Forest Inventory and Analysis
Sampling Hexagons

FIA Fact Sheet Series

Background. Federal legislation passed in 1998 (Agricultural Research, Extension, and Education Reform Act of 1998 – PL 105-185), required major changes to the FIA program. A primary driving force behind this change was user requests to minimize differences in inventory techniques and therefore maximize the ability to compare and contrast the forest resources in different places or in different time periods. One of the more fundamental changes mandated by the legislation was to conduct annual inventories in each State. The target for Eastern states is to complete 20% of their entire inventory each year while Western states are to complete 10% of their entire inventory each year. Inventory cycles for Alaska, Hawaii, and other island areas will be tailored to their needs.

A consistent, regular, spatial and temporal distribution of sampled locations across the U.S. is one part of the strategy developed to meet this objective. This fact sheet describes the approach used to locate field plots in the lower 48 states of the U. S. near a regularly spaced array of points and also assign them to a specific measurement year.

The FHM Experience. The FHM (Forest Health Monitoring) program used hexagons of equal area to establish monitoring plots systematically across the landscape and regularly spaced in time (Scott *et al*. 1993). The hexagons completely covered the conterminous 48 states, were assigned to one of four inter-penetrating groups (called panels), and included one and only one location to be sampled on the ground. The field locations within hexagons assigned to a given panel were visited once every four years. Thus, this method distributes field locations regularly in both time and space (figure 1).

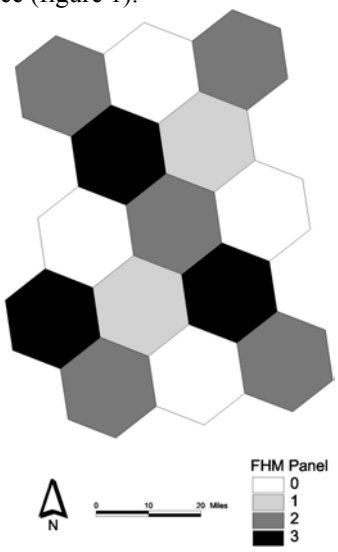

Figure 1. Original FHM hexagons.

The FIA Hexagons. The FHM hexagons served as the basis for the FIA hexagons. A 27 factor increase in the FHM sampling intensity, resulted in hexagons that encompassed 5937.2 acres. Selecting one plot for each hexagon made the sampling intensity close to the 1 field plot per 6000 acres estimated to meet mandated national sampling precision (M. H. Hansen 1998, personal communication). Temporal regularity was incorporated by systematically assigning each hexagon to one of 5 inter-penetrating panels (figure 2). Plots located in eastern panel 1 hexagons were to be measured in 1999. Half the western panel 1 hexagons were to be measured in 1999 (called subpanel 1) and the other half in 2004 (subpanel 2). Panel 2 was to be measured in 2000 (for subpanel 1 in the west or 2005 for subpanel 2). The same pattern is repeated for panel 3, 4, and 5. Once the five or ten-year cycle is complete, the sequence would start again.

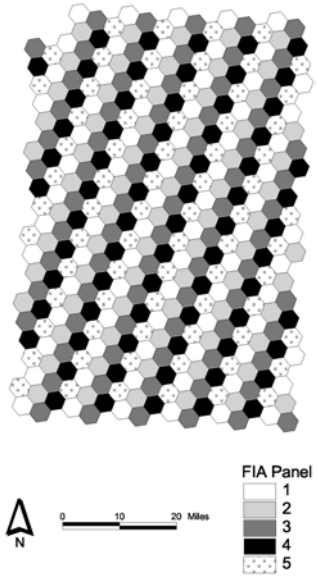

Figure 2. Original FIA hexagons.

Various attributes for each hexagon have been stored. These include a unique identifier, the latitude and longitude of its center, the state and county in which its center is located, the panel assigned to the hexagon, and if the hexagon is also a P3 hexagon (see below).

Plot locations. A variety of grids and methods had been employed by FIA to locate field plots. For the annual inventory, the actual field location selected for each hexagon followed these rules:

1. If an FHM plot existed within the hexagon, it was selected (to satisfy the national objective to integrate the samples and maintain existing FHM plots);
2. If no FHM plot existed in the hexagon, then an existing FIA plot within the hexagon and closest to the center of the hexagon was selected (to satisfy the national objective to maintain existing FIA plots

and select them without bias);

3. If the hexagon did not contain an existing FHM or FIA plot, then a new location near the center of the hexagon was chosen.

Panel Adjustments. The regular temporal order for collecting FIA data enhances the ability to analyze change. Rule 1, from above, redistributed FHM plots temporally from their originally assigned measurement sequence to the sequence based on the panel associated with their FIA hexagons. The redistribution also reduced the number of FHM plots measured each year by 20%. A further reduction in the number of plots measured annually was caused by the elimination of FHM overlap plots; i.e. plots measured in consecutive years. To compensate for the reduction in annually measured FHM plots, a new set of locations (a 67% increase) were created. This maintained the original locations plus added new locations for the fifth panel and the loss of overlap plots (William D. Smith, 1999, personal communication).

The negative impact to the FHM program caused by using the FIA panel sequence would be significant. Therefore, the original panel assigned to those FIA hexagons with existing FHM plots was changed to match the original FHM panel (Brand et al. 2000). The resulting spatial and temporal irregularity (figure 3) was deemed an acceptable tradeoff for maintaining FHM temporal continuity.

The final FIA sampling hexagons (figure 4) are 5937.2-acres in area, each containing one plot for the base National program. About 1 out of every 16 hexagons is designated as the FHM (now called a phase 3 or P3) hexagon. For plots located within the P3 hexagon, P3 measurements in addition to standard P2 (phase 2) are collected (Burkman 2002 FIA Fact Sheet: "Sampling and Plot Design" for additional information on P2/P3 measurements).

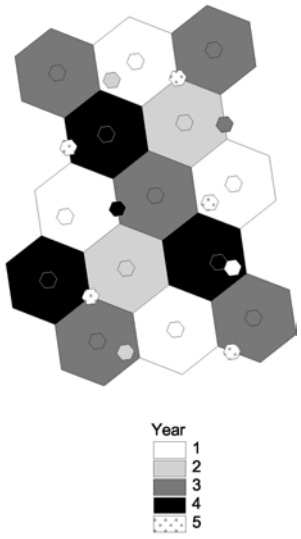

Figure 3. Comparison of original FHM hexagons (large ones) with the FIA hexagons designated as P3 hexagons (small ones).

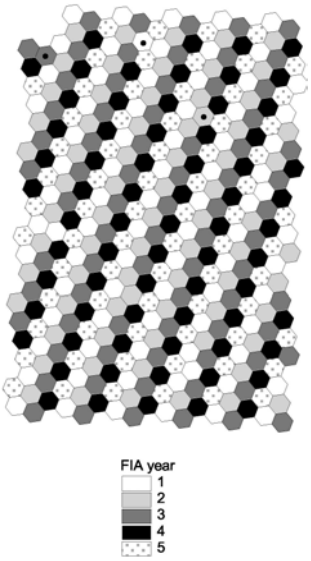

Figure 4. The final FIA hexagons. Note that the hexagons with the dots are examples of hexagons with reassigned panels to accommodate the original FHM panel.

References:

Brand, G.J., Nelson, M.D., Wendt, D.G., and Nimerfro, K.K. 2000. The hexagon/panel system for selecting FIA plots under an annual inventory. In Proceedings of the first annual forest inventory and analysis symposium, (R.E. McRoberts, G.A. Reams, P.C. Van Deusen, Eds.), Gen. Tech. Rep. NC-213 U.S. Department of agriculture, Forest Service, North Central Research Station, St. Paul, MN, pp. 8-13.

Scott, C.T., Cassell, D.L., and Hazard, J.W. 1993. Sampling design of the U.S. National Forest Health Monitoring Program. In Proceedings of the Ilvessalo symposium on national forest inventories, 1992 August 17-21, Helsinki, Finland, Res. Pap. 444, Finish Forest Research Instituted, pp 150-157.

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- Visit our national FIA website: http://www.fia.fs.fed.us
- See our "FIA Contacts" Fact Sheet