhum*/Forest Mix and Natural Forest Cover areas, we assumed that both areas provided some sort of suitable habitat for elephants, the focal species of the analysis area. Environmental threats we defined as any human activity which involves a dangerous amount or method of resource extraction, directly destroying habitat (e.g. coal or uranium mining). To the map the data, we combined two different methods. With the first method, community mapping, we used data on the topography of the region to generate maps of elevation (i.e. valleys and hills) at the level of each *aking*. This topographical data also allowed us to determine where streams are located in the landscape.

Using these base maps as reference, we conducted interviews, in Garo (the local language), with as many members of each *aking* as possible (never less than four), always involving the *nokma* (or headman). In these interviews we asked *aking* members where forest cover and environmental threats occur in their *aking* and we then drew these features together on the *aking*-level map. We were able to pinpoint accurately our location on the map by measuring our distance from a fixed point in the center of the *aking* whose location we determined before arrival. After establishing exactly where we sat, we identified various points of reference (i.e. hills and streams) on the map to the *aking* members so that they would understand what we were all looking at. We then drew in forest cover and environmental threats together on our map.

After filling in the paper map, we next employed the second part of our methodology. We asked to visit the sites of forest cover and environmental threats with members of each *aking* to verify what we learned in the interview. We used GPS technology to keep track of where we had walked during the day and to make digital signposts of what we had seen. The GPS unit also allowed us to accurately measure how far we were from a fixed point in the center of the *aking* in our community interviews. It told us in which direction the aforementioned center point lay, so that we could use a scale bar and north arrow (both included on the printed *aking* maps) to determine our position (relative to how far away we were from the center point and in which direction). We combined the data of our visits collected with the GPS with the maps from the community interviews to make sure we had the most accurate picture of the landscape. Having surveyed 395 square kilometers of the 1689 square kilometer South Garo Hills district (or 23.4%) we have found that total forest cover (including both *Jhum*/forest mix and natural forest cover) in South Garo Hills, directly abutting Balpakram National Park, averages a paltry 27.32% (standard deviation ± 16.67) in each *aking*. Including government reserves (215 square kilometers or 54.4% of the analysis area), the total forest cover mushrooms to 74.0% of the total area. This figure, however, reflects an analysis area that contains half of Meghalaya's National Parks and two-thirds of its Wildlife Sanctuaries in less than a quarter of the total district area and still lies directly in contrast to the stated 91.35% which the Forest Survey of India has determined for the entire South Garo Hills District (FSI, 2009).

This field-based methodology reflects a vast improvement over typical remote sensing techniques. Our method is far more comprehensive and includes multiple sources of data, *Aking* the resulting analysis much more robust and producing a more accurate understanding of forest cover in the landscape than standard remote sensing techniques. Collecting the data on foot takes more time than remote sensing, but it also allows for important community education work as we are able to explain the benefits of keeping forest intact to local community members as we work with them. Furthermore, the extensive groundtruthing work we have done in this area will allow us to scale our work up and undertake a remote sensing effort with a much better defined understanding of forest cover, resulting in a more accurate remote sensing effort than the usual techniques.

This methodology is not limited to identifying forest cover, but can be used to map any land-use patterns in almost any terrestrial conservation project. Since land-use is one of the key factors determining impacts on biodiversity, understanding what kind of effects are occurring and where these effects are t*aking* place is of paramount importance to achieving practical conservation goals.

Literature Cited:

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