A PROCEDURE TO DEVELOP LOCATION COORDINATES FOR SAMPLE POINTS FROM INVENTORY SAMPLING

Robert B. Barnes

ABSTRACT

A procedure is described for assigning Universal Transverse Mercator (UTM) coordinates to sample points from an air photo. Sample points are selected by coordinate location. Two methods for subsequent selection of sample points by coordinate location are mentioned.

INTRODUCTION

The Forest and Rangeland Renewable Resources Planning Act of 1974, other recent legislation, and expanded information needs for planning revealed the need to coordinate forest resource inventory sample information with other map or inventory data on a geographic basis. The availability of map coordinates or digitized data associated with specific resource information provides a crosswalk to other resource data sets, and also allows the plotting or mapping of these data. Digitized data bases allow for the display of resource information for any sampled geographic areas, including those not aligned with any political boundaries. They allow the selection of sample base resource information to fit specifically defined units or management areas. It may be necessary to set a minimum area to prevent the standard error of the estimate from becoming too large.

This paper describes a procedure developed by the Northeastern Forest Experimental Station's Resource Evaluation Work Unit to assign UTM coordinates to its sample locations, and then to select locations that fall within a predefined sample area.

METHODS AND MATERIALS

The coordinate system chosen was the Universal Transverse Mercator grid developed by the military (Dept. Army 1958). This is a rectangular metric grid (Reeves et al. 1975) that is hierarchical and can be subdivided to any level of metric linear measure. The UTM grid is overprinted on all new USGS topographic maps and is becoming the preferred reference system (Reeves et al. 1975).

The digitizing procedure consists of a mechanical transfer of location position for a single photo interpretation (PI) point from an air photo to a topographic map, and subsequent determination and recording of its UTM coordinates. Geometric calculations are made to determine the UTM coordinates for any additional PI points on a photo.

The materials required include:

1. A series of air photos, of any available scale, with sample points systematically located and marked on each photo.
2. A series of USGS topographic maps that include the same geographic coverage as the air photos.
3. A set of UTM grids drawn on clear acetate overlays: A large overlay, to cover an entire topographic map, drawn with a 1000-meter grid, and a small overlay that subdivides a single 1000-meter cell by a 100-meter grid.
4. A pair of proportional dividers that can be adjusted to the scale ratio between the air photos and the topographic maps.
5. Tally sheets on which to record photo and PI point location numbers and UTM easting and northing coordinates.
Many resource evaluation (Forest Survey) units, and other public and private groups, use double sampling procedures in their forest resource inventories. The first step is a photo interpretation of sample points on aerial photo coverage of the area of interest. This is followed by the selection, location, and measurement on the ground of a subset of photo-interpreted points. At the Northeast Resource Evaluation unit (Barnard, 1978), each air photo used in a state forest survey is systematically marked with several P1 points using a fixed geometric grid. The number of points per photo varies with photo scale and the intensity of the sample. A single point is chosen from each photo for determination of sample point location coordinates. The shooting point should be adjacent to some easily recognizable natural or cultural feature, to aid in point identification on and transfer to a topographic map. The point location is transferred to the appropriate map using proportional dividers for accurate placement. The UTM coordinates, to the 10-meter cell, are then determined using the transparent grid overlays. The 100-meter grid transparency is aligned on the topographic map by the UTM edge ticks found on recent maps. The 100-meter grid is centered on the approximately 1000-meter cell. UTM easting and northing coordinates are read and recorded to 100 meters. Eventually USGS topographic maps will be overprinted with a 1000-meter UTM grid and coordinates can be determined directly.

The digitizing procedure uses the constant geometric relationship between all the P1 points located on each photo to calculate UTM coordinates for all V1 points on a photo. The geometric relationship is modeled, based on a marked geometric grid and the magnetic orientation of the aerial photo flight line. Once the relationship is established, it is used to produce the UTM coordinates for all points on a photo, given the coordinates of any single point. When UTM coordinates have been assigned to all photo points, the above procedure can be repeated.

This information is merged with the interpreted land use codes (Table 1) assigned to each photo point. The point identification number is used as the common element for the merging process. A subset of photo points is selected as a sample, with a minimum area selected by these routines. A minimum area is necessary to insure sufficient photo and field sample locations to protect data integrity.

RESULTS

The described digitizing procedure was tested using recent photo coverage for Jefferson County, New York. This county is in the recent Resource Evaluation survey of New York State, and air photo coverage of the county is readily available. The coverage is 1:48000 scale B/W photography. As part of the Resource Evaluation survey procedures, 23 P1 points were marked on each of the 125 photos that constitute complete county coverage.

All the necessary materials described above were gathered at one place, and the UTM coordinates were determined for one P1 point on each of the 125 photos. The end product was a list of the 125 photos with the UTM easting and northing coordinates for one identified point on each photo. The UTM coordinates for the balance of the P1 points for the county (approximately 2000 points) were calculated later by computer processing. A final data file was created containing photo number, point number and UTM coordinates for every P1 point for the Jefferson County survey. This file can be used to sample for subcounty areas or to map or plot point-level data.

The digitizing process is labor intensive. Once the topographic maps and air photos were aligned in the same order, UTM coordinates were assigned to the 125 photos in about 10 hours. This averages less than 5 minutes per photo. This compares favorably with the labor cost of 5.9 to 8.1 minutes per sample point in a similar test conducted by the Southeastern Forest Experiment Station (Cost 1976). Cost found that determining UTM coordinate locations by hand was reasonable, greatly reduced by determining easting and northing locations using a coordinatograph and computer. Ideally, several location coordinates should be field-checked by accepted navigational procedures. I feel that this digitizing procedure is an efficient and cost-effective method for assigning location coordinates to survey points. If it were implemented as standard Survey procedures, the additional location information could greatly expand Resource Evaluation's ability to satisfy data requests from potential users.

LITERATURE CITED

<table>
<thead>
<tr>
<th>FI CODE</th>
<th>LAND USE CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Forest land, 0 - 100 ft³/gross volume</td>
</tr>
<tr>
<td>22</td>
<td>Forest land, 101 - 600 ft³/gross volume</td>
</tr>
<tr>
<td>23</td>
<td>Forest land, 601 - 1250 ft³/gross volume</td>
</tr>
<tr>
<td>24</td>
<td>Forest land, 1251 - 2000 ft³/gross volume</td>
</tr>
<tr>
<td>25</td>
<td>Forest land, 2001 - 2500 ft³/gross volume</td>
</tr>
<tr>
<td>26</td>
<td>Forest land, 2501+ ft³/gross volume</td>
</tr>
<tr>
<td>31</td>
<td>Forest land (public reserved)</td>
</tr>
<tr>
<td>32</td>
<td>Forest land (private reserved - urban land)</td>
</tr>
<tr>
<td>37</td>
<td>Forest land (public reserved - Catskill Forest Preserve)</td>
</tr>
<tr>
<td>40</td>
<td>Forest land, nonproductive</td>
</tr>
<tr>
<td>61</td>
<td>Non-forest (public reserved)</td>
</tr>
<tr>
<td>62</td>
<td>Agriculture</td>
</tr>
<tr>
<td>63</td>
<td>Rural non-agriculture</td>
</tr>
<tr>
<td>64</td>
<td>Right-of-way (transportation and utility)</td>
</tr>
<tr>
<td>65</td>
<td>Urban and other (including surface mining)</td>
</tr>
<tr>
<td>67</td>
<td>Non-forest (public reserve - Catskill Forest Preserve)</td>
</tr>
<tr>
<td>70</td>
<td>Unknown</td>
</tr>
<tr>
<td>92</td>
<td>Non-census water</td>
</tr>
</tbody>
</table>

Table 1.—1979 photo-interpretation codes used by the Northeastern Forest Experiment Station, Resource Evaluation Work Unit.

The Resources Inventory Techniques Project, Rocky Mountain Forest and Range Experiment Station, is conducting a review of the estimation of phytomass (or biomass) with nondestructive sampling techniques. Included are such methods as open-wire transmission lines, capacitance instruments, beta and microwave attenuation, infrared emitter units, etc.

Any literature or references will be greatly appreciated. Please send to: Meredith J. Morris, Resources Evaluation Techniques Program, Rocky Mountain Forest and Range Experiment Station, 240 West Prospect Street, Fort Collins, Colorado 80526, U.S.A.

CURRENT LITERATURE

Please order directly from sources given (sources in parentheses). In the case of journal articles, contact your local library for availability.
INVENTORY


ANALYSIS


WANTED--Materials for the Newsletter--feature articles, news items, current literature, and meeting notices. All articles received are to be grammatically and technically correct. Send your material to Resources Evaluation Newsletter, Rocky Mountain Forest and Range Exp. Sta., 240 West Prospect Street, Ft. Collins, CO 80526.