Nontimber Forest Product Inventorying and Monitoring in the United States: Rationale and Recommendations for a Participatory Approach

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Abstract

This document explores the potential of collaborative approaches for nontimber forest product inventory and monitoring in the United States. It begins by reviewing results of a federal and state survey that documented inventory and monitoring efforts for nontimber forest products in the United States. The surveys show that the majority of NTFP-related inventory and monitoring on National Forests and state forests consists of non-scientific forms of monitoring, such as tracking permits, general site inspections, and informal visual checks of harvest areas. We argue that broadening participation in inventory and monitoring efforts can provide managers and policymakers with the data needed to develop and maintain sustainable NTFP management programs in an era of declining forest management budgets and staffing levels. Our fieldwork with NTFP harvesters identified several characteristics of harvesters and their work that could be compatible with or enhance inventory and monitoring efforts. In addition, harvester perspectives regarding incentives for participation are discussed. Profiles of eight participatory inventory and monitoring projects illustrate how this concept has already been put into practice. We then draw on our ethnographic research and results from four regional workshops to explore the barriers to involving harvesters in inventory and monitoring of NTFP species. In testing the idea of collaboration, we found that NTFP stakeholders are generally supportive of the concept. The benefits, potential incentives for participation, and potential barriers to participatory inventory and monitoring are described. Key recommendations include: 1) developing and implementing collaborative inventory and monitoring pilot programs; 2) modifying existing inventory and monitoring programs to explicitly include NTFPs; and 3) develop curricula and training courses for forestry students, managers and extension agents that focus on the current and potential role of nontimber forest products in ecosystem management.

This document is a companion report to: *The Relationship between Nontimber Forest Product Management and Biodiversity in the United States* and *Workshop Guide and Proceedings: Harvester Involvement in Inventory and Monitoring of Nontimber Forest Products*. All of these documents are available online at: www.ifcae.org/projects/ncssf1/ and www.ncssf.org

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Preface

In June 2002, the Institute for Culture and Ecology (IFCAE) received an 18-month grant from the National Commission on Science for Sustainable Forestry (NCSSF) to assess the relationships between forest management practices, nontimber forest products (NTFPs), and biodiversity in the U.S. The objectives of this research were to: 1) synthesize data regarding the impact of nontimber forest products management on forest ecosystem sustainability and biodiversity; and 2) directly support the ability of U.S. forest managers to assess nontimber forest product sustainability.

To achieve these objectives, we developed five interrelated project components. The first involved the expansion of IFCAE's web-based NTFP species database for identifying commercially harvested NTFPs in the United States. The second component expanded IFCAE's web-based NTFP bibliographic database that catalogs references specific to NTFP conservation, policy, management, culture and ecology (See www.ifcae.org/ntfp for both databases). The third component consisted of updating state and federal NTFP management surveys to document managers' views on how management activities affect local biodiversity and to learn more about inventory and monitoring (I & M) efforts. The fourth component involved conducting ethnographic interviews in eight ecoregions of the United States to synthesize harvester knowledge about management and biodiversity (See Appendix 1 for map). The final component consisted of four regional workshops designed to bring together land managers, policy makers, scientists, buyers and harvesters to discuss multi-stakeholder approaches to biological monitoring.

This report focuses on the results that specifically inform the issue of collaborative inventory and monitoring of NTFP species. The intended audience for this document includes resource managers and policy makers, although anyone with an interest in improving the management of nontimber forest products (NTFPs) in the United States will find it useful.

Introduction

Nontimber forest products (NTFPs) have been recognized internationally and nationally as important elements in sustainable forestry and for their "contribution to environmental objectives, including the conservation of biological diversity" (FAO 2003). NTFPs represent the subset of biological diversity actively sought and collected by humans (Wong 2000:3). As such, they are of particular interest to inventory and monitoring efforts because: 1) they have cultural and/or economic value; 2) they face harvesting pressures in addition to other pressures, such as loss of habitat; and 3) their loss would have both ecological and cultural repercussions.

Yet, NTFPs have been marginalized and largely ignored in modern forestry. The Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests for the Montreal Process has noted the lack of adequate information about NTFPs is a critical information gap hampering the implementation of sustainable forest management (McLain and Jones 2002).[1] In the United States, the USDA Forest Service has acknowledged that more knowledge is needed on how harvesting of NTFPs affects species and ecosystems and that many NTFP species do not appear in monitoring and inventory databases (USFS 2001; Hyatt 1993).

This report explores collaborative inventory and monitoring efforts for NTFPs as one mechanism to address these gaps and support sustainable forestry and the conservation of biological diversity. The impetus and underlying framework for this research is derived from the recommendations published by the Secretariat of the Convention on Biological Diversity (SCBD 2001a:3):

- Ecosystem level planning and the management of harvested or hunted populations must take place through a process of consultation, which takes relevant scientific, local and indigenous knowledge into account;
- Sustainable levels of harvest of popular, less resilient plant and animal species need to be established and monitored as part of an adaptive management process. This can be achieved through creative partnerships between scientists and local resource-users and requires technical cooperation;
- Appropriate and economically viable monitoring systems should be developed and established at the landscape level and local level;
- Integrate non-timber forest resources uses into forest inventory and management.

Working from these recommendations, we explored how to develop "appropriate and economically viable monitoring systems" for nontimber forest products that incorporated "relevant scientific, local and indigenous knowledge" and the use of "creative partnerships."

Defining Terms

For this study we defined nontimber forest products (also referred to as special forest products and nonwood forest products) using six broad product categories: foods, such as wild edible mushrooms, fruits, and nuts; medicinal plants and fungi; floral greenery and horticultural stocks; fiber and dye plants, lichens, and fungi; oils, resins, and other chemical extracts from plants, lichens, and fungi; and fuelwood and small diameter wood used for poles, posts, and carvings. (See *The Relationship between Nontimber Forest Product Management and Biodiversity in the United States*, for a detailed description.)

We use the term 'harvester' broadly to refer to anyone who gathers NTFPs for subsistence, market exchange, recreation, spiritual purposes, healing, the development of formal scientific knowledge, the development of informal scientific knowledge, and educational purposes. 'Harvesting' is used to refer to the wide-array of NTFP-related activities, including "digging" medicinal roots, "pulling" moss, "gathering" nuts, "picking" berries, “tapping” maple syrup or turpentine, “foraging” for wild foods, “wildcrafting” medicinal plants, and “collecting” wildflowers and seeds.

Inventorying as used in this report is defined as surveying, sorting, cataloguing, quantifying and mapping of individuals, populations, or species (ARBEC 2001). NTFP inventories frequently consist of a checklist of the taxa identified within the sample plot and often voucher specimens are collected and archived. Tuxill and Nabhan (2001:86) note that inventories are “quantifiable, repeatable methods of sampling, classifying and measuring an environmental feature or cultural pattern.” Inventories provide baseline data on the current status of the species in question and are often used to determine species distributions.

Monitoring is defined as the process of observation over time to detect changes (Kerns et al. 2002). This can include observing ecological variables such as species, ecosystems and landscapes, as well as socio-cultural variables such as knowledge, attitudes, and practices that influence and define human/environment interactions. Examples include wildlife population sizes, biomass of vegetation, growth, and production. According to ARBEC (2001), monitoring is “usually goal-oriented and provides a strategic framework for predicting the behavior of key variables for improving management and providing early warning of pending changes within the system.”

Biological diversity, or biodiversity, refers to “the variability among living organisms from all sources, including, among other things, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems” (SCBD 2001b:5). Biological diversity has also been defined by its components (landscapes, ecosystems, communities, species/populations, and genes) and attributes (structure, composition, and function) (Putz, et al. 2000).

Research Focus

The National Commission on Science for Sustainable Forestry (NCSSF) initially requested research that would document NTFP management impacts on biodiversity. However, we found little evidence of land managers managing *for* NTFPs, except through the use of regulatory mechanisms such as permits. The impact of these NTFP regulatory mechanisms on forest sustainability and biodiversity appear to be largely unmonitored and unknown. Furthermore, we found that efforts to monitor the impacts of current forest management practices on NTFP resources are minimal or non-existent, as are efforts to monitor the impact of the harvest of NTFP resources themselves.

Without data about the density and distribution of NTFPs, population structure and productivity, and the impact of biomass removal (of timber and NTFPs alike) on ecosystem stability, it is difficult to determine sustainable harvest levels for NTFPs. To complicate the issue, managers and scientists have limited knowledge of the economic, political and cultural factors that drive NTFP use patterns. Moreover, cultural use patterns for NTFPs are diverse, and the decentralized nature of NTFP gathering presents a challenge to current forest management. In short, current ecological, cultural and economic understandings of the NTFP arena are insufficient to guide land managers and policy makers.

Therefore, our attention shifted to identifying mechanisms by which this data could be obtained. Inventory and monitoring has long been recognized as a way to deepen our understanding of biological diversity and ecosystem functioning. It provides a means to detect changes over time and space and enhances our ability to understand species trends. This data enables policy makers to head off unacceptable declines that could trigger enactment of the Endangered Species Act. Thus, inventory and monitoring can act as an early warning system to prevent unacceptable declines in species and help ensure the sustainability of products harvesters and society depend on.

Recent budget and staff cuts have constrained inventory and monitoring efforts, which led us to explore how NTFP harvesters might be included in biological inventory and monitoring efforts. We included questions regarding inventorying and monitoring on our Federal and State surveys as well as in our ethnographic research. We used the four regional workshops to obtain input from a variety of stakeholders on the possibilities and problems of involving harvesters in inventory and monitoring programs.

The objective of this report is to offer suggestions on how to improve NTFP inventory and monitoring, so as to provide the information needed to develop and maintain sustainable NTFP management programs. The document is divided into five major sections.

The first section "NTFP Inventory and Monitoring on US Forest Service and State Lands," presents a short summary of relevant results from two national surveys—one of all Forest Service Ranger Districts of US Forest Service and the other of all State Forestry offices—which sought to document managers' efforts to inventory and monitor NTFPs in the United States. The next section, "Broadening Participation in Inventory and Monitoring," looks at theoretical arguments for participatory approaches, with particular attention paid to democratic theory. Eight short profiles are then presented to illustrate how collaborative approaches have been implemented. The following section, "Involving Harvesters in Inventory and Monitoring," takes a closer look at the potential for involving NTFP harvesters and possible barriers to their participation. This discussion draws from our anthropological fieldwork with NTFP harvesters and four regional workshops that examined how harvesters could be involved in NTFP inventory and monitoring. The next section, "Developing a Collaborative Inventory and Monitoring Process," provides specific suggestions for setting up a collaborative approach involving harvesters. We mention some potential indicators and methods that might be considered by anyone wishing to develop a collaborative I & M program. We conclude with a synthesis of our recommendations. The Appendices include information on our research sites and an annotated reference guide to web resources on citizen science, participatory, and volunteer monitoring projects.

Figure 1. Eric Jones in the field observing and learning about medicinal roots. (Photo by Kathryn Lynch, 2002)

NTFP Inventory and Monitoring: Forest Service and State Efforts

To determine the extent to which NTFP inventory and monitoring occurs on National Forests and state forests, we administered two written surveys as part of this research. We emailed one version of the survey to all U.S. Forest Service Ranger Districts, and the other to the State Foresters of all 50 states. Both surveys included a section asking respondents about their administrative unit's use of NTFP inventory and monitoring efforts, as well as their views on barriers to and opportunities for effective NTFP inventory and monitoring. We also included a question designed to elicit information about ecological monitoring efforts of the impacts of NTFP management activities on forest ecosystems.

We received responses from 84 National Forests, or 78% of the National Forests in the U.S. Thirty-four state foresters completed the state survey, a response rate of 68%. The following sections briefly summarize the key findings for the questions on NTFP inventory and monitoring. A companion report to this document, *The Relationship between Nontimber Forest Product Management and Biodiversity in the United States,* provides a detailed discussion of the survey results.

Lands Managed by the Forest Service

Respondents on 36% of the National Forests reported that NTFP inventories take place on their forests. The reported incidence of NTFP monitoring was much higher, occurring on 60% of National Forests (see Table 1). On 11 forests, or 55% of the 20 forests for which details on inventory programs were provided, NTFP inventories consisted of informal field checks or general surveys of prospective harvest sites. Six forests (30%) noted that they used inventory field plots and four (16%) gathered NTFP data as part of stand exams.

Similarly, descriptions of NTFP monitoring programs from the 29 National Forests who provided them suggest that much NTFP monitoring consists of permit compliance checks (52% of the monitoring efforts described by responding Forests) or informal visual checks of harvested areas (31%). Respondents from only 6 National Forests (21% of those describing NTFP monitoring programs) mentioned using scientifically designed field plots for NTFP monitoring.

Table 1: USFS Inventory and Monitoring

	Response (n=84)	
	%No	**%Yes**
Inventory NTFPs*	63	36
Monitor NTFPs*	39	60
Ecological Impact Monitoring of NTFP Activities**	46	54

* 1 missing value
** 2 missing values

We also asked survey respondents whether their administrative units conducted ecological monitoring to determine the effects of NTFP management activities on biodiversity.[2] Respondents from slightly more than half (54%) of the National Forests indicated that ecological monitoring of NTFPs takes place on their forest. Respondents from 23 National Forests included a written description of their ecological monitoring efforts. On 65% of these National Forests, ecological monitoring focused on determining unspecified types of ecological impacts of NTFP management, and 44% noted that their ecological monitoring was aimed at determining the impacts of NTFP management on the NTFP species themselves.

As with the NTFP-specific inventory and monitoring question on the survey, Forest Service respondents interpreted the term "ecological monitoring" to include a range of activities ranging from informal checks of harvest areas (listed for 52% of the National Forests), general site inspections (listed for 27%), and permit tracking (14%) to scientific field plots (5%) and surveys (5%). In short, the majority of NTFP-related inventory and monitoring on National Forests consists of informal, non-scientific forms of data collection.

Survey respondents mentioned a variety of barriers to implementing NTFP inventory and monitoring, ranging from lack of funding to limited commercial demand for NTFPs to the low prioritization of such efforts within the agencies. These barriers fell into the following three broad categories: 1) lack of internal capacity to develop and carry out inventory and monitoring programs; 2) lack of political will within the agency; and 3) limited or no perceived need due to either abundant NTFPs or a small number of harvesters relative to supply.

Among the participating National Forests, the most commonly cited barrier to NTFP inventory and monitoring was lack of funding (listed by respondents from 85% of the forests). The second biggest barrier for the Forest Service was lack of staff (listed by respondents from 73% of the forests). Both of these fall into the internal capacity category. The two other major barriers to inventory and monitoring -- lack of political will within the agency and perceived lack of need for inventory and monitoring -- were mentioned by respondents from fewer than 20% of the National Forests.

Lands Managed by States

The survey data for state forests suggest that NTFP inventory and monitoring is even less likely to take place on state forestlands. 9% of the state foresters reported that NTFP inventories took place on their forests, while 29% indicated that they monitored NTFP harvesting activities. Of the 10 respondents who provided details on monitoring programs, six stated that monitoring consisted either of visual exams or of informal checks as part of conservation officers' regular duties. The remaining respondents didn't provide enough information for us to determine whether monitoring consisted of informal or scientific procedures.

Four state foresters (12%) reported that ecological impact monitoring takes place for NTFP management activities on their state forestlands. The state foresters who mentioned ecological monitoring noted that it consisted of visual checks or inspections done as part of a forester's other duties.

Table 2: State Forest Inventory and Monitoring

	Response (n=34)	
	%No	**%Yes**
Inventory NTFPs	91	9
Monitor NTFPs	74	26
Ecological Impact Monitoring of NTFP Activities*	88	12

* Includes 1 missing value

When asked about barriers to inventory and monitoring, state forest respondents mentioned lack of funding (76%) and lack of personnel (76%) as the major barriers to NTFP inventory and monitoring. Twenty-five percent of the state survey respondents mentioned other institutional capacity types of barriers, such as lack of agency knowledge and logistical difficulties, 14% listed lack of agency support, and 14% perceived no need for inventory and monitoring.

Federal Inventory and Monitoring Programs

Inventory and monitoring of U.S. forest ecosystems are carried out through a variety of local, state, and federal programs, none of which specifically monitor nontimber forest products. Table 3 provides a list of some of the national programs that obtain forest data.

Table 3. Partial List of Federal Inventory and Monitoring Programs

Program	Main Federal Agencies Involved
Forest Inventory and Analysis (FIA)	USDA FS
Forest Health Monitoring Program (FHM)	USDA FS, EPA, BLM
Long Term Ecological Monitoring and Research (LTER)	NSF, USDA FS, NASA
Land Margin Ecosystem Research (LMER)	NSF
National Environmental Research Parks (NERP)	DOE
National Resources Inventory (NRI)	USDA NRCS (NRI)
GAP Analysis Program (GAP)	USGS
Environmental Monitoring and Assessment Program (EMAP)	EPA
Multi Resolution Land Characteristics (MRLC)	EPA, NOAA, USGS

While all these programs have projects that include species that may be NTFPs (e.g., berries, roots, bark), we could find no evidence that any of these programs specifically target data collection or analysis on species because they are NTFPs. In contrast, one the most important programs for forest inventory and monitoring information, Forest Inventory and Analysis (FIA), timber is the only natural resource product that serves as a central organizing concept in research designs and data collection. According to Brad Smith (pers.comm. 2003), the FIA program is working with related scientists to keep up with opportunities to incorporate nontimber work into the FIA program as collaborative functions. FIA has also provided assistance to researchers by providing FIA data. He notes, "FIA simply does not have the resources [nor the mandate] to do it all- but we can assist other researchers and programs. We did a lot of work on Pacific Yew for instance for taxol research efforts providing range maps and resource quantities." In addition, FIA does take full floristic samples on every 16^{th} FIA plot (known as the P3 plots) in order to get better information on forest structure and understory vegetation. While some information about NTFPs can be found in data collected in federal programs like FIA, key questions concerning NTFPs, such as the ecological impacts of NTFP removal, cannot be answered.

Some individuals or teams in the Forest Service (e.g., Pilz and Molina 2002; Pilz et al. 1996; Vance and Kirkland 1997; Kauffman 2001, 2003) have conducted biological investigations of NTFPs. Likewise, the US Fish and Wildlife Service has commissioned studies to analyze the sustainability of ginseng and goldenseal harvesting (Gagnon 1999a, 1999b) and the National Park Service has initiated studies such as the All Taxa Biodiversity Inventory of the Great Smoky Mountain National Park (Francis et al. 2003; White and Morse, 2000). Such efforts have begun to provide a body of research specific to NTFPs at appropriate spatial and temporal scales and are critical for informing future research. These projects are helping define key questions and appropriate research design and methods for NTFPs. However, these researchers have few resources to work with and little agency support overall. Consequently, federal agency science is only minimally addressing the vast gap in NTFP research for federal lands.

The cost of labor is a major potential impediment to expanding inventorying and monitoring efforts. FIA's labor costs are projected at around 50% of their total budget of $82 million (FIA 1998). FIA labor primarily consists of full and part-time staff, seasonal contractors, and limited use of volunteers for special projects. In the following sections we look at the concept of participatory inventory and monitoring and discuss how approaches involving commercial and noncommercial NTFP harvesters can reduce labor costs while increasing the relevance and quality of data collection for NTFPs.

Broadening Participation in NTFP Inventory and Monitoring

Resource managers face the difficult situation of being mandated to manage ecosystems while lacking sufficient data to carry out that mandate. To address this situation, we looked for alternatives that could provide the data managers and policy makers need to make sound decisions. Broadening participation to include those people who harvest nontimber forest product resources emerged as a viable option.

Recognizing the Value of Participation

Participation as a concept has been widely discussed, and as a practice has been implemented in a multitude of ways, for many purposes (Slocum et al. 1995). Within international development circles, participatory processes have been encouraged as a mechanism for supporting the development of democracies (USAID 1998). Within educational institutions and nonprofit organizations, programs that involve educators and their students in data collection are widely acclaimed as an effective way to get students interested in studying real-world environmental problems while obtaining much needed data (e.g., the GLOBE program).[3] The first national conference on Science, Policy, and the Environment entitled, "Recommendations for improving the scientific basis for environmental decision-making," recommended "meaningful and sustained mechanisms to incorporate perspectives of diverse stakeholders, particularly those outside the federal government" (NCSE 2000). Within academia, political scientists, anthropologists and natural resource scientists have acknowledged the value of participatory approaches in conservation efforts (e.g., Agrawal 1997; Schmink 1999; Meffe and Carroll 1994). Environmental regulatory agencies such as the Environmental Protection Agency advocate the use of volunteers in monitoring, having found that volunteers provide quality data and their involvement helps strengthen stewardship of local waters (EPA 2002). The National Park Service has turned to the public for assistance with rare plant inventories (e.g., Dingman 2003). The concept of public participation has moved beyond merely providing public comment opportunities to involving the public in data collection and monitoring of natural resources (de Beer, pers.comm.).

Experiences within fisheries are particularly instructive and provide pragmatic insight into collaborative processes. Many fisheries management agencies have adopted participatory approaches to address data gaps and to build better public relations (NRC 2000). McCay and Jentoft (1996) make strong arguments for collaborative approaches based in democratic theory, noting that involving everyone affected by decisions in the decision-making process results in the legitimacy of the decision-making processes itself. Jentoft et al. (1998) note that involving fishermen in fisheries management has resulted in improved management decisions because those with hands-on knowledge are involved. Jentoft (2000:53) also argues that well-functioning communities make an important contribution to fisheries management, and that in fact viable fishing stocks require viable fishing communities.

In forest management, the value of participatory approaches has also been recognized (Carter 1996). The United Nations Environment Programme (UNEP) notes, "resource assessment, as well as determining harvesting impacts, would arguably be best achieved through community participation" (UNEP 2003:5). The Forest Service acknowledges that monitoring should be done in collaboration with others (e.g., agencies, interested publics, researchers, and NGOs) in order to share the workload, gain expertise, and build credibility and trust (USFS 2003). In 1999, Congress instructed the Forest Service to implement multi-party monitoring in association with the National Stewardship Pilot Program (American Forests 2001)[4]. At a Sustainable Forestry Roundtable, Cromley (2002) noted that, "multi-party monitoring promotes collaborative learning, ensures accountability, builds trust, and helps to ensure corrective action is taken." Guidelines such as those developed by Moseley and Wilson (2002) and Savage (2002) illustrate how communities can be involved in forest monitoring.

In regards to the conservation of biodiversity, Samper (2003:1149) notes that the Global Biodiversity Assessment has been largely ineffectual due to the lack of involvement of all stakeholders and that the new Millennium Ecosystem Assessment has responded by creating a large governing board that includes representation for governments, scientists, non-governmental organizations, the private sector and local communities. The National Commission on Science for Sustainable Forestry (NCSSF) notes that "encouraging locally-driven, participatory inventory and monitoring leads to greater stakeholder understanding, involvement and support for management direction, and generally, contributes to the democratization of science in the United States" (NCSSF 2003). In a workshop convened by NCSSF in 2003 on how to improve communication and understanding between researchers and practitioners, participants noted the opportunity for involving local communities, youth and the media in data collection and information dissemination (NCSSF and NFF 2003). When asked in a survey "What additional types of data, information, approaches and tools would most help you in addressing biodiversity and sustainability issues?," forest professionals responded that collaborative approaches that involve all parties in monitoring and value indigenous knowledge were needed (Cluck and Kenny 2003). Our research, and this document specifically, respond to this need by examining collaborative approaches to the inventory and monitoring of NTFP species. We focus on NTFPs because they represent a critical element of forest biodiversity—the element that people consider valuable to meet human needs.

Examining Participation

The level of participation in any project varies depending upon the goals and objectives of the person or groups involved. The depth of understanding—and commitment to— participatory processes of those involved also influences how participation is conceptualized and put into practice. Scientists and practitioners often conceptualize participation as a continuum (Rocheleau 1994; World Bank 1996; Guijt and Shah 1998). At one end, participation is limited to providing information. In this scenario, researchers may ask community members to participate by answering questions or filling out surveys. If the research is designed outside of the community as it typically is, the questions may or may not be of interest or relevance to the community. In contrast, at the other end of the continuum, communities define and conduct the research themselves. In this case, the data gathered may or may not be of interest or relevance to mangers and policymakers. In between those extremes exist a range of possible types of participation. Looking at the continuum in terms of power, projects move from a place where the researcher maintains all control to a place where the community is in control. The impetus for engaging in participatory processes can come from the grassroots or be imposed from the 'top.' This continuum illustrates that the term 'participation' applies to a wide range of activities, from simply asking people to provide information, to addressing unequal power structures by creating projects that allow all to share their opinions and take part in the decision-making and management of projects. Thus, defining what is meant by participation early in any project is important.

This continuum is more than a tool for understanding the concept of participation. We have applied the continuum to consider how harvesters might participate in inventory and monitoring (See Table 4). At one end, a few harvesters are involved but they have no real voice in research design, implementation or analysis of the results, and do not participate in decision-making based on the I & M data. This is often referred to as tokenism. Sustaining harvester involvement is highly unlikely. Next follows co-operation and consultation, in which harvesters are increasingly incorporated but in which managers and scientists still maintain power and control over the process. Again, the potential for harvesters to take ownership in this project and continue long-term involvement is low. Based on our research, the next two modes—collaboration and co-learning—are likely to be most effective forms for harvester participation. In collaboration, harvesters, resource managers and scientists work together to determine priorities in terms of the inventory and monitoring work. In co-learning, harvesters, managers and scientists work together to develop action plans based on the results of this I & M work and the various stakeholders work as partners. In these modes, the potential for harvesters to take ownership increases. In the final category of collective action, harvesters act as the directors of the project as they develop and implement their own I & M programs.

Table 4. Participation Continuum

Mode of Harvester Participation	Types of Participation	Potential for Sustaining Harvester Involvement & Ownership	Role of Harvesters in Inventory & Monitoring
Co-option	A few harvesters are chosen to participate, but have no real power.	Unlikely	Subjects
Co-operation	Harvesters are assigned tasks, with incentives. Managers and/or scientists decide agenda and direct process.	Unlikely	Employees
Consultation	Harvesters are asked for their opinions & input. Managers and/or scientists analyze information and decide course of action.	Low	Clients
Collaboration	Harvesters work together with managers & scientists to determine priorities. Managers and/or scientists direct the process.	High	Collaborators
Co-learning	Harvesters, managers & scientists share their knowledge to create new understanding and work together to form action plans. Managers and/or scientists facilitate.	Higher	Partners
Collective Action	Harvesters set and implement their own inventory and monitoring program. Managers, scientists absent.	Highest	Directors

(Adapted from Cornwall 1996)

While this continuum helps characterize relationships between stakeholders, Guijt and Shah (1998:9) point out several of its limitations. First, this model assumes that within each level, participation of each stakeholder is of equal intensity throughout a project's lifecycle. Yet, this is not always the case. Second, this model reduces the complexity of stakeholders involved in any natural resource issue into a simple dichotomy of 'insiders' versus 'outsiders.' This hides the diversity within both the 'insider' and 'outsider' groups. It is important to take note of who from within stakeholder groups is participating and in what form in any project. In NTFP monitoring, this means paying attention to which types of harvesters are participating and if there are segments within the harvester community that are not being included that should be involved. Third, the continuum model can be incorrectly interpreted as implying that it is preferable to move from the co-option to collective action, without analysis of local peoples' preferences and abilities to participate. Guijt and Shah write that participation continuums are:

> .....often couched in normative terms, moving from coercion to autonomy. Thus they imply that it is possible, desirable and necessary to move across this continuum to the most intense form of participation, a kind of participation 'nirvana' in which everyone gaily commits themselves to what can be a quite conflictual and tedious process of local analysis and planning" (Guijt and Shah 1998:10).

The nature of participatory processes means that each group of stakeholders must discuss and decide for themselves what level of participation is desirable and feasible. Plus federal laws and regulations also influence this process, for on federal lands the final decision authority must be maintained by the federal agency. Nonetheless, collaboration with stakeholders can improve that decision-making process. Taking into consideration these concerns can help clarify participants' expectations for participatory processes.

Potential Benefits of Collaborative I & M Approaches

Inventory and monitoring has long been recognized as a way to deepen our understanding of biological diversity and ecosystem functioning (Hellawell 1991). Monitoring provides a means to detect changes over time and space, enhances our ability to predict future trends, and is a central element within adaptive management (Oglethorpe 2002; Holling 1978). Within the NTFP arena, inventories can help determine if commercial quality and quantities of specific NTFPs exist, while monitoring can help determine sustainable harvest levels. Such information can potentially inform and improve management decisions.

Current monitoring efforts have been critiqued as inadequate, in terms of temporal and spatial scales, for local planning purposes. The National Science and Technology Council acknowledged that "Current monitoring programs do not provide integrated data across multiple natural resources at the temporal and spatial scales needed to develop policies based on current scientific understanding of ecosystem processes" (NSTC 1997). This sentiment is echoed in the recent writing of Ohmann:

> In order to address policy issues relating to biodiversity, productivity and sustainability, we need detailed understanding of forest vegetation at broad geographic and time scales. Most existing maps developed from satellite imagery describe only general characteristics of the upper canopy. Detailed vegetation data are available from regional grids of field plots, but the data are not spatially complete—they do not cover an entire area of interest (Ohmann 2003:1).

Broader participation might yield benefits by fostering data collection at the appropriate spatial and temporal scale needed for effective management and policy decision-making. This is particularly true for many nontimber forest products that are missed at larger scales (Kerns et al. 2002:257).

Within this context, there is growing recognition within academia and among practitioners that achieving sustainability through the use of biological monitoring tools depends on *who* is involved. For example, Salick (1991) argues that involving local peoples in conservation efforts helps them develop a sense of responsibility for the environment. Likewise, such participation can improve communication between stakeholders and help all parties understand how and why decisions are made (Jentoft et al. 1998). This in turn can improve implementation of management plans over the long-term (Stiglitz 2002).

Specific to NTFPs, Kerns et al. (2002:259) note, "Local harvester knowledge of where particular harvest techniques are used and have been used for long time periods can be incorporated into field inventories to develop relational inferences between harvest practices and observed productivity." Everett (2001) presents a case study of participatory research from northern California, in which harvesters collaborated with the Forest Service, scientists and local NGOs to address ecological, economic and social aspects related to harvesting from public lands. In her work with the Biodiversity Support Program, Alcorn (1994:ix) notes, "If the who includes local people and other forest users in the roles of decision-making planners and results analysts, then biological information developed will provide critical material for constructing a sustainable system for harvesting NTFPs." Indeed, community self-monitoring systems for NTFPs are appearing in many countries, including the Philippines, Sri Lanka, India, Vietnam, and Indonesia, in response to community concerns over depletion of NTFP resources (de Beer, pers. comm.). According to de Beer, Indonesian rattan harvesters see monitoring as a mechanism to "gain recognition and credibility for their age-old sustainable management practices and to serve as a useful foundation for certification."

Involving commercial interests in inventory and monitoring is not without precedent in natural resource industries in the U.S. A vast network of commercial fishermen are involved in various levels of data collection for fisheries scientists and managers (e.g., Fishresearch.org). For example, fishermen contribute information on fish populations, locations, diseases, water quality, and many other important types of data that would not be collected at the level without their involvement (NRC 2000). Government agencies, nongovernmental organizations, academic scientists, and fishermen themselves have worked hard to develop these collaborative systems because of the many important benefits working together has afforded. For example, involving commercial fishermen in data collection has reduced labor and time costs; improved quality of commercial fishery-dependent data; and reduced mistrust between fishermen and scientists (NRC 2000). The sophistication of these collaborative relationships and data collection systems exceeds anything occurring in U.S. forest management.

Another benefit of collaborative approaches is the potential to promote shared responsibility for managing the resource. This means that while everyone can take pride and credit for successes, everyone must also take responsibility for the shortcomings. Thus, everyone shares responsibility for tough decisions and the tendency to blame others is reduced (NRC 2000). Proponents of participatory approaches argue that participation has the potential to create a sense of ownership in a project, make programs more applicable to the local context and increase transparency and empowerment (e.g., DELIVERI 2004). Participatory processes are also seen as a means to develop local capacity and tap local knowledge and expertise. For some researchers, participatory processes are seen as mechanisms to enhance the validity of research findings (e.g., Bernard 1994). Participation is sometimes promoted as a means to an end, such as achieving better cost-effectiveness in a project. Participation is also promoted as an end in itself, in that it enhances individuals' capacities to express their perspectives and influence the decisions and actions that affect their lives (Slocum et al. 1995). Finally, participation can also be a means to increase democratic skills and foster more stable political environments (Anyanwu 1988).

Specific to NTFPs, inventory and monitoring data can help establish whether a system is ecologically sustainable and lead to the possibility of certification. Certification of NTFPs is an emerging practice on state and private forestland, and one benefit is the potential for increased market access and price premiums (Mallet 2002; Shanley et al. 2002). In addition, involving harvesters could help capture the geographic variability of many NTFPs, thus addressing what Kerns et al. (2002) call the frequent inadequacy of current I & M spatial grids and temporal scales.

Despite these benefits, a dialogue regarding the effectiveness of participatory approaches for protecting biodiversity is taking place within the conservation community. Some have noted that participatory approaches (sometimes referred to as people-centered conservation strategies) are not sufficient and that renewed emphasis on authoritarian protection strategies is necessary (Kramer et al. 1997; Oates 1999; Terborgh 1999). Advocates for participatory approaches, such as Wilshusen et al. (2002:17) respond that while participatory approaches may have shortcomings, authoritarian protectionist strategies most likely will not provide long-term protection of biodiversity, for they "largely ignore key aspects of social and political processes that shape how conservation interventions happen in specific context." McCay (2002:385) also argues that participatory management has the potential to be more effective than top-down natural resource management:

> The notion that local communities can and should play a major role in conservation and environmental management has been adopted by many important players in the world, from the World Bank to international NGOs such as the World Wide Fund for Nature (WWF). It is the one unifying message of the network of scholars and practitioners centered on the International Association for the Study of Common Property (IASCP), as well as the larger and more diffuse network of people devoted to community-based sustainable development and natural resource management. The reason is simple: "even well-funded coercive conservation generally fails" (Agrawal and Gibson 1999:632; Peluso 1993).

Participatory Inventory and Monitoring - Profiles

The history of collaborative efforts in fisheries management illustrates that the use of volunteers, amateurs and laypersons in scientific efforts to inventory and monitor biological diversity is not an idea without precedent. Indeed, such efforts extend well beyond fisheries and are worth examining for clues about how to enhance forest managers' knowledge about NTFPs. The following section provides brief sketches of eight collaborative inventory and monitoring profiles (Table 5). The profiles are not meant as prescriptive models, but rather to illustrate a multitude of ways in which collaborative inventory and monitoring might be pursued. The profiles include international and national examples, including several efforts of NTFP monitoring already being tried in the U.S. Although not an exhaustive list, it provides a sense of the diversity of mechanisms and strategies for implementing collaborative approaches. It also includes examples from various NTFP sectors, including medicinal plants, mushrooms and floral greens.

Table 5. Overview of Participatory Inventory and Monitoring Profiles

Project	Participants	Scale; Ownership	Species Focus	Year
Profile # 1: National Inventory of Biodiversity (Costa Rica)	- Non-profit organization - Community members - National scientists - International scientists	National; Public Private	- Arthropods - Plants - Mollusks - Fungi	1989 to present
Profile # 2: Audubon Christmas Bird Count (North America)	- Amateur ornithologists - Professional ornithologists - Non-profit organization	International; Public Private	- Birds	1900 to present
Profile # 3: NatureMapping (WA)	- K-12 teachers - K-12 students - Various government agencies and scientists	Multiple states; Public Private	- Wildlife generally - Reptiles - Amphibians - Fish, etc. - Plants	1993 to present
Profile # 4: Medicinal Plant Inventory and Monitoring Project (NC, CO)	- Medicinal Plant Working Group members (industry, herbalists, botanists, etc.) - Garden Club volunteers	Multiple states; Public (National Forest)	- Medicinal plants - Black cohosh - Bloodroot	2000 to present
			- Osha	2002 to present
Profile # 5: La Montaña de Truchas Community-Based Forest Products (NM)	- Community youth - Community members - USFS	Local; Public (National Forest)	- Small diameter timber for: - Fuelwood - Latillas - Vigas - Carving	1996 to present
Profile # 6: Ecological Research (WA)	- Commercial harvesters - Non-profit organization - Academic researcher	Local; Public Private	- Salal, a floral green	2001-2003
Profile # 7: Matsutake Mushroom Ecological Monitoring (OR)	- Harvester - USFS managers - USFS scientists - University scientists	Local; Public Private	- Matsutake mushrooms	1994 to present
Profile # 8: Chanterelle Mushroom Ecological Monitoring (WA)	- USFS managers - USFS scientists - University scientists - Mycology club volunteers	Local; Public (National Forest and State)	- Chanterelle mushrooms	1993-1996

Profile # 1: El Instituto Nacional de Biodiversidad (INBio), Costa Rica

INBio is a non-profit scientific organization based in Costa Rica, whose mission is "to promote an awareness of the value of biodiversity, and thereby achieve its conservation and use to improve the quality of life." In pursuit of this mission, INBio oversees the National Inventory of Costa Rica's biodiversity, which focuses primarily on arthropods, plants, mollusks and fungi. The National Inventory uses an interdisciplinary approach to: 1) catalog the number of species found in Costa Rica; 2) document their distribution throughout Costa Rica; 3) identify natural history features that can contribute to protect them, use them and manage them adequately. The National Inventory team consists of parataxonomists, technicians, local curators, and national and foreign experts. The collaborative element of this project is that lay people from communities near National Parks carry out the data collection. They are trained as "parataxonomists" through a 6-month intensive course which includes the fundamentals of biology and ecology; taxonomy; evolution; collection and preservation techniques; information management, administration and equipment maintenance techniques. INBio's personnel facilitate training with support from national and international instructors. The parataxonomists then collect specimens in 23 biodiversity stations scattered across the country and bring them to INBio on a monthly basis. Apart from supplying information on the natural history of the specimens, these individuals act as educators in their communities and are active participants in the joint processes between INBio and the National System of Conservation Areas (SINAC). www.inbio.ac.cr/en/invn/Invent.html

Profile # 2: Audubon Christmas Bird Count

The Audubon Christmas Bird Count (CBC) is the oldest, cooperative citizen science bird survey in the world. When the Christmas Bird Count began in 1900, only 27 people participated. By 2000 that number had risen to 52,471. The CBC is an early-winter bird census conducted by volunteers throughout North America, including Canada, United States and Mexico. The primary objective to is to monitor the status and distribution of bird populations across the Western Hemisphere. The counts are conducted annually between December 14 and January 5. Volunteers follow specified routes through a designated 15-mile (24-km) diameter circle, counting every bird they see or hear all day. Issues of data quality are addressed through several mechanisms. First, beginners are placed in a group with at least one experienced birdwatcher. Second, a six-page manual is found on their website which provides instructions to volunteer data compilers on how to record weather, effort, rare species and other key information.[5] Third, editors of the CBC review the data before it is published. CBC data provides a valuable source of information regarding the status and distribution of early winter bird populations and a large number of scientific studies have relied on this data. Scientists, resource managers and policy makers have used the data to identify environmental threats to bird populations and for determining conservation priorities. www.audubon.org/bird/cbc/

Profile #3: NatureMapping

The NatureMapping Program began in Washington State in 1993 when researchers realized they lacked sufficient wildlife and habitat data to complete a state biological survey. In addition, the NatureMapping Program is a response to the fact that long-term monitoring is rarely funded (Dvornich et al. 1995). University researchers and State Department of Natural Resources (DNR) scientists invited K-12 students and teachers, Audubon chapters and retired natural resource management professionals to help create a "public layer" to fill in the gaps in the biological survey.[6] Program objectives include: involving citizens in the activity of science, acquiring broad data sets not otherwise available, and involving portions of the community not typically involved in data collection, analysis and discussion of the issues affecting the community. The volunteer monitors are asked to record sightings of mammals, reptiles, birds and fish. These observations are then transformed into statewide distribution maps. Monitoring guidelines, supporting training materials and workshops were developed to help ensure quality control. To ensure data was collected and reported consistently the team created forms and processes for ground-truthing land cover maps (Dvornich et al. 1995). The underlying premise of the NatureMapping Program is that the collection of these large but limited datasets is as valuable as the collection of the more detailed, but smaller datasets of formal scientists because they provide the opportunity to identify scale dependent biodiversity indicators. Furthermore, the program illustrates how a biodiversity data-gathering project can become a community resource for understanding the environment in which the community lives. The program has over 50,000 people involved in Washington State alone and 16 other states have begun to develop programs. www.fish.washington.edu/naturemapping/

Profile #4: Medicinal Plant Working Group

The Medicinal Plant Working Group (MPWG) is a working committee of the Plant Conservation Alliance (PCA) and involves representatives from U.S. and tribal governments, academia, industry, and environmental organizations. The MPWG seeks to address conservation issues associated with the harvesting of medicinal plants native to the United States and has coordinated several volunteer-based monitoring projects to gauge the impacts of commercial harvesting of medicinal plant roots. The first of these projects was initiated in 2000 on the Pisgah National Forest in North Carolina and was an inventory and monitoring effort of black cohosh (*Actaea racemosa*), yellow cohosh (*A. podocarpa*) and bloodroot (*Sanguinaria canadensis*). The project's objective was to obtain information on species distribution, relative species abundance, and effects of different harvesting intensities (Ford 2001). A US Forest Service botanist served as the scientist for the project, providing advice on research design and methods. Volunteers from local Garden Club chapters provided assistance in conducting the field treatments (Schlosser 2002). Commercial buyers of medicinal roots participated in the study by helping develop the research questions, identifying habitat for study plots and providing information on harvesting techniques. They also played an important role in the training and supervising of volunteers. In fall 2002, a second monitoring effort began in southern Colorado on the Rio Grande National Forest. This monitoring effort focused on the medicinal root osha (*Ligusticum porteri*) in order to help identify sustainable commercial harvest levels. www.nps.gov/plants/medicinal

Profile #5: La Montaña de Truchas Community-Based Forest Products

This collaborative project began in 1996, when the community of Truchas, New Mexico and the Camino Real Ranger District of Carson National Forest entered into a collaborative stewardship agreement. As part of this pilot, a local community group, La Montaña de Truchas Woodlot, was formed and its members began harvesting wood from the restoration site in 1998. The project had several goals, including restoring the densely overstocked forests that exist in northern New Mexico, providing jobs for local people, and supplying low-cost fuelwood to residents for heating and cooking. The contract required monitoring of the results of the pilot program. The Truchas Montaña Youth Team carried out the monitoring work.[7] Founded by three youth from the community, the Team's role is to provide an internal monitoring mechanism for the community thinning efforts. The Forest Service trains the Youth Team in how to use a compass and GPS equipment, and how to lay out stewardship blocks and photo points. The community organization, La Montaña de Truchas, provides the video camera, digital camera and other photographic equipment to document the work. The youth team participates in identifying plots and setting up photo points on the different units. They take measurements once a month and use this data to make recommendations to the Forest Service, such as requesting that piñon trees, which the community and wildlife rely on for food, be set aside (Córdova, Jr. nd). www.lamontanadetruchas.com/

Profile #6: Ecological Research on Salal (*Gaultheria shallon*)

In 2001, a researcher from the University of California, Berkeley, collaborated with the Northwest Research and Harvester Association (NRHA) in Washington State to involve commercial harvesters in monitoring the ecological impacts of harvesting salal (*Gaultheria shallon*), a multi-million dollar floral green product. NRHA was created by harvesters to address ecological, social and management problems in their region in part by helping conduct research and monitoring of harvest impacts. From 2001 to 2003, the researcher, a group of harvesters, and public and private land managers participated in all aspects of designing and conducting the study, including but not limited to:

- Developing the precise research question within the larger question of harvest intensity impacts;
- Developing hypotheses about particular ways the plants will respond to harvest;
- Designing methods to measure impact on re-growth on the plant;
- Defining the harvest treatments to be tested based on actual harvest practices;
- Choosing the appropriate plot locations to represent real harvest conditions;
- Collecting data for the 2 ½ years of the study;
- Interpreting the results after the researcher completed the statistical analysis;
- Developing management recommendations based on experimental results and local knowledge;
- Dissemination of the results of the research to harvesters, public and private land managers, and research scientists in the region.

This work will provide both the landowner and harvesters with the ecological information they need to manage the harvest of salal, but just as importantly, the process of participatory research on sustainability will provide concrete links between harvesters and public and private land managers, and potentially provide a foothold for citizen science within forest management agencies. See Ballard (2004) for more information.

Profile #7: Matsutake Mushroom Ecological Monitoring

In 1994, a unique collaboration began between a matsutake harvester and the NTFP coordinator for the Forest Service on the Umpqua National Forest that has resulted in several long-term and on-going monitoring studies. The objectives of the first collaborative effort, initiated on the Diamond Lake Ranger District, were to: 1) evaluate the effects of six harvest techniques on short and long term matsutake production, in terms of both the number of sporocarps (the fruiting body of fungi) produced and total biomass; 2) evaluate small and large mammal use; 3) evaluate sustainability; 4) evaluate variability of fruiting from year to year; 5) publish and communicate findings; and 6) to have fun. The Forest Service has funded this work periodically and volunteer effort has made the continuation of the project possible when no funding has been available. Other collaborators included Forest Service and OSU mycologists. The second monitoring effort, referred to as the "Boswell Study," is located on private land in Cave Junction, OR. The objectives of this effort were to: 1) monitor

and record biomass produced on 400 acres; 2) determine economic value of the mushroom production; 3) monitor and evaluate environmental conditions conducive to fruiting; and 4) generate information to aid harvesters in efficiently locating fruit.
www.matsiman.com/formalpubs/harvestmethodposter/harmethposter.htm

Profile #8: Chanterelle Mushroom Study

This profile illustrates the potential for integrating recreational pickers into I & M efforts. In 1993 an interdisciplinary and multi-stakeholder effort was initiated the Olympic Peninsula of Washington State to study the ecological and cultural impacts of chanterelle mushroom harvests (Liegel et al. 1998). Due to budget constraints, recreational harvesters from the Puget Sound Mycological Society were invited to participate in the project. Sixteen volunteers from the Society made single or multiple visits to collect data on four of the eleven monitoring sites over two field seasons (Liegel et al. 1998). The research team's biologist trained one of the volunteers who then helped train and supervise the other volunteers. Corresponding ethnographic fieldwork discovered that several commercial harvesters would have been willing to help harvest field research plots had they been asked. The US Man and Biosphere Program funded this three-year study and a variety of articles were published in an AMBIO special report.

(Photo by Dave Pilz)

As illustrated by the above eight participatory research profiles, scientific inventory and monitoring can involve a variety of stakeholders, including concerned citizens, amateur scientists, educators and their students, as well as people directly influenced by management decisions. Both noncommercial and commercial harvesters have been involved in various inventory and monitoring efforts and have played key roles in research design, data collection, data analysis and dissemination of results. These profiles illustrate the potential for the use of collaborative approaches and can provide valuable insight for inventory and monitoring of NTFPs in the future.

Involving Harvesters in Inventory and Monitoring

As indicated in the literature on public participation and through the profiles of citizen science projects, broadening participation in inventory and monitoring is one possible mechanism for addressing the data needs of managers and policymakers. We now turn to our ethnographic research and workshop data that specifically address the opportunities and barriers to involving harvesters in inventory and monitoring of NTFP species in the United States. (For a discussion of the ethnographic fieldwork and workshop results in full, please see our companion reports.)

Research Design and Methods

Since sustainable forestry depends on an understanding of both ecological and social systems, and NTFP harvesters have often been marginalized or invisible in forest management (McLain 2002) we decided to focus on acquiring a more detailed understanding of NTFP harvesters. To do so, we spent a year talking with and learning from harvesters about harvesting practices across the United States.

Given the large geographical scope (see Appendix 1) and the short time frame of this study, the ethnographic fieldwork might be characterized more as an exploratory rapid appraisal than traditional ethnographic research based in a single community over an extended period of time. Nonetheless, we relied upon two standard methods of anthropology—ethnographic interviews and participant observation—as we sought to understand the characteristics of harvesting practices and how these could influence inventory and monitoring activities. Using semi-structured, open-ended interviews we documented peoples' experiences harvesting, changes they had observed in their harvesting areas, and their perspectives on the idea of a collaborative approach to biological inventory and monitoring. For these formal interviews we selected harvesters from all NTFP sectors who had at least five years of experience. These interviews were taped and usually lasted an hour, but sometimes stretched into long afternoons as we learned about local harvesting issues. In total, we conducted 143 formal interviews. In addition, we spent time in the field with harvesters and conducted hundreds of informal interviews with a variety of relevant stakeholders. These shorter conversations often covered the same topics, although we did not use the formal interview guide to structure the discussions. To keep these conversations informal we took personal notes rather than tape-recording these interactions. We also took thousands of digital photographs to visually document the fieldwork.[8]

To complement the fieldwork, we held four regional workshops to explore how harvesters might participate in biological inventory and monitoring efforts. The workshops were held in Denver, Atlanta, Pittsburgh and Portland, Oregon. In total over 100 people participated, including land managers, policy makers, research scientists, extension foresters, harvesters, buyers and other NTFP stakeholders. We began the workshops by presenting our emerging analysis on the benefits of using a collaborative approach to inventory and monitoring. Profiles illustrated the varied ways in which harvesters, amateur scientists, or the general public had been involved in inventory and monitoring efforts. We then used focus group discussions to gain insight into participants' perspectives regarding: 1) regional/local inventory and monitoring efforts of NTFPs; 2) potential barriers to including harvesters in inventory and monitoring and how to overcome them; and 3) recommendations on the design and implementation of pilot programs.[9]

Analysis of the ethnographic interviews and workshop data led to the development of the synthesis lists presented below. The first list outlines some of the characteristics of harvesting that we feel are compatible or an asset to inventory and monitoring efforts. We then summarize harvesters' comments about the potential incentives that would motivate them to become involved in a collaborative I & M effort. The discussion then turns to explore some of the barriers to collaborative inventory and monitoring of NTFP species.

Reasons to Involve Harvesters in Inventory and Monitoring

In talking with harvesters and accompanying them out in the forest, we identified numerous features of harvesting that could be compatible with or enhance inventory and monitoring efforts. These include:

Harvester Characteristics

- **Harvesters come from diverse ethnic, class, gender, age and cultural backgrounds.**
  Data sets obtained from a broader constituency have a better chance of accurately representing that constituency, ensuring that cultural use patterns are not missed or neglected in management plans.[10]

- **Harvesters have diverse motivations.**
  People may gather NTFPs for a variety of reasons, including for subsistence, cultural, spiritual, commercial, recreational and educational purposes. They may gather for one or many of these reasons and harvesting activities often shift in response to economic conditions, season, need, weather conditions and NTFP availability. Although we often talk about 'harvesters,' as one category, harvesters are NOT homogenous. This diversity provides flexibility and options for I & M programs since each type of harvester can offer different insights. Active involvement of harvesters in I & M could give resource managers greater understanding of how these underlying motivations shape their interactions with the forest, which has a direct relationship to issues of sustainability.

- **Harvesters are often in the forest on a frequent basis (often daily or weekly).**
  I & M efforts could be designed to take advantage of this, resulting in data being collected more frequently, over larger areas, and possibly at lower costs. Many I & M research designs require data collection only once or twice during a growing season, thus even harvesters who go out once a year could play a role in I & M.

- **Harvesters often make regular empirical observations.**
  Harvesters who are out frequently and return to the same areas year after year, are able to make critical observations of changes that often go missed by others. A collaborative I & M process could help translate these experiences into useable data by creating a process for harvesters to keep systematic records.

- **Harvesters can have valuable knowledge based on years of experience**.
  Variables that influence a harvester's knowledge include (but are not limited to): years gathering; from whom they learned to harvest; and years gathering in one particular location. This local knowledge could provide valuable insight into sustainable management of these resources.

- **Harvesters can have an aptitude for the scientific method.**
  Some harvesters have developed sophisticated formal data recording systems, productivity models, and harvesting guidelines. This knowledge could be valuable in itself, but it also illustrates the potential compatibility of harvesters and formal scientists and the potential for these two groups to work together on ecological research aimed at understanding such factors as NTFP productivity and regeneration rates.

- **Harvesters often exhibited stewardship attitudes and a concern for protecting the resources they harvest.**
  Many harvesters have developed practices to conserve the resources they harvest and some have developed harvesting guidelines to ensure the long-term sustainability of the plants they gather. The existence of this stewardship ethic reflects the deep respect that many harvesters have for the resources they depend upon.[11] Pilot I & M programs could test for the ecological results of these practices and guidelines.

- **Harvesters are directly affected by natural resource management decisions.**
  Democracy is based on the principle that those who have a stake should have a voice. Because harvesters are affected by resource management decisions, they should be involved in those decisions. Broader participation results in greater legitimacy for the decision-making processes and thus often reduces conflict, as well as law enforcement costs.

Figure 5. NTFP Harvesters. Clockwise from top left: Medicinal plant harvester and buyer teaching us how to ross (peel) slippery elm bark; Southern Appalachian root diggers; Artists who gather grapevine and other NTFPs; Hardwood forest seed gatherer.

Although the above characteristics seemed promising, we were unsure whether harvesters have sufficient incentives to get involved in participatory inventory and monitoring. Therefore, we asked harvesters directly why they might want to participate. Their responses ranged from the personal to the political, and are summarized below. These are not listed in any particular order.

Harvester Incentives

- **Incentive 1: To maintain quality of life.**
  Many harvesters indicated taking pride in their ability to provide food and/or medicines for their family and friends. This is linked with valuing working in the woods, and enjoying the freedom to set their own hours and being their own boss. Many expressed the sentiment that harvesting provided a higher quality of life than a desk job and they willingly took the risks inherent in harvesting to be able to be in the woods on a regular basis.

- **Incentive 2: To maintain family and cultural traditions.**
  Many harvesters learned to gather from their grandparents or parents, and it is important to them to maintain these family and cultural traditions. If I & M could be a mechanism to ensure the continuation of harvesting traditions, these harvesters were interested in participating.

- **Incentive 3: Job opportunity.**
  Poverty and high unemployment rates plague many rural areas in the U.S. Many harvesters expressed interest in I & M if it represented a job opportunity with financial reward. Likewise, displaced workers from the timber and coal industries were looking for other opportunities. Some harvesters noted that participatory I & M could provide both economic development and conservation benefits in rural areas.

- **Incentive 4: To promote local economic development.**
  Many harvesters have developed small NTFP businesses, and said that they would support I & M if it would ensure a steady supply of the raw materials they needed to ensure the long-term viability of their business. In addition, many harvesters felt that supporting local businesses was important for promoting local economic development in impoverished rural areas where much gathering occurs. Some harvesters stated that supporting local business was their political stand against large corporations who they felt unfairly extracted local wealth.

- **Incentive 5: To have a voice in how public lands are managed.**
  Many harvesters noted that they have felt invisible and that NTFPs have been basically ignored in forest management. Many harvesters reported extensive loss of harvesting locations and declines in forest biodiversity due to land conversion and development, logging, grazing, wildlife management (especially for deer in the eastern United States). Harvesters stated that they want managers to stop managing exclusively for timber or cattle and consider the other species that should be part of an ecosystem management approach.

- **Incentive 6: To protect habitats where they gather.**
  Many harvesters return to the same locations year after year and have developed an intimate relationship with the ecosystems where they gather NTFPs. Many have lost their favorite and/or most productive spots to logging, grazing, development or road closures, and are motivated to get involved in I & M to protect their remaining harvesting locations.

- **Incentive 7: To ensure long-term access.**
  Many harvesters felt that I & M would help ensure long-term access to favorite harvesting areas and possibly open up access to new areas since it would contribute to ensuring that harvesting was sustainable.

- **Incentive 8: Regulatory fears.**
  The FY2000 Appropriations Act included a rider (known as Section 339), which requires the Forest Service to charge fair market value for permits and ensure that NTFP harvesting levels are sustainable.[12] The impending implementation of these regulations has created concern among harvesters that given the lack of ecological data, NTFP harvesting will be restricted or banned altogether. A number of harvesters (primarily in the PNW) noted that the passage of the rider has created an incentive for them to participate in NTFP monitoring efforts to ensure that managers have the ecological data needed to justify keeping access open.

While these findings indicate that many characteristics of NTFP harvesting in the United States appear to be assets for a collaborative approach to inventory and monitoring, and many harvesters see incentives for their participation, there are also numerous barriers that must be addressed. In the following section we discuss these challenges.

Potential Barriers to Implementation

Our fieldwork and workshops were designed to provide a sense of NTFP stakeholder attitudes towards the idea of collaborative I & M, and to identify the potential barriers to developing such an idea. We found that workshop participants and interviewees were generally supportive of the idea of involving harvesters in inventory and monitoring efforts, although certain concerns and doubts were voiced. In the interviews and workshops we explored these potential barriers, seeking to understand the root causes and ways to overcome them. Synthesis of these discussions is presented below, again not listed in any particular order, as all are important to consider.

Potential Barriers

- **Barrier 1: Concerns about data validity.**
  How to ensure data validity is a fundamental concern with any inventorying and monitoring system, whether it is collaborative or not. Adding a collaborative approach to inventory and monitoring tends to increase concerns about bias and other data inadequacies, especially if members of commercial interest groups are participating. To address this, third-party data verification systems should be considered a normal and desirable feature of any I & M program. Quality control mechanisms usually include training, field audits, and the collection of replicate samples. For example, in the case of permanent monitoring plots for the Forest Health Management program, a third party team randomly checks the work of data collectors. Another strategy used by NatureMapping (see Profiles above) is to create a separate public layer of information. Keeping data layers separate allows for scientists and others to crosscheck findings and see who contributed what data.

- **Barrier 2: Integrating scientific and local knowledge systems.**
  Many scientific community members are biased against non-expert/local/indigenous knowledge systems (Chambers 1997). These "expert vs. non-expert" clashes can present a formidable barrier to collaborative I & M. But as Wong (2000:12) states, "Experience has shown that local perspectives often serve a practical purpose and are a sensible starting point for understanding and/or classifying the ecological environment." Any collaborative approach should seek to integrate different knowledge systems and to assure participants that the project will incorporate the rigor of scientific method with local ways of knowing to strengthen overall understandings of ecosystems. (See Berkes 1999; Berkes et al. 2000; Shanley and Laird 2002; Michel and Gayton 2002 for more information).

- **Barrier 3: Professional cultural differences.**
  The differences between harvester, manager, and scientist cultures may hinder communication and understanding among stakeholders. Each group and sub-group has its own norms, rules, language, etiquette and requirements that, if not understood by the others, could result in miscommunication and conflict. Cultural differences between natural and social scientists also hinder collaborative interdisciplinary work. Setting up a process that ensures multiple opportunities for communication and working with professional facilitators can help overcome this barrier.

- **Barrier 4: Lack of experience with NTFPs and/or participatory processes.**
  Many NTFP stakeholders stated that they did not have enough experience with collaborative processes to know how to initiate them, let alone facilitate them. Additionally, many Forest Service staff conveyed that they did not know enough about NTFPs in general to be able to participate effectively in the process. This barrier can be overcome with educational workshops and trainings.

- **Barrier 5: Logistical (budget/staff/time) constraints.**
  Resource managers are facing budget cuts, decreases in staffing levels, and increasing demands on their time. Many already feel overburdened and unable to take on additional projects, let alone take leadership for a new approach that is based on a more time-consuming process. Many managers must show immediate results or face further cuts, which discourages long-term collaborative approaches. Overcoming these large-scale political, institutional and bureaucratic barriers will be a formidable challenge. Starting with small, local pilots that produce useable data relatively quickly is one strategy to overcoming such barriers. Documentation of the ecological and social outcomes from collaborative efforts is another strategy for illustrating the benefits of a collaborative approach.

- **Barrier 6: Ensuring Continuity.**
  Many harvesters face economic uncertainty and instability. This reduces their ability to commit to participating in inventory and monitoring projects over long periods of time. District Rangers and other staff are also frequently transient, often serving a two or three-year term before moving to another forest. I & M project design can address this by ensuring long-term financial incentives for harvesters for on-going participation, and creating mechanisms to handle changes in participants, including recruitment, orientation and training sessions. Ensuring long-term funding is a formidable challenge. For scientists, funding cycles typically define their research activities. Budget cuts and short budget cycles often reduce chances for long-term participation. Overcoming this barrier will require demonstrating the benefits (ecological, economic, political and social) of long-term projects.

- **Barrier 7: Lack of immediate, tangible, visible results.**
  Participatory processes generally require more time than non-participatory processes. While this may lead to a deeper, more meaningful understanding of the situation, results are not always immediate, visible or easily quantified. This may hamper interest in participating, and may reduce the ability to secure continuing funding. One way to overcome this would be to develop “measures of success” collectively with all participants, in order to have a means to evaluate progress.

- **Barrier 8: Information access, ownership and management issues.**
  Harvesters expressed concern that participation in I & M programs would reveal their harvesting areas to others and have a detrimental impact on the areas where they harvest and their ability to continue gathering. Similarly, scientists expressed concern with revealing the location of their experimental plots. One way to address this barrier would be to adopt data access/sharing agreements similar to those developed by the Heritage Program. These agreements include “buffering” the plant population/occurrence using a random grid, anywhere from 1 to 36 square miles depending on the sensitivity. In addition to these concerns over geographical data, buyers expressed concern over their financial privacy. Stakeholders should work together to develop and implement information management mechanisms that protect proprietary business information.

In addition, we also identified some barriers specific to harvester participation. These include:

<u>Barriers Specific to Harvesters</u>

- **Barrier 1: Lack of trust.**
  Some harvesters reported that they felt that federal land managers were not interested in their suggestions about managing NTFP resources and that their experiences and knowledge were not recognized. Some harvesters have had such negative experiences with resource managers that they do not have an interest in helping them with data collection. This attitude is compounded by the anti-government sentiment in many rural areas of the country. In addition, lack of trust may be intensified if the harvester is a refugee and/or has had negative experiences with governmental authorities in their country of origin and/or experienced discrimination or racism here in the U.S.

- **Barrier 2: Lack of interest in participating in a group effort.**
  Some harvesters dubbed this the ‘loner factor,’ noting that many are involved in harvesting because they like to be outside, in the woods, alone. It may be difficult to get these harvesters to participate in a process that involves meetings and potential confrontations with other stakeholder groups. This barrier can be overcome through research design, such as developing small training workshops for data collection and/or independent

data collection efforts (e.g., modeled along the lines of the Maine Marine Resources lobster project. See Appendix 2 for details).

- **Barrier 3: Differences in experiences, knowledge, attitudes, values.**
  Not all harvesters are the same in terms of their experience in the woods or their knowledge of plants and plant ecology. Some harvesters have gathered for many years and are astute observers and may have deep knowledge. Others may be new to gathering and have less knowledge. Some people work well in groups, others don't. Thus, developing a selection process that is inclusive *and* results in the most qualified participants is challenging.

- **Barrier 4: Welfare/disability status.**
  Some harvesters gather NTFPs to supplement social security or disability checks and do not want to jeopardize their eligibility for transfer payments by participating in an official I & M program.

- **Barrier 5: Lack of experience with scientific review/critique process.**
  Harvesters may not be used to receiving critical feedback from scientists (whose job is to provide that critical feedback as part of the scientific process). The challenge is to create a program where this review/evaluation process is non-threatening and integrated in such a way that everyone goes through it, not just harvesters. It is critical to integrate adequate opportunities for communication between participants so any problems can be identified and corrected early in the process. Mechanisms for dealing with issues as they arise will help the project avoid misunderstandings that could undermine or destroy the trust necessary for collaborative projects.

- **Barrier 6: Lack of legal work documents**.
  In many NTFP sectors (e.g., floral greens) the labor force is predominantly Latino, some of whom may not have legal papers. Given the current political climate, undocumented workers must be even more cautious and this would most likely limit their ability to participate.

- **Barrier 7: Labor structure differences.**
  Some harvesters are self-employed, but others are hired as employees. The type of labor structure may affect how harvesters work in the woods (how often they go out, how much they harvest, stewardship practices, etc.) and their willingness or ability to participate in I & M.

- **Barrier 8: Language and literacy skill barriers**.
  In some NTFP sectors, harvesters are immigrants whose first language is not English. Depending on the objectives of the I & M program and the data needed, translation of the training program, data forms, and protocols may be needed.

The results were further substantiated in the findings from our federal and state survey. When asked about barriers, managers questioned whether harvesters would have the skills to carry out I & M work and if they would have any incentive to participate. In addition, managers were concerned about harvesters producing biased results and had reservations about the Forest Service's ability and political will to implement I & M for NTFP species. The survey results are presented in the companion report, *The Relationship between Nontimber Forest Product Management and Biodiversity in the United States.*

To conclude, our findings indicate that NTFP stakeholders—including harvesters, buyers, scientists, non-governmental organizations involved in forestry and rural development issues, resource managers and policy makers—were generally receptive to the idea of a collaborative approach. Workshop participants and interviewees helped identify features of harvesting that could be compatible with or enhance inventory and monitoring efforts as well as potential barriers to implementation. Fortunately, as the profiles demonstrated earlier, models exist for collaborative I & M that indicate that these barriers can be overcome. The next section looks into how to develop a collaborative I & M program to overcome these barriers.

Developing a Collaborative Inventory & Monitoring Process

Various resources explain the essential elements of monitoring programs for conservation purposes (e.g., Peck 1998; Freese 1997; Goldsmith 1991; Spellerberg 1991). Margoluis and Salafsky (1998) offer some very user-friendly approaches to designing, implementing and monitoring conservation and development projects. Likewise, monitoring programs such as those implemented by the Natural Heritage Programs, the Nature Conservancy and the IUCN, provide practical insight into the challenges of developing successful I & M programs.[13] Kerns et al. (2002) and Wong et al. (2001) have analyzed and discussed I & M design issues specific to NTFP monitoring. The following discussion builds on this work and focuses on the elements specific to a *participatory* approach for NTFP inventory and monitoring.

While it is not possible to provide a "one-sizes-fits-all" prescriptive model for participatory inventory and monitoring, this section outlines a general approach that can be adapted to meet the specific circumstances and needs of anyone interested in carrying out I & M for NTFPs. We draw on the recommendations of harvesters and workshop participants, as well as the literature on inventory and monitoring, to develop suggestions for overcoming the barriers to participatory approaches for inventory and monitoring of NTFP species. These suggestions address various issues of research design, indicators, methods and process and are summarized in Figure 11 at the end of this discussion.

Trust-Building

Collaborative approaches require trust, which is often lacking between NTFP stakeholders. Taking time to build trust is well worth the effort. It is our experience that formal meetings and workshops, especially multi-stakeholder events, are not the most appropriate forum for reaching out to NTFP harvesters. Therefore, we suggest that informal gatherings in harvester camps, communities or other appropriate locations be coordinated to create space for sharing of stories between and among stakeholders. The objective of these exchanges is for the different stakeholders to learn more about each other, their needs, interests, histories, and constraints and challenges they each face. Ensuring that everyone has a chance to share- especially groups traditionally not involved or marginalized- is important. This may mean creating separate meetings at the beginning and/or ensuring space on the agenda for harvesters to speak and/or ensuring translation is available. Consider developing skits, interactive activities or other culturally appropriate mechanisms to share stories and challenges faced. Food, music and storytelling help create incentives for participation and help create atmosphere in which diverse stakeholders can start to learn about one another.

Specific steps should be taken to promote clear channels of communication between and among all stakeholder groups. This includes clearly defining the roles and responsibilities of each participant and ensuring that everyone understands and agrees to these responsibilities. Developing handouts and/or a website to make these agreements accessible for reference would be useful. These then become the benchmark from which evaluations can take place. Creating opportunities to reflect on the process, and to discuss challenges at regular intervals allows the team the chance to identify problems and make adjustments before major problems emerge. Non-threatening evaluation protocols should be built into the process and made a regular part of the functioning of the project. In addition, a team should be tasked with documenting the projects' goals and objectives, methods, procedures for ensuring data validity and reliability, and the specific roles and responsibilities of all the participants. Documenting this organizational history is useful for creating an internal culture, to help orient newcomers to the effort, as well as provide insight to outsiders who seek to develop similar efforts. Documentation can also play a pivotal role in securing future funding by demonstrating the benefits of such approaches.

Needs Assessment

Once sufficient trust has been established, the next step is to conduct a site-specific needs assessment. The needs assessment step defines "why," and makes the purpose of the I & M effort explicit. Defining goals and objectives collaboratively is essential since the goals and objectives provide the foundation for determining all other features of the I & M effort. Different stakeholders have different expectations and informational needs. If these needs are not met through the collaborative I & M process then there will be no incentive for stakeholders to participate. Therefore, having all stakeholders define what data they consider to be important or relevant is a critical step in the process (Smith 1995). Through this process the priorities of each stakeholder group are made explicit and it becomes possible to identify where stakeholders' interests and needs overlap and where collaboration is most logical. For example, it may turn out that information needs overlap and it is more efficient and effective to implement the project using one multi-disciplinary, multi-stakeholder team. Alternatively the stakeholders' priorities might be sufficiently distinct that it makes more sense to conduct multiple assessments in parallel, with subsequent sharing of results.

As part of the needs assessment, it is important to do a complete literature review to see if the information needed is already available. Although NTFP research is limited, there is a growing body of literature and a growing number of researchers who might be able to provide valuable insight, and save costs and time. The idea is to build on what is out there and not duplicate efforts. In addition, identify potential collaborators in the other stakeholder groups, in particular buyers/brokers in the area of interest that would be willing to participate at this point, for they can play a critical role in I & M, and facilitate communication and building trust with harvesters.

Developing Site-Specific Inventory and Monitoring Protocols

In determining "how" the I & M program will be carried out, a variety of elements must be considered. Various inventory and monitoring approaches can be used for NTFPs, including both quantitative and qualitative approaches. Developing a research design entails identifying who will be involved, whether single or multiple species will be included, which indicators to measure, defining the sampling units, determining the number of replications needed to be statistically rigorous, and determining how to manage and analyze the data.[14] Kerns et al. (2002) and Wong et al. (2001) provide useful overviews of these elements. It cannot be stressed enough that the objectives and goals of the project determine the answer to these questions. As Hellawell (1991:14) notes, it has been the failure to link research design with clearly stated objectives that has resulted in the failure of many I & M efforts to produce tangible benefits. Working directly from the objectives and goals also ensures that the data collected is specifically relevant to the data needs of the participants and helps prevent the tendency to collect more data than is needed. As one scientist noted, "I've seen a lot of wasted effort and unnecessary worker burn-out resulting from unclear data-use goals in the early phases of project design"(Pilz, pers.comm.).

Determining Who Will Do What

The development of site-specific monitoring protocols includes determining who should be involved and how the data should be gathered, analyzed and interpreted. In regards to "who," the participants should generally define the requirements for participation for each stakeholder group (harvesters, buyers, managers, researchers, etc.). These should relate back to the objectives and goals of the I & M project and be linked in with the design. Therefore, requirements might specify a time length for participation or require that stakeholders have a certain number of years experience working with NTFPs. In all cases, finding participants who are excited about forging an innovative collaborative relationship will be invaluable. Participants might have widely divergent educational backgrounds, experiences and ideas regarding how to successfully implement the project. Organizers and participants should work to create a space that facilitates respect and deep listening, and that promotes cross-cultural collaborative work. In addition, participants need to be honest and upfront about why they are participating and the constraints they face. Once criteria are established, the team must determine how to identify and recruit participants, how to sustain their interest in the project, and what training is needed and how to provide it. Providing adequate and appropriate training to all participants is crucial for ensuring data validity. Likewise, determining mechanisms for 3rd party monitoring and evaluation of the NTFP inventory and monitoring project should be decided as you begin the project. For example, a scientist unconnected to the data collection process would be an optimal person to periodically visit and randomly sample data collection areas and log books.

Developing rigorous I & M design is complicated, particularly for the many NTFP species that occur sporadically on the landscape. Therefore, it is valuable to begin with a collaborative approach and have scientists, statisticians, harvesters and managers involved in the process of developing the research design. Scientists and statisticians can assure that the research design is rigorous, harvesters can assure that the design makes sense on the ground, and all participants can clarify their data needs. Without the input of everyone, the risk of developing a project that results in unusable data increases.

Determining What Indicators to Measure

Supporting biodiversity conservation, sustainable forestry and the sustainable management of NTFPs, requires a holistic understanding of the inter-relationships between a multitude of complex ecological and social variables. Since it is typically not possible to inventory and monitor everything, indicators are used. Indicators are discrete and measurable variables that can provide a tool for gauging the status of a complex social and/or ecological system. Thousands of biodiversity indicators exist and various researchers have defined the characteristics of good indicators (e.g., Whitman and Hagan 2003; Noss 1999).[15] For any I & M project, indicators should directly link to the different stakeholder priorities identified in the initial 'groundwork' phase. For examples of how indicators have been selected for specific studies on NTFPs see Gagnon (1999a); Peck and McCune (1998); and Peters (1999).

Tables 6-8 below (adapted from EWW/ANSAB 2001) highlight a few indicators that are relevant to determining the sustainable management of nontimber forest products. This list is not meant to be comprehensive, but rather illustrates the value of including both ecological and social elements in a holistic approach to supporting sustainable forest and NTFP management. Following the recommendations of Whitman and Hagan (2003), we have divided the indicators into condition indicators (which measure the current condition of the value), pressure indicators (which measure the level of pressure affecting the value), and policy response indicators (which measure what steps are being taken to reduce the pressure). We have substituted "human response" for "policy response" in order to emphasize that harvesters, as well as managers and policymakers, respond to pressures and changes in NTFP populations.

The interdisciplinary focus of these indicators and the blending of qualitative and quantitative methods help provide a holistic understanding of the interactions between the ecological and cultural systems. They also provide a better foundation for understanding the effects of NTFP harvesting relative to other forest activities, and the effects of other forest activities on NTFPs and biological diversity. As Kerns et al. (2002:255) note, "Policy makers require detailed scientific information, but this information can be more useful if social scientists, economists, stakeholders, and the public are involved in the monitoring or scientific process." For discussions on participatory assessment, monitoring and evaluation of biodiversity, see Lawrence (2002) and Lawrence and Elphik (2002). For models of how participatory inventory protocols have been implemented, see Peters (1999) and Stockdale and Corbett (1999).

Table 6. Condition Indicators Relevant for NTFP Management

CONDITION INDICATOR	VERIFIERS	UNIT OF MEASUREMENT	METHODS
Plant Species diversity	Young/mature plants	No. of species	Resource inventory, transect walk
Density by species	Young/mature plants	No/ha	Resource inventory
Size-class structure by species	Young/mature plants	No./ha	Resource inventory
Biomass of herbs by species	Utilizable biomass	Kg/ha	Monitoring plot
Growth and yield of selected NTFP species	Tree diameter growth	Mm/year	Monitoring plot
	Shrub height growth	Cm/year	Monitoring plot
	Utilizable biomass growth	Kg/ha/year	Monitoring plot
	Product yield	Kg/ha/year	Monitoring plot
NTFP Regeneration by species	Young growth	4 point ordinal scale	Resource inventory
Seed production by species	Occurrence of seed mast	Qualitative	Focus group discussions, transect walk
		Quantitative	Experimental plot (mean kg/ha; % germination)

(Adapted from EWW/ANSAB 2001)

Table 7. Pressure Indicators Relevant for NTFP Management

PRESSURE INDICATOR	VERIFIERS	UNIT OF MEASUREMENT	METHODS
Biomass Removal	Timber	Volume/ha/year	Landowner records
		No. of trees/ha/year	Landowner records
	Fuelwood	Volume/ha/year	Landowner records
	Poles & Posts	Volume/ha/year	Landowner records
	NTFP species	Weight/ha/year	NTFP harvester & buyer records Landowner records (for estimates)
Grazing	Area	Ha	Landowner records
	Livestock units	No./ha/year	Landowner records, Transect walk
	Period	Months/year	Focus groups
Land conversion	Forest to Farm	Ha/year	Landowner, County records
	Forest to Housing	Ha/year	Landowner, County records
	Forest to Roads	Ha/year	County, State records
NTFP Harvesting Practices	Season	Degree of appropriateness	Landowner records, Focus groups
	Tools used	Degree of appropriateness	Focus groups
	Method/technique	Degree of appropriateness	Focus groups
Fire	Area	M2/ha/year	Landowner records, Transect walk
	Frequency	No./year	Landowner records, Transect walk
	Type	Crown, ground, surface	Landowner records, Transect walk
	Cause	Natural, prescribed	Landowner records
Socio-economic pressures	Price	Dollars/unit	Buyer records & trade databases
	Unemployment	Rate	County, State records
	Out-migration	No. young people continuing extractive activities	Interviews, Focus groups

(Adapted from EWW/ANSAB 2001)

Table 8. Human Response Indicators Relevant for NTFP Management

HUMAN RESPONSE INDICATOR	VERIFIERS	UNIT OF MEASUREMENT	METHODS
Promotion of Regeneration	Timber	Ha/year reseeded, planted or managed for natural regeneration	Landowner records
	NTFP species	Describe various techniques	Interviews, Focus groups
Conflicts	Stakeholders	List each group	Interviews Focus groups Ethnographic fieldwork
	Frequency	No./year	
	Issue	Describe conflict	
	Resolution	Facilitation, negotiation, mediation, arbitration, litigation, coercion	
Perceptions	Of nature	Describe, categorize	Ethnographic fieldwork Participant observation Interviews Focus groups
	Of value of NTFPs to livelihood, quality of life		
	Of land management		
	Of conservation		
	Of I & M efforts		
	Of regulations		
Resource Management Regulations	Federal regulations	Describe, categorize	Landowner records Interviews or focus groups with managers and policymakers
	Forest level regulations		
	District level regulations		
Law Enforcement	Frequency	No. of incidences/year	Law enforcement records
	Types	Describe incidences	Law enforcement records Interviews

(Adapted from EWW/ANSAB 2001)

Sampling Designs, Plot Configurations and Enumeration Methods

In addition to selecting indicators, the inventory and monitoring group needs to determine the most appropriate sampling design and plot configuration for the given objectives and indicators. This will be determined by the life-form of the NTFP(s) of interest, the type of information needed, time and fiscal constraints, and overall project goals and objectives (Kerns et al. 2002:246-47; see also Usher 1991). Wong et al. (2001) provide a valuable overview of inventory approaches relevant for NTFPs. This thorough review includes discussions of the role of biometrics in resource assessment, quantitative methods for determining various elements, such as how much of a resource is present, the yield of a resource, and growth and production rates. Determining sustainable harvest levels and monitoring management actions are also discussed, along with the role of participatory approaches and social science in inventory and monitoring designs. The document concludes with a very useful step-by-step overview of how to design a biometric inventory for NTFPs, including an inventory design decision-support framework. This publication is based on a study of NTFP resource assessment methods, in which Wong (2000) characterizes the sampling design, plot configurations, and enumeration methods of 126 NTFP studies. The three tables below are slightly modified from Wong (2000:26-27) and illustrate the range of possibilities for NTFP research design. There is nothing inherent in these methods that would exclude their use in collaborative approaches.

Table 9. Example Sampling Designs

Sampling Design	Description	Previous Applications
Census	100% enumeration of small area	All useful plants
Simple random sampling	Selection of plots using random number tables (probability of sampling any plot equal)	Useful plants, plants in general
Systematic sampling	Location of plots on a fixed grid, normally with randomly selected origin for grid.	Trees, mushrooms
	Line-plot sampling- plots located at fixed distances along a transect line	Perennial herb, saplings
Stratified sampling	Area divided into strata and sampling undertaken independently in each strata	Bamboo
Multi-stage sampling	Hierarchy of nested sample plots: sample of largest plots selected with further selection of smaller plots within chosen plots	Shrubs, rattan

(Adapted from Wong 2000)

Table 10. Possible Plot Configuration Methods

Plot Configuration	Description	Previous Applications
Measured plots with fixed dimensions	Square	Insect larvae
	Rectangular	Rattan, herbs
	Circular	Perennial herb
	2-D plane at fixed height from ground or oriented vertically	Liana, rattan
	Fixed volume	Liana
Plotless sampling	Point-centered quarter method	Trees, palms
	Sample fixed number of individuals closest to sample point or within sample area	Shrubs
	Individuals sampled within timed walk from house	Palm
Cluster sampling	Systematic group of sub-plots in fixed pattern used at each plot location	Rattan
Point and line transects (variable width transects)	Observations are made while standing on the point or walking along the line. Perpendicular distance from point or line to observed individuals measured.	Mammals
Line-intercept transects	Observations made of intercepts (plant clumps) with a line or plan projected above line	Large mammal (single species)
Distance sampling	Record distance from observation point to target and use of Fourier analysis to estimate target population	Birds
Strip transects	Narrow, very long transects treated as a fixed sample area	Mammals, game animals
Torus	Strip arranged around geometric shape (e.g. square) - space inside not enumerated)	Tree (single species)

(Adapted from Wong 2000)

Table 11. Example Product Enumeration Methods

Method	Description	Previous Applications
Presence/absence	Record occurrence in plot (Y/N)	Useful plants
Tally	Counts of individuals in plot	Useful plants
Size measurement	Measure size of all individuals in plot (height, diameter)	Herb (single species)
Cover	Record percentage of plot covered by species of interest	Herb (single species)
Subjective scores	Score features of species into subjective classes	Tree bark (single species)
Weight	Measure weight of all individuals in plot or harvested	Mushrooms, salal
Volume	Measure volume produced	Maple syrup, turpentine

(Adapted from Wong 2000)

The key here is that the inventory and monitoring efforts deepen our understanding of biological diversity and ecosystem functioning by providing vital information regarding trends within NTFP species populations. This information will alert all stakeholders to the current status of NTFP species, and hopefully help empower these stakeholders to take action to prevent these species from reaching threatened or endangered status. The participatory process will contribute to our understanding of the economic, political, and cultural context in which harvesting takes place, thus providing us with more sophisticated analysis, which is good for plant conservation, forest ecosystem health, NTFP harvesters and managers alike.

Data Analysis, Interpretation, and Management

Participants should also decide how the data will be analyzed, interpreted and archived. The challenge is to get data into useable formats in a useable time frame. It might be that all parties agree that analysis should be done by trained statisticians/ecologists or other professional. The key point is that everyone agrees up front who is going to do it. Various computer tools (e.g., BRAHMS, TREMA) can help with the organization, analysis and mapping of inventory data (Wong 2000:11). For an overview of various software tools for the management of biodiversity data, see Podolsky (1996).

In addition, the process of data verification and interpretation should be decided at the beginning of the project. Again, the group may decide to vest that power with one particular participating member of the collaborative effort. Alternatively, the group may opt for a process similar to that used in the salal monitoring profile described earlier in which scientists do the analysis and then present these findings in focus groups with harvesters for review and verification. Regardless of the outcome of the group decisions, the process needs to involve all stakeholders in defining the roles and responsibilities of all participants.

Attention should be paid to the need to produce results within a reasonable time-frame to encourage continuing participation and ensure continuing funding. Test phases are standard in most inventory and monitoring programs and should also be standard with collaborative approaches. Beginning with an initial small pilot project phase provides an opportunity for the program team to show progress and benefits early on. These small successes will help to build trust and interest in the collaboration. In addition, starting with smaller pilots allows the team to adapt the effort to local conditions and to refine the process. Likewise, developing “measures of success” collectively with all participants will provide a means to evaluate progress.

Summary:

Suggestions for Developing a Collaborative Inventory and Monitoring Process

1. **Start with trust building activities**

- Hold informal gatherings- in harvester camps, communities or other appropriate locations- to create space for sharing of stories between and among stakeholders. Food and music help create incentive to participate and help create good atmosphere.
- Ensure that everyone has a chance to share- especially groups traditionally not involved or marginalized, such as harvesters. This may mean creating separate meetings at the beginning and/or ensuring space on the agenda for harvesters to speak and/or ensuring translation is available.
- Consider developing skits, plays, games or other culturally appropriate mechanisms to share stories and to discuss challenges faced.

2. **Conduct a site-specific needs assessment**

All stakeholders need to share their perspectives and work together to:

- Determine specific informational needs of all stakeholders. In essence, stakeholders each define "what data is important to collect" (e.g., regeneration rates of black cohosh).
- Identify where interests and needs overlap.
- Conduct a literature review to determine if any of this information is already available.
- Identify potential collaborators (individual harvesters, buyers, researchers, managers, practitioners).

3. **Develop site-specific inventory and monitoring protocols**

All stakeholders need to share their perspectives and work together to determine:

- Criteria for selecting participants (harvesters, buyers, managers, researchers, etc.).
- Methods for identifying and recruiting participants.
- Methods for ensuring all stakeholders participate from beginning.
- Methods to sustain interest of participants (i.e., use of preferential access to resources?)
- Training needs and how they will be met.
- How data should be gathered (by whom, when, where, how often).
- Data sheet formats that make sense to all participants.
- How data will be analyzed (by whom, when, where, how often).
- How data validity will be ensured.
- How data will be archived.
- How data will be shared with different collaborators and the general public.
- Process for evaluating the monitoring activities and documenting lessons learned.
- Process to protect Intellectual Property Rights and ensure mutual benefits to all participants.

4. **Develop good communication practices**

All stakeholders need to share their perspectives and work together to:

- Define the roles responsibilities for everyone involved in the I & M effort.
- Ensure everyone understands and agrees to these roles and responsibilities.
- Develop notebooks for participants that include copies of the roles and responsibilities and other useful info.
- Develop a website where these can be posted for reference.
- Evaluate how it is going on regular basis and make adjustments.
- Develop a manual to document the project: including goals, objectives, methods, procedures for ensuring data validity and reliability, the people involved and their specific roles and responsibilities.

Figure 6. Summary of Suggestions for Developing a Collaborative Inventory and Monitoring Process

Recommendations

Participatory NTFP inventory and monitoring programs could be a powerful tool for promoting NCSSF's mission to improve the scientific basis for sustainable forestry in the United States. A review of state, national, and international programs shows that involving local people in collecting social and ecological data about their environment often has benefits such as improved data collection ability, broader stakeholder relevance, and increased public support for science in general. Forest managers have expressed that their biggest barriers to inventory and monitoring NTFPs is funding and staffing. Ethnographic findings show that commercial and noncommercial nontimber forest product harvesters all across the country have a keen interest in the well-being of the resource, spend regular time in the forests, and would participate in a formal inventory and monitoring program if it were a mutually beneficial relationship. In fact, as we have described in the profiles, some harvesters have already begun to develop or participate in inventory and monitoring programs.

Continuing to neglect the interests and knowledge of NTFP harvesters has significant implications for biodiversity conservation. Humans all through time across the world have harvested NTFP species. They will continue to do so, even where efforts are made to limit access. Regulations and management perceived as unfair by harvesters will only serve to perpetuate secretive strategies and obscure understandings of what is happening on the ground. Active management for NTFPs, including inventorying and monitoring, can help recast NTFPs as an important tool for biodiversity conservation. Instead of being forced to struggle under forest management and policies that marginalize NTFPs, harvesters could be embraced as valuable proponents of sustainable forestry. Participatory NTFP inventory and monitoring is an important step toward that objective. Given these findings we have three main recommendations:

1. **Develop and implement collaborative inventory and monitoring pilot programs.**
   Pilot programs are needed to reveal how local ecological and sociocultural factors shape appropriate research design. We recommend that a series of ten participatory inventory and monitoring pilot programs be funded across the country. Program lengths should be minimally five-years long and have third-party ethnographic evaluation. Profiles of the projects could be used in creating a handbook for participatory inventory and monitoring and a long-term national strategy.

2. **Modify existing inventory and monitoring programs to include NTFPs and expand opportunities for harvester participation.**
   Federal programs, such as the Forest Inventory and Analysis, need to work with harvesters and other stakeholders to better integrate NTFP species into current inventory and monitoring efforts.[16] Integrating participatory I & M programs into ongoing agency functions will require a clear articulation of how they will contribute to the function of the agency, as well as demonstrate an understanding of institutional barriers.

3. **Develop curricula and training courses.**
   New interdisciplinary curricula are needed in forestry schools and management training programs to provide students, managers, scientists, and extension agents with knowledge regarding: a) the ecological and cultural importance of NTFPs; and b) the role of NTFPs in ecosystem management. This capacity building effort contributes to the goals of ecosystem management and biodiversity conservation by training current and future foresters, resource managers and policy makers. In addition, specific courses designed to impart the requisite skills for creating and implementing participatory NTFP inventory and monitoring programs are needed to support the implementation of our first two recommendations.

Notes

[1] For more information on the Montreal Process, see http://www.mpci.org/home_e.html

[2] The specific questions were: Are ecological impacts of district regulatory and non-regulatory SFP management activities monitored? Are ecological impacts of regulatory and non-regulatory NTFP management activities monitored on your state forests?

[3] GLOBE involves students from around the world in monitoring atmosphere, hydrology, soils and land cover (www.globe.gov/globe_flash.html). In addition, conferences such as the Citizen Science at Environmental Learning Centers have explored ways environmental education organizations can work together to incorporate citizen science into their programs and develop a handbook of best practices for developing citizen science programs targeted to non-formal education institutions. For more information, see www.gsmit.org/Programs/citizenscienceforum.html

[4] See also the Pinchot Institute for Conservation (2001) report to the USDA Forest Service entitled *Implementation of Multi-party Monitoring and Evaluation: The USDA Forest Service Stewardship Contracting Pilot Projects.* Available: www.fs.fed.us/forestmanagement/projects/stewardship/pilots/fy2001_report/fy2001_stewardship_contracting_report.pdf

[5] See Peterson (1995) for a discussion of a method to correct erroneous observer effort data.

[6] Many have expressed concern over data validity when involving students in data collection, but this concern has been refuted by various experiences. For example, Derr (2002:2) notes, "When the idea of involving youth in restoration work was initially discussed, some scientists and community members expressed concern about the quality of data that youth could provide. Our experience has been that with adequate training and a context that the information will be used, youth provide an excellent resource for gathering quality data."

[7] The Southwest Community Forestry Research Center has also successfully involved youth in developing monitoring programs. See Derr (2002) for an overview.

[8] Please see the companion report to this document, *Relationship Between Nontimber Forest Product Management and Biodiversity in the United States* for more detail on the ethnographic research results. To see a few photos from the fieldwork, please see http://www.ifcae.org/projects/ncssf1/images/index.html

[9] For a complete review of the planning process and detailed transcripts from the workshops, please see the Workshop Guide and Proceedings on our website at: www.ifcae.org/projects/ncssf1/

[10] For more discussion on the relevance of socio-cultural variables, see Jones and Lynch (2002).

[11] For a detailed case study of harvester stewardship attitudes and practices, see Jones (2002).

[12] See Antypas et al. (2002) for a discussion of federal laws and policies relevant to NTFPs, and the FY2000 Appropriations Act and Section 339.

[13] See http://www.dnr.state.md.us/wildlife/rimon.html for one example of how Heritage programs are involved in monitoring, and also http://www.wnps.org/cbasin/pdf/phlox_phlyer_200305.pdf to see how the Washington Natural Heritage program is recruiting volunteers to help.

[14] Vantomme (2003), in his discussion of the need for data on NTFP production and trade, argues that in selecting species to monitor, NTFPs that are exported or widely used in national markets should be given priority since these markets can exert considerable pressure on a resource.

[15] See also Whitman and Hagan's web-based decision support tool at www.manometmaine.org.

[16] See UNEP (2003) for a discussion on integrating NTFPs into existing forest inventory protocols.

Acronyms

AHPA	American Herbal Products Association
ANSAB	Asian Network for Sustainability Agriculture and Bioresources
ARBEC	ASEAN Review of Biodiversity and Environmental Conservation
BLM	Bureau of Land Management
CBC	Christmas Bird Count – (Audubon)
CBD	Convention on Biological Diversity
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DCNR	Department of Conservation and Natural Resources
DNR	Department of Natural Resources
DOE	Department of Energy
EMAP	Environmental Monitoring and Assessment Program
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ETFRN	European Tropical Forest Research Network
EWW	EnterpriseWorks Worldwide
FACA	Federal Advisory Committee Act
FAO	Food and Agriculture Organization, United Nations
FHM	Forest Health Monitoring Program
FIA	Forest Inventory and Analysis
GAP	GAP Analysis Program
I & M	Inventory and Monitoring
IFCAE	Institute for Culture and Ecology
LMER	Land Margin Ecosystem Research
LTER	Long Term Ecological Monitoring and Research
LUCID	Local Unit Criteria and Indicators Development Project
MAB	Man and the Biosphere Program
MPWG	Medicinal Plant Working Group
MRLC	Multi Resolution Land Characteristics
NASA	National Aeronautics and Space Administration
NCSE	National Council for Science and the Environment
NCSSF	National Commission on Science for Sustainable Forestry
NERP	National Environmental Research Parks
NFMA	The National Forest Management Act
NGO	Non-governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NRCS	National Resource Conservation Service
NRHA	Northwest Research and Harvester Association
NRI	National Resources Inventory
NSF	National Science Foundation
NSTC	National Science and Technology Council
NTFP	Nontimber Forest Product
PCA	Plant Conservation Alliance
PCV	Plant Conservation Volunteer Program
PNW	Pacific Northwest, United States
SCBD	Secretariat of the Convention on Biological Diversity
SFP	Special Forest Product, aka Nontimber Forest Product
UNEP	United Nations Environment Programme
UNFF	United Nations Forum on Forests
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

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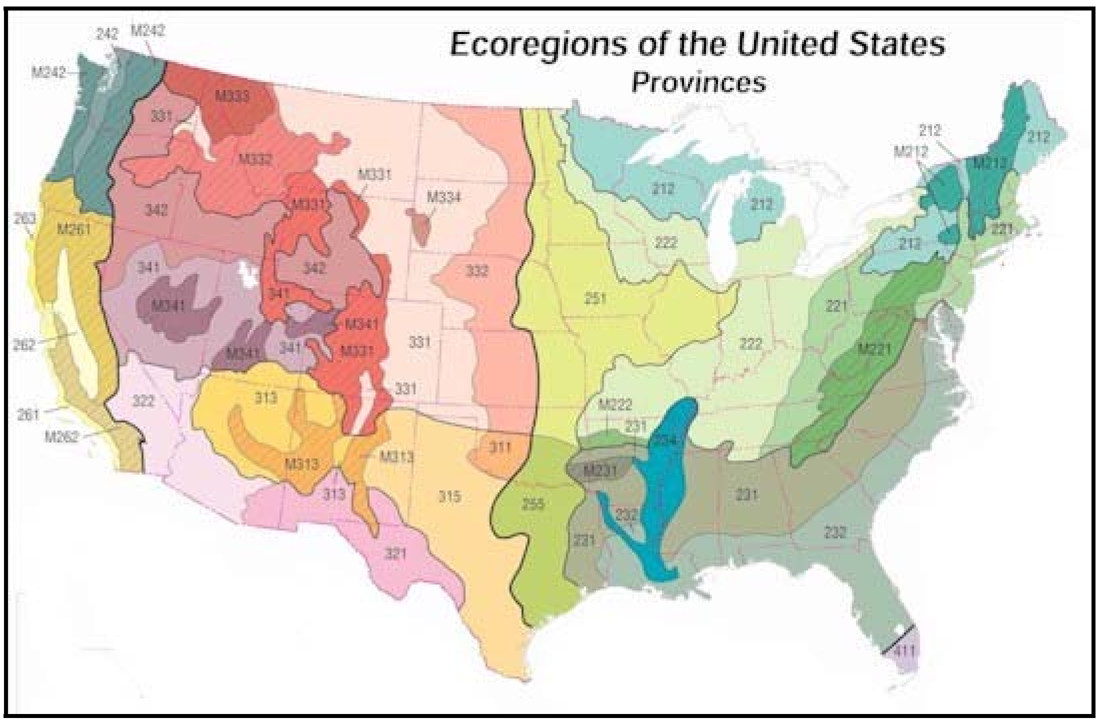
Appendix 1
Research Sites: Bailey's Ecoregions and Map

Table 12. Bailey's Ecoregions

Area	**Ecosystem Province**
West (Rocky Mountain States)	**M313** AZ-NM Mtns. Semi-desert – Open Woodland – Coniferous Forest– Alpine Meadow **M331** S. Rocky Mtn. Steppe – Open Woodland – Coniferous Forest – Alpine Meadow
Southeast	**231** Southeastern Mixed Forest Province **232** Outer Coastal Plain Mixed Forest Province
Northeast and Great Lakes	**212** Laurentian Mixed Forest Province **221** Eastern Broadleaf Forest (Oceanic) Province
Pacific Coast	**M242** Cascade Mixed Forest – Coniferous Forest – Alpine Meadow Province **M261** Sierran Steppe – Mixed Forest – Coniferous Forest – Alpine Meadow Province

Figure 7. Ecoregions of the United States. Provinces.



Appendix 2
Web Resources: Citizen Science, Participatory, and Volunteer Monitoring

Audubon Christmas Bird Count
www.audubon.org/bird/cbc/ho.html (Website accessed 01/02/04)
The Christmas Bird Count is one of the oldest and largest citizen science programs in existence. Over 50,000 observers participate each year in this early-winter bird census. This page explains its history and results.

Audubon Citizen Science
www.audubonofflorida.org/leadership/citizen.htm (Website accessed 01/02/04)
This page provides links to three different Audubon sponsored programs utilizing citizen scientist volunteers.

Canadian Community Monitoring Network (CCMN)
www.ccmn.ca/ (Website accessed 01/02/04)
CCMN is a program to advance community based monitoring approaches to inform policy and decision-makers, discover the best approaches for engaging entire communities in monitoring activities, develop, test, and refine a model for nationally coordinated community-based monitoring initiatives, and build local capacity to collect, deliver, and use ecological information to facilitate sustainable decision-making.

Community-based Collaboratives Research Consortium
www.cbcrc.org/ (Website accessed 01/02/04)
A coalition of organizations exploring a variety of issues around community-based resource use including processes of evaluation and monitoring.

Community Environmental Monitoring
www.environmentmonitor.green.net.au/ (Website accessed 01/02/04)
Concerned citizens established this site following the 2001 Australian National Forest Summit. This site includes links to a toolbox of low cost tools and techniques for monitoring water conditions and logging practices, among other things.

Community Mapping Network
www.shim.bc.ca/ (Website accessed 01/02/04)
CMN builds capacity within communities to collect and manage resource information; develops common methods and standards for data collection; and provides information about watershed management, stream ecology, fish and wildlife habitat and restoration opportunities and promotes active stewardship.

Cornell Lab of Ornithology Citizen Science
http://birds.cornell.edu/citsci/ (Website accessed 01/02/04)
The Cornell Lab of Ornithology utilizes citizen scientists to assist in monitoring avian populations of interest. This page provides links to a variety of volunteer monitoring projects including: Project FeederWatch, The Birdhouse Network, Project PigeonWatch, House Finch Disease Survey, Birds in Forested Landscapes, Golden-Winged Warbler Atlas Project, and an online database, BirdSource, that collects data from these and other projects.

EPA Volunteer Water Monitoring Program
www.epa.gov/owow/monitoring/vol.html (Website accessed 01/02/04)
This website provides valuable fact sheets and documents on monitoring methods. In addition, it has links to an on-line newsletter and on-line database with updated information on volunteer monitoring programs nationwide. Conferences proceedings are also posted, and other useful links too, including to the EPA's home page information regarding water quality and monitoring.

Experience International
www.expint.org/ (Website accessed 01/02/04)
This program has created opportunities for students to learn aspects of natural resource management and science through participation in programs like Pacific Resource Inventory, Monitoring, and Evaluation Program (PRIME) to learn about forest inventory and monitoring.

European Tropical Forest Research Network (ETFRN)
www.etfrn.org/etfrn/workshop/ntfp/ (Website accessed 01/02/04)
This is ETFRN's homepage for the 2000 workshop titled 'Developing needs-based inventory methods for nontimber forest products. Application and development of current research to identify practical solutions for developing countries" held 4-5 May, 2000 by FAO in Rome, Italy. Links to the review paper "The biometrics of non-timber forest product resource assessment: A review of current methodology" with separate appendix can be found on this page.

www.etfrn.org/etfrn/workshop/biodiversity/index.html (Website accessed 01/02/04)
This page documents results from the Internet workshop and policy seminar titled 'Participatory monitoring and evaluation of biodiversity,' held in 2002. Links to tools and methodologies are found under Key Theme #3.

www.etfrn.org/etfrn/newsletter/news36/index.html (Website accessed 01/02/04)
This page is for the ETFRN Report: New Instruments for Monitoring and Evaluation, including Turner, Craig; Cadbury, Sarah. 2002. Forest surveys using non-specialist volunteers. ETFRN News No. 36:59-61. European Tropical Forest Research Network, Wageningen, The Netherlands.

FishResearch
www.fishresearch.org (Website accessed 01/02/04))
The FishResearch program provides information about fishermen, scientists, research priorities, funding sources and project updates to enable collaborative fishery research between commercial fishermen and scientists. The two key sections: "Is collaborative research for you?" and "How to Get Involved" make this website user friendly and a great model for future efforts in the forestry sector.

Heritage Networks-Natureserve
www.natureserve.org/ (Website accessed 01/02/04)
NatureServe connects the network of Natural Heritage programs throughout the country. Many local organizations have opportunities for volunteers to get involved in inventory and monitoring of at risk species.

Institute for Culture and Ecology (IFCAE)
www.ifcae.org (Website accessed 01/02/04)
Applied research organization that has conducted national workshops and published on participatory inventory and monitoring.

Instituto Nacional de Biodiversidad (INBio)
www.inbio.ac.cr/en/default.html (Website accessed 01/02/04)
INBio's webpage (in either English or Spanish) includes information about their national biodiversity database, inventory efforts, prospecting program, conservation for development program and information and outreach efforts, including INBioparque. They also have a special children's section and a link to recent news.

Inventory and Monitoring Institute
www.fs.fed.us/institute/monitoring/ (Website accessed 01/02/04)
This website supports National Forest and Grasslands monitoring initiatives and is designed to facilitate access to legal, technical and program guidance for multi-scale monitoring in the National Forest system. The intent is to bring together in one place links to all of the various monitoring guides and resources including information on community-based monitoring.

Maine Marine Resources
www.state.me.us/dmr/rm/lobster/coll_research_project.htm (Website accessed 01/02/04)
This website describes the way that commercial lobstermen can get involved in lobster management by participating in data collection. The lobstermen submit data on catch types and quantity and they receive reports and maps that illustrate their fishing effort and success.

Measuring Plant and Animal Populations
www.esf.edu/efb/gibbs/monitor/popmonroot.html (Website accessed 01/02/04)
The book Monitoring Plant and Animal Populations offers an overview of population monitoring issues that is accessible to the typical field biologist and land manager with a modest statistical background. The text includes

concrete guidelines for ecologists to follow to design a statistically defensible monitoring program. This website is a slightly older version than the published hardcopy book.

Medicinal Plant Working Group
www.nps.gov/plants/medicinal/ (Website accessed 01/02/04)
The Medicinal Plant Working Group forges partnerships with industry, government, academia, tribes and environmental organizations to facilitate sustainable use and conservation of medicinal plants and has been involved in several monitoring projects of medicinal plants.

Millennium Ecosystem Assessment
www.millenniumassessment.org/en/subglobal.overview.aspx (Website accessed 01/02/04)
Emphasizes the need for multi-scale approaches in ecosystem evaluation and recognition of sociopolitical factors and use of local knowledge in assessments.

Multiparty Monitoring Guidebook
ewp.uoregon.edu/guidebook/ (Website accessed 01/02/04)
A guidebook designed to help communities and their agency partners monitor activities related to ecosystem management and community-based forestry, especially the National Fire Plan. This guidebooks offers suggestions about how to develop a multiparty monitoring program for employment in restoration and maintenance of public lands, utilization of by-products of ecosystem management, grants and other investments, and ecological efforts.

NRM-Changelinks.net
nrm.massey.ac.nz/changelinks/par_eval.html (Website accessed 01/02/04)
This website is an on-line resource guide for those seeking to improve the use of collaborative and learning-based approaches, by providing Links for developing change in Natural Resource Management. The 'participatory monitoring and evaluation' page covers the following topics: evolving approaches to monitoring and evaluation, case studies, guides and handbooks, improving environmental monitoring, measuring social capital and community development, and evaluating information technologies.

NatureMapping
www.fish.washington.edu/naturemapping/about.html (Website accessed 01/02/04)
NatureMapping is a nationwide educational program designed to engage citizens in the process of monitoring wildlife in their favorite local greenspaces and wild areas, and reporting those observations to a centralized database. Students, teachers, natural resource specialists, wildlife enthusiasts, trackers, birders, and others share observations and help track biodiversity to promote conservation and preservation.

PlantWatch Canada
www.naturewatch.ca/english/plantwatch/why_monitor.html (Website accessed 01/02/04)
PlantWatch is part of NatureWatch, part of Canada's national effort to identify and observe environmental change through volunteer monitoring programs. The PlantWatch program enables "citizen scientists" to get involved by recording flowering times for selected plant species and reporting these dates to researchers through the Internet or by mail.

Reef Watch Community Environmental Monitoring Program
www.reefwatch.asn.au/newsIntro.html (Website accessed 01/02/04)
The Reef Watch program in South Australia utilizes recreational divers to assist in monitoring coral reef health, invasion of exotic species, and status of endangered species.

River Network's River Watch Monitoring and Assessment Program
www.riverwatch.org/howwecanhelp/index.cfm?doc_id=195 (Website accessed 01/02/04)
The organization provides guidance, planning, and support to schools, nonprofit organizations, government agencies, and Native American Tribes to carry out community-based monitoring programs.

Society of Amateur Science
http://www.sas.org/ (Website accessed 01/02/04)
A society that networks and promotes citizen science.