Overview of the Forest Health Monitoring Program

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Abstract.—This paper presents an overview of the Forest Health Monitoring Program (FHM), a partnership among the USDA Forest Service, State Foresters, universities, and the USDI Bureau of Land Management. The purpose of FHM is to annually assess the condition of the nation's forested ecosystems in a standardized way. There are four components of the program—Detection Monitoring, Evaluation Monitoring, Intensive Site Ecosystem Monitoring, and Research on Monitoring Techniques. At the current level of FHM development, approximately 60 percent of all forestlands in the lower 48 states, regardless of ownership, are covered by the Detection Monitoring permanent plot system.

Forests provide numerous benefits to society at large, including clean water, high-quality recreation, important habitat and biodiversity, wood products, and spiritual values. It is important for society to have a basic understanding of the condition of the forestlands of the United States so that critical policy decisions related to forest condition can be made.

The Forest Health Monitoring Program (FHM) started in 1990 as part of the Environmental Monitoring and Assessment Program (EMAP). This unique partnership among the USDA Forest Service (FS), the Environmental Protection Agency (EPA), State Forestry agencies, the Tennessee Valley Authority, the USDI Bureau of Land Management (BLM), the USDA Natural Resource Conservation Service, and numerous universities was established to respond to long-term forest health monitoring needs. Current partners include the FS, State Foresters, several universities, and the BLM.

The FHM program began in New England as a response to concerns about the effects of acid precipitation on local forests. Since then, it has expanded the permanent plot grid system to 27 states, covering 59 percent of the forestlands of the lower 48 states. The intent of the FS and State Foresters is to expand the plot system to all 50 states by 2003.

The overall purpose of FHM is to provide a basic understanding of conditions in our nation's forests by annually assessing the status and trends of forest ecosystem condition across all forestland ownerships. Data are collected and analyzed to determine the current condition and trends over time for a variety of forest ecosystem indicators. This information is used to guide management decisions.

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CONCEPTUAL MODEL FOR FHM

Although there is not complete agreement in the forestry community on the definition of forest ecosystem health, there is a consensus emerging around the definition the FS uses, namely:

> Forest ecosystem health is a condition of forested ecosystems characterized at the landscape scale by ecological integrity and, within the capability of the ecosystems, sustainability of multiple benefits, products, and values.

There are two parts to this definition: one related to ecological integrity—defined as a concept that expresses the degree to which the biological and physical components (including structure, process, and composition) of an ecosystem and their relationships are present, functioning, and capable of self-renewal—and one related to human needs and values.

Sustainability is another term needing clarification. The World Commission on Environment and Development (1987) defined sustainable development as meeting the needs of present generations without sacrificing the needs of future generations. Sustainable forest management is viewed as the forest community's contribution to sustainable development and has been in the news extensively over the past few years (Mangold 1995). The FS and other forestry agencies are recasting their respective missions to meet sustainable forest management criteria.

In FHM we are viewing forest ecosystem health as an integral part of sustainability. The two concepts go hand-in-glove, with sustainability being the more encompassing term. However, it is clear that without healthy forests there can be no ecosystem sustainability. FHM attempts to measure indicators that are related to attributes of healthy ecosystems that Kolb *et al.* (1994) have expressed. These attributes include diversity of seral stages and stand structure for habitat, physical biotic and trophic network integrity, functional equilibrium between supply and demand of essential resources, and resistance to catastrophic change and ability to recover. Rapport *et al.* (1995) defined the attributes of a system judged to be in a non-sustainable condition—reduction in size of components, system retrogression, changes in species diversity, change in primary productivity, and change in nutrient cycling. Based upon the conceptual model for sustainability described above and extensive peer review, indicators of forest ecosystem condition were developed over time for FHM.

In 1995, the Santiago Declaration was signed by countries participating in the "Montreal Process" (Montreal Process 1995). This landmark voluntary agreement among 12 nations provided for the first time an internationally agreed upon system for characterizing sustainable forest ecosystems. It includes seven criteria that generally describe the components of sustainability, and within these seven are 67 measurable indicators. The criteria are biological diversity, productive capacity, ecosystem health and vitality, soil and water resources, global carbon cycles, socioeconomic factors, and legal-institutional factors. Twelve nations agreeing to characterize forests in a similar way and report on their progress to achieve sustainability based upon these 67 indicators was a historic event. The FHM program has cross-walked its program to link up with the Santiago Declaration so that we are measuring as many of these indicators as possible. For the 28 biophysical indicators, the FHM program, together with the FS Forest Inventory and Analysis program (FIA) is making a significant contribution to addressing 18 of them (table 1).

FHM STUCTURE

FHM has four interrelated phases. Together they provide a spatial and temporal sensitivity at national and regional scales for an integrated ecological assessment of forest health. All phases are needed. The first part is Detection Monitoring (DM), which has two components—the permanent plot grid system and the aerial and ground surveys. The permanent plot system is located on a national hexagonally based sampling grid, with fixed-area plots approximately 27 km apart. There are about 12,000 plots nationwide; about one-third of them occur in forests. Each plot is sampled on four fixed-area subplots that are each 7.32 m in radius. Details of the sampling design can be found in Smith *et al.* (1998). This grid provides the spatial sensitivity required to extrapolate results to a landscape level at national and regional scales. A series of indicators is measured on these plots every year in a nationally standardized way, so that the data can be aggregated from regional to national levels.

The other phase of Detection Monitoring is the annual aerial survey and other surveys conducted by the Forest Health Protection Staff within the State and Private Deputy Area of the FS. In essence, this phase of FHM can be viewed as the synoptic layer, i.e., it is nearly wall-to-wall coverage for forestlands in many states. This is an annual survey of about 85 percent of the nation's forests, done mostly from airplanes, in which areas of mortality, defoliation, and other conditions are "sketch mapped" onto topographical maps. The data are subsequently digitized and compiled in a standardized way and put into geographic information systems to provide annual maps of mortality and damage. The two systems—aerial survey sketch maps and the permanent plot grid system—are used together to identify either areas that need immediate treatment in the form of suppression of insect epidemics (like southern pine beetle identified in aerial sketch mapping) or areas that need further study because the permanent plot data indicate a troubling increase in crown dieback, for example.

Where further study is warranted, the second phase of the FHM program is initiated—Evaluation Monitoring. In this phase, a 2- to 3-year study of the trend observed either through aerial survey or the permanent plot grid is initiated to verify the extent of the problem and to ascertain the reason for the observed effect. This portion of the FHM program was begun in 1998 with the initiation of nine Evaluation Monitoring projects, some of which will be mentioned later in this paper.

The third phase of FHM is the Intensive Site Ecosystem Monitoring (ISEM). ISEM consists of a series of 21 intensive sites located in the major forested ecosystems of the United States. It provides critical information on time-sensitive indicators—i.e., some ecological effects will be entirely missed with only the once a year visit used in DM. ISEM will monitor at a higher temporal frequency, compared to Detection Monitoring, which will monitor at a spatially more intense frequency. Both phases are needed to provide accurate assessments and to ensure that no important effects are missed. Unfortunately, only incidental funding has been available to date to implement ISEM.

There are four main functions of the ISEM program:

1. ISEM sites will allow measurement of indicators that require monitoring over long periods of time. These indicators normally could not be measured during the usual 1-day site visit employed in Detection Monitoring. For instance, the timing of budbreak or budset requires personnel to be on site for several weeks at a time. Other components to be measured on ISEM sites include abiotic inputs, vegetation variables (structure, composition, regeneration, succession), soils, and aquatics and wetland variables.

Table 1.—*Ecological criteria and indicators for the sustainable management of forest ecosystems*

Criterion	Santiago Declaration Indicator	Measurement	FHM and FIA Programs
Biological Diversity			
Ecosystem diversity	Areal extent of forest types	Percent total forest	***
		Percent non-protected [a]	*
		Percent protected [a]	*
	Fragmentation of forest types		***
Species diversity	Forest-dependent species	Total number [b]	**P
		Status of risk species [c]	*
Genetic diversity	Proportion of former range		?
	Population levels of representative species [d]		*
Productive Capacity	Timber production [e]		***
	Total growing stock [f]	Plantations [g]	***
		Annual removal wood products [h]	*
Ecosystem Health and Vitality [i]	Insects and disease		***
	Competition from exotics		**P
	Abiotic stressors	Fire	***
		Storms	***
		Flooding	***
		Salination	***
	Management/use	Land clearance	***
		Domestic animals	*
	Air pollutants	S, N, O_3, etc.	**P
		UV-B	?
	Biological indicators of key Processes [j]	Epiphytes	***
		Insects	*
		Fauna	*
		Vegetation Communities	**P
Soil Resources [k]	Physical properties	Erosion	***
		Compaction	**
		Other physical properties	***
	Chemical properties	Organic matter	***
		Nutrients	***
		Toxins	**
	Protective functions [l]		**

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(Table 1 continued)

Criterion	Santiago Declaration Indicator	Measurement	FHM and FIA Programs
Water Resources [m]	Stream flow and timing		*
	Biological diversity		*
	Physical properties	Temperature	*
		Sediments	*
	Chemical properties	pH	*
		Dissolved oxygen	*
		Electrical conductivity	*
Global Carbon Cycles [n]	Total ecosystem biomass/carbon pool [o]		**
	Sequestration/release of carbon	Standing biomass	**
		Coarse woody debris	**P
		Peat	*
		Soils	***
	Forest products		*

* = Techniques for measurement or estimation developed in other programs
** = Techniques for measurement or estimation under development in FHM Program
**P = Techniques for measurement or estimation under development and tested in regional FHM pilot studies
*** = Techniques for measurement or estimation developed by the FHM Program and implemented nationally
? = Unknown whether regional monitoring methods exist

[a] By forest types and age class.
[b] Number of forest-dependent species.
[c] Number of breeding populations.
[d] Species/diverse habitat/total range.
[e] Area and net area available; population estimate is coarser than those obtained by FIA.
[f] Merchant and non-merchant available.
[g] Area/growing stock, native and exotic species.
[h] Compared to sustainable volume.
[i] Based on area and percent forest affected.
[j] Nutrient cycling, reproduction, etc.
[k] Based on area and/or percent.
[l] Watersheds, floods, avalanche, riparian.
[m] Based on historical patterns.
[n] Contribution of forests.
[o] e.g., forest type, age class, etc.

2. ISEM will determine cause and effect relationships when Evaluation Monitoring projects do not provide clear resolution of an issue.

3. ISEM is also used to improve the current list of grid-based indicators used in Detection Monitoring. This is done through an intensification of the grid on ISEM sites and related research. We expect new indicators to be developed on ISEM sites as well.

4. ISEM sites will link continuous monitoring conditions, as measured on ISEM sites, with the anecdotal concerns of local managers about areas where no current data may exist. We should be able to correlate conditions observed on a regionally representative ISEM site with casually observed conditions in local management units. For example, we know some mushrooms fruit only every 10 years or so. If we know the flora associated with these kinds of mushrooms, we have a predictive indicator for other sites where we may need to manage for these mushrooms. This will be a very powerful tool, although the details need to be developed.

We have just begun to implement the ISEM portion of FHM. First projects have focused on linking the existing computer networks of Long-term Ecological Research areas (LTER's) that we expect to be included in FHM ISEM network so they have common and linked databases and common meteorological capability.

The fourth phase of FHM is Research on Monitoring Techniques (ROMT), which is our process of improving the existing indicators, data collection, analysis, and assessment reporting. It is an essential function and one that has contributed significant improvements to FHM, including a new statistical sampling design for the permanent plot grid system (the overlapping rotating panel design currently in use) and new indicator protocols for the vegetation structure indicator.

The four phases of FHM taken together are necessary to provide a powerful conceptual model for conducting integrated ecosystem monitoring. Integrated ecosystem monitoring is currently an important consideration in natural resource management. The National Environmental Monitoring Framework, a product of the Committee on Environment and Natural Resources (National Science and Technology Council of the White House), showed that to be effective, environmental monitoring needs to be done across scales (national to local), across agencies, and across media (terrestial, aquatic, air, etc.). This framework for monitoring across scales that uses intensive sites, systematic surveys, wall-to-wall surveys, and research is based on the FHM four-phase design (Committee on Environment and Natural Resources 1997).

INDICATORS MEASURED ON THE DETECTION MONITORING PERMANENT PLOT GRID SYSTEM

The cornerstone of FHM has been the visual crown rating measurements that are unique to FHM. We have devised a repeatable system to assess crown condition via several parameters—crown dieback (the amount of branches in the live crown that have died), foliage transparency (the amount of skylight visible through the live, normally foliated portion of the crown), and crown density (the amount of light blocked by branches, fruit, and foliage in a tree). We also record mensurational variables such as tree diameters, and heights on selected trees and we take species information. In addition, we measure a damage indicator that describes the type and amount of damage to the tree and its location on the roots, bole, or crown. The damage indicator does not ascribe causal agent because our program does not routinely use professional pathologists and entomologists to take plot data, and we feel the level of repeatability for ascribing causal agents is low for non-specialists. The aerial survey portion of Detection Monitoring provides us with the causal agent data that we need for immediate suppression treatments and other purposes.

We also monitor air quality impacts using two indicators. Damage from ozone is assessed using bioindicator plants that are sensitive to ozone. Lichen communities, key indicators of biodiversity and air pollution, are also measured. A full description of all measurement protocols can be found in the FHM Field Methods Guide (USDA Forest Service 1998).

A soils indicator is being fully implemented for the first time in 1998. This indicator is sampled by digging a small soil pit (no deeper than 50 cm) whereby the litter layer and the A horizon can be measured for depth and samples can be taken for lab analysis. Lab analysis includes assaying for total organic carbon and nitrogen in both the O and A horizons and assaying for exchangeable calcium, magnesium, and potassium in the A horizon.

We are also pilot testing several new key indicators in 1998 in five states. Vegetation structure is measured and consists of a full vascular plant inventory on three, 1-m square quadrats (plots) in each of the four fixed-area subplots. Within each square quadrat, vegetation is identified to the species level at four different levels of the forest canopy—at ground level (0 to 0.61 m), at 0.6 to 1.83 m, 1.83 to 4.88 m and greater than 4.88 m. This inventory gives us a good indication of biodiversity and wildlife habitat. From these data, we can also obtain the percent non-native (exotic) species present—currently a key interest. We also estimate the amount of coarse woody debris and the amount of fuel loading—which are key for quantifying rates of carbon sequestration and fire ecology and behavior—all are part of the Criteria and Indicators of the Montreal Process. If the pilot is successful in 1998 for these indicators, we expect to measure them in more states in 1999, or possibly nationally.

From the above list of indicators, it is clear that FHM is measuring a robust set of forest ecosystem health indicators. FHM has also considered implementing indicators for wildlife status. For example, we have developed a song bird indicator that has not yet been tested due to lack of funding. Other possible issues we are considering developing indicators for relate to amphibians or insect pollinators.

STATES INCLUDED IN THE PLOT SYSTEM

Currently there are 27 states within the Detection Monitoring plot system. They are Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, Pennsylvannia, New Jersey, Delaware, Maryland, Virginia, West Virginia, Alabama, Georgia, North Carolina, South Carolina, Indiana, Illinois, Wisconsin, Michigan, Minnesota, Colorado, Idaho, Wyoming, California, Oregon, and Washington (fig. 1). Together these states make up about 59 percent of the forest lands of the lower 48 states—across all ownerships. The FS is commited to including all 50 states by 2003. However, all states have aerial and/or ground survey programs as part of the second component of Detection Monitoring, covering 85 percent of all forestlands in the United States.

FHM MANAGEMENT AND ORGANIZATION

FHM is organized into four "mega-regions"—North, South, Interior West, and West Coast (fig. 2). Each of the regions is managed by a regional manager; the overall program is managed by a national manager and two deputy national managers. FHM is a collaborative and consensus-driven program that is directed by an FHM Management Team. The Management Team consists of the national manager, four regional managers, two deputy national managers, representatives from the FS Regions and Northeastern Area Forest Health Protection staffs, four state representatives (from each of the FHM mega-regions), a representative from the National Association of

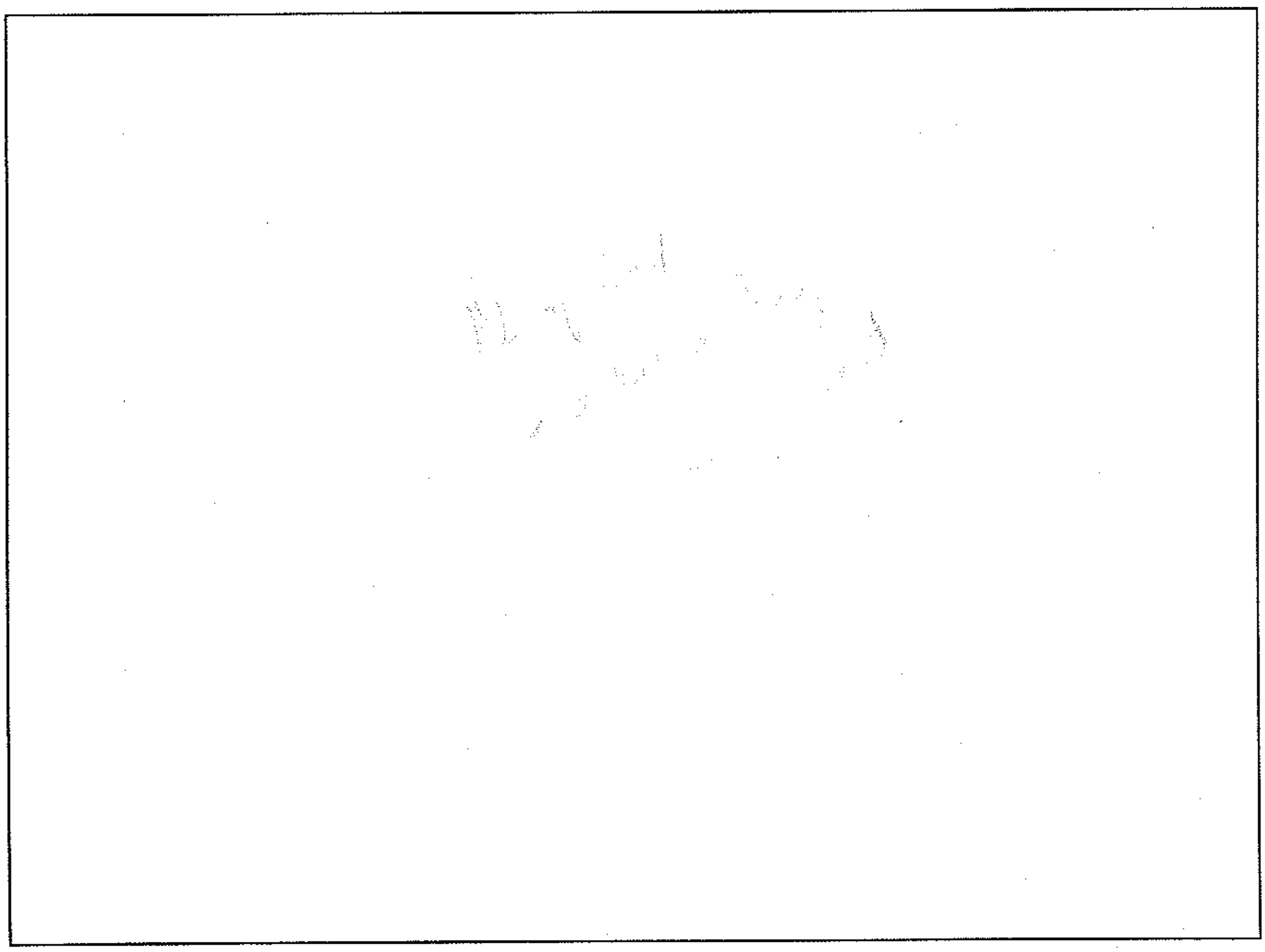

Figure 1.—*Implementation of detection monitoring plots for Forest Health Monitoring.*

Figure 2.—*Forest Health Monitoring regions, regional offices, and national office locations.*

State Foresters (NASF), a Bureau of Land Management representative, and the national Forest Inventory and Analysis (FIA) manager. If consensus cannot be reached, an issue is forwarded to the FHM Core Team, consisting of the national manager, the four regional managers, and the NASF representative. Strategic oversight is provided by an FHM Steering Committee, consisting of the Associate Deputy Chiefs for Research, National Forest System, and State and Private Forestry of the FS, and the Chairs of the NASF Forest Health and Research Committees. Day-to-day operations at the national level are run by the national manager (located in Washington, DC) and the national office staff, located in Research Triangle Park, North Carolina. The national manager reports to the Director of the Southern Research Station, located in Asheville, North Carolina.

QUALITY ASSURANCE

The FHM program maintains a strong emphasis on quality assurance. All trainers for field data collection are certified, and all field crew members are certified after successfully completing a training program. Data are collected on portable data recorders that include substantial internal validation checks to prevent entry of aberrant values. Crews are audited throughout the season in blind checks (the field crew does not know which plot will be audited), and reference plots are established across the country to compare accuracy. All indicators have specified measurement quality objectives and data quality objectives. Each indicator is peer reviewed before implementation, and the overall program has been reviewed by the National Research Council (Committee to Review the EPA's Environmental Monitoring and Assessment Program 1994).

CENTRALIZED INFORMATION MANAGEMENT

Another advantage of FHM is that all data are processed at one central location in Las Vegas, Nevada. We use a relational database—Oracle platform. This provides consistency and efficiency, and it greatly improves our quality assurance. Improvements and standardized protocols can thus be implemented simultaneously across the country with this approach.

RESULTS TO DATE

A variety of reports has been produced to date. These reports have focused necessarily on current status rather than trends. The scale of these reports is national and regional—not local. The FHM grid system cannot by itself be used to address local issues. Only now are we beginning to focus on trends because we now have an 8-year collection of annual measurements that can be used to discern trends. The current status indicators for visual crown rating for the FHM North Region, for example, indicate that over 96 percent of the hardwoods and softwoods combined had good or average crown density, crown dieback, and crown transparency across all of the states in the North Region in 1996 (Stoyenoff *et al.* 1998a-c). For this same region, the FHM damage indicator shows that 80 percent of the trees have no discernible damage. Also, ozone damage to bioindicator plants has been identified. To provide a more complete portrayal of health, in future assessments we will incorporate other factors such as the status of invasive species, weather patterns, and ecological information.

In the FHM South Region, 97 percent of the trees measured had good or average density in 1993, 98 percent had normal transparency (0 to 30 percent) and 98 percent had good or average crown dieback (less than 20 percent) (Burkman *et al.* 1996). More recent data are currently being analyzed and reported.

In the FHM Interior West Region, only 1 percent of the trees measured had dieback and transparency exceeding 25 percent (low values indicate vigorously growing trees), and 96 percent had crown density between 25 and 75 percent (high values indicate vigorously growing trees during the 1992-95 baseline reporting period. There were, on average, 10 epiphytic macrolichen species per plot, with 90 species identified in total. In downtown Denver, only two lichen species were detected on a forested plot, thus lichens may be a powerful indicator of atmospheric pollution. Exotic plant species accounted for about 4.5 percent of all plant species and 1.5 percent of the plant cover, the lowest value for any region in the country (Rogers *et al.* 1998).

In the FHM West Coast Region, we currently have data only for California, which entered the program in 1991. Oregon and Washington entered in 1997. In California, the baseline data, collected between 1992 and 1995, showed that 90 percent or more of the trees measured had good or average crown density (above 20 percent—high values indicate vigorously growing trees), but timberland oaks and pines had low values only for crown density on average (Dale 1996). The relatively lower values for these species need further clarification, because many factors, including weather effects, can create these patterns. About 80 to 90 percent of the trees had dieback less than or equal to 5 percent and 95 percent of the trees had good or average crown transparency (between 0 and 30 percent). About 70 to 75 percent of the trees were damage free. Exotics make up 13.2 percent of all plant species and were responsible for about 25 percent of the forest cover, the highest value for any region in the country (Rogers *et al.* 1998).

Aerial survey results (table 2) show that on average, 21 million acres of a total of 740 million total forested acres nationwide are defoliated each year (during 1986-1995) due to the combined activity of five major insects—gypsy moth, southern pine beetle, mountain pine beetle, spruce budworm, and western spruce budworm. We are currently working on digitizing and mapping current and previous years' data and linking them to the Detection Monitoring plot data.

One of the benefits of the FHM program is that the data are collected in a standardized way with nearly the same protocols used across the country and in six other countries. This allows us to make interregional and international comparisons.

We are now beginning to assess change across sampling years. Knowing current status is important, but knowing the trends of indicators is just as important, or perhaps more important. For example, indications are there will be some areas that have experienced sizable increases in the amount of crown dieback during the last 6 years. This may present a different picture compared to the earlier data for current status, but we have not finished these analyses yet. Preliminary data analysis (fig. 3) shows areas outlined in red where dieback for softwoods from 1991 to 1997 has increased from 5 to 17 percent on an average ecoregion basis. This is a biologically and statistically significant amount. We will continue to investigate and report on these analyses as they are done. We intend to relate FHM indicators to other stressor information such as air deposition data, Palmer Drought Index, aerial survey Detection Monitoring data, and FIA data, to produce truly integrated assessments. Once the assessments are made, the implications for management and strategic policy can be determined.

INITIATING THE EVALUATION MONITORING PHASE

In 1998, there were sufficient resources to begin the Evaluation Monitoring phase of FHM. Projects were submitted to the national office for competitive peer-review. A series of projects was selected that identified problematic situations in the field based upon Detection Monitoring data that warranted further evaluation. A list of the top projects follows:

1. Evaluation of Lake States Basswood Decline

Table 2.—*Acres of insect activity by years (in 1000 acres)*

Year	Gypsy moth[a]	Southern pine beetle[b]	Mountain pine beetle[c]	Spruce budworm[a]	Western spruce budworm[a]
1986	2,413	26,389	3,450	1,042	13,223
1987	1,329	13,796	2,442	680	7,953
1988	709	7,936	2,206	265	6,063
1989	2,996	5,333	1,614	145	3,140
1990	7,304	4,232	936	201	4,632
1991	4,152	10,744	617	108	7,171
1992	3,057	14,307	641	126	4,594
1993	1,784	10,414	782	116	447
1994	880	5,251	405	778	496
1995	1,418	21,676	576	569	478
Total	26,042	120,078	13,669	4,030	48,197
Average	2,604	12,008	1,367	403	4,820

[a] Acres of aerially detected defoliation.
[b] Acres of host type with one or more multiple-tree spots per 1,000 acres.
[c] Acres of host type with one dead or dying tree per 10 acres.

Source: Forest Insect and Disease Conditions in the United States, reports 1986-95.

2. Evaluation of Sugar Maple Decline in Pennsylvania

3. Evaluation Monitoring of Coastal Forest Health in Florida

4. Aerial Survey and Ground Verification to Monitor Swiss Needle Cast in Coastal Oregon and Washington

5. Fire Risk Rating of FIA/FHM Plots in Evaluation Monitoring (Interior West Region)

Other projects are also being funded within each FHM Region. After 2 to 3 years, we will evaluate these Evaluation Monitoring projects to determine if they satisfactorily resolved the issue or if they need to be referred to ISEM sites.

UNIQUE FEATURES OF FHM

FHM is a nationally standardized monitoring system providing annual information on forest ecosystem health that can be used in a variety of assessment reporting venues. These include reporting on the Santiago Declaration of Sustainable Forest Management (Criteria and Indicators), the Resource Planning Act Assessment (RPA), the Environmental Report Card, various reports to Congress from the Chief of the FS, and others. The value of a standardized protocol where data can be aggregated is enormous. We have too many examples where regional programs had difficulty aggregating data to provide a broad national picture because of disparate measurement protocols.

The data collected in FHM are ecologically robust. FHM collects a broad suite of indicators related to forest ecosystem condition. These indicators are needed to portray a complete picture of ecosystems, the kind of information for which our constituents and partners are asking.

Although FHM provides national and regional information only, there is direct value to local managers in three main categories.

1. Local areas or states can intensify the plot system to provide fine-scale information. This is currently being done in a several places, most notably on the Allegheny National Forest (John Palmer, Forest Supervisor, Allegheny National Forest, Warren, PA, personal communication).

2. Local areas or states can use the FHM protocols for local needs, even if they are not involved in the FHM Detection Monitoring grid. This is being done in Region 6 of the FS, where the lichen protocols are being used on six national forests "off grid." It allows managers to link their data results with the national results of FHM's lichen indicator. Why should local jurisdictions develop their own protocols when FHM has already spent many dollars developing peer-reviewed methods?

Figure 3.—*Dieback: Initial value and annual change—softwoods by ecosection (1991-1997).*

3. Even if the scale of inference of the FHM program is regional, it provides an ecosystem-wide context for showing how a local unit's ecological condition fits in with the larger ecoregion condition, which will be invaluable to local area managers.

FHM is in the process of merging its plot component of Detection Monitoring with the FIA program. Currently the two programs are using the same sampling design (FHM's current design) and are attempting to relocate plots on the same plot centers. Taken together, the two programs will provide invaluable information on an annual basis to various stakeholders. FIA is contemplating moving to an annualized cycle (like FHM) in which some plots are sampled every year in all 50 states. By having FHM plots as a subset of the more spatially intense FIA plots, FHM and FIA will be very effective in meeting many of the nation's inventory and monitoring needs.

CONCLUSION

Forest health is a topic on most people's radar screens in the natural resource community. We believe that it is essential to have the proper information to make accurate resource management decisions. Before the advent of FHM, management decisions were based on a FS aerial survey program that was not standardized (FHM has now standardized it) and other information that was not standardized or not always quantified. FHM, combined with FIA, will provide quantitative, standardized information on the nation's forestland resources. How the FS, other agencies, and society at large decide to use the data is another issue. We want to be the purveyors of the information, similar to the economic indicators that are reported monthly in the lower left corner of the first page of USA TODAY. We would like to provide some of the list of leading Environmental Indicators to our constituents.

FHM has made great strides in expanding the permanent grid system and is poised to be able to provide information for all 50 states. The grid currently covers about 60 percent of the forestlands of the lower 48 states, and the plan for fiscal year 1999 is to increase this to about 70 percent. Once the Detection monitoring grid is in place in all 50 states and we fully implement Evaluation Monitoring and ISEM, we will be able to provide an annual picture of status and trends for specific attributes on all of the nation's forestlands in a standardized manner—something that currently still eludes us. This will greatly increase our ability to report confidently about the health and condition of the nation's forests, as well as improve our ability to manage forests on a more sustainable basis.

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